PUBLIC DOCUMENT

UNITED STATES OF AMERICA
BEFORE THE FEDERAL TRADE COMMISSION
OFFICE OF THE ADMINISTRATIVE LAW JUDGES
Washington, D.C.

ORIGINAL

In the Matter of **ECM BioFilms, Inc.,** **a corporation, also d/b/a** **Enviroplastics International,** **Respondent.**	**Docket No. 9358** **PUBLIC**

RESPONDENT'S RENEWED MOTION FOR LEAVE TO SERVE SUBPOENA *DUCES TECUM* ON DR. STEPHEN MCCARTHY

Pursuant to Rules 3.21(c) and 3.31A(d) Respondent ECM BioFilms, Inc. (ECM) hereby seeks leave to serve Complaint Counsel's expert, Dr. Stephen McCarthy ("McCarthy" or "Witness"), with a subpoena *duces tecum*.[1]

ECM has a right to discover all grounds germane to expert qualifications, knowledge, training, and experience, including expert bias, conflicts of interest, and lack of independence. Subpoenas *duces tecum* are the most appropriate means to achieve that end, particularly because ECM has completed Dr. McCarthy's deposition. ECM therefore moves this Court to compel Complaint Counsel's experts to respond to ECM's subpoenas *duces tecum*. On June 10, 2014, this Court denied ECM's original motion for leave to serve a subpoena on Dr. McCarthy without prejudice, thus permitting ECM to separately move for leave to subpoena Dr. McCarthy after completion of his expert deposition. ECM completed Dr. McCarthy's deposition on June 27, 2014.

Information revealed during that deposition demonstrates that Dr. McCarthy is not an objective expert witness. He has considerable personal financial investment in the outcome of

[1] Respondent's proposed subpoena is attached as Exhibit RX-I.

this matter. Dr. Stephen McCarthy has agreed to testify in this matter as Complaint Counsel's lead scientific witness. He will testify that, in his opinion, ECM's claims are not supported. Dr. McCarthy also has established financial relationships with ECM's competitors. Among other facts detailed in ECM's accompanying memorandum, Dr. McCarthy collects money from ECM competitors through licensing agreements involving his patented technologies. If complaint counsel is successful in its case against ECM, Dr. McCarthy's patented technologies increase in value, and he likely receives more money from ECM's competitors who license Dr. McCarthy's technologies. Dr. McCarthy also receives considerable funding from ECM's competitors through grant money paid to UMass where McCarthy teaches, which money is shared with Dr. McCarthy. Those competitors have lobbied the FTC to take action against ECM and similar businesses, likely to increase their market share. Dr. McCarthy, working individually or on behalf of ECM's competitors, has been involved with the Biodegradable Products Institute ("BPI"), a trade organization that favors "compostable" products over landfillable products. BPI has also lobbied the FTC against ECM, and had a substantial role persuading the Commission to adopt unscientific standards that benefit compostable products over those like ECM's additive. Dr. McCarthy has adopted "opinions" in his Rule 3.31A expert report and deposition that conflict with prior work he has done for ECM competitors, as described in his patents. Those deviations reveal that his personal bias has influenced the credibility of his testimony.

Dr. McCarthy's role as an objective expert is highly questionable because of his bias. ECM must subpoena Dr. McCarthy to fully understand the scope of his personal relationships that certainly bear on his scientific opinions in this case.

Respectfully submitted,

/s/ Jonathan W. Emord

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DATED: July 7, 2014

UNITED STATES OF AMERICA
BEFORE THE FEDERAL TRADE COMMISSION
OFFICE OF THE ADMINISTRATIVE LAW JUDGES
Washington, D.C.

In the Matter of **ECM BioFilms, Inc.,** **a corporation, also d/b/a** **Enviroplastics International,** **Respondent.**	**Docket No. 9358** **PUBLIC**

RESPONDENT'S MEMORANDUM IN SUPPORT OF MOTION TO COMPEL EXPERT RESPONSE TO SUBPOENAS *DUCES TECUM*

Respondent ECM BioFilms, Inc. ("ECM") hereby seeks leave to serve Complaint Counsel's expert, Dr. Stephen McCarthy ("McCarthy" or "Deponent"), with a subpoena *duces tecum*. Complaint Counsel's lead scientific witness, Dr. Stephen McCarthy, is an agent of ECM's competitors. He has a direct financial interest in the outcome of this litigation. He receives royalties for patented technologies used by ECM's competitors in the biodegradable plastics market. He receives significant funding from grant money given to the University for the Center he directs from those ECM competitors. Those same competitors lobbied the FTC to prosecute ECM. Put simply, Dr. McCarthy owns technology and financial interests that directly compete with ECM Biofilms. If Complaint Counsel succeeds in this action against ECM Biofilms, Dr. Stephen McCarthy stands to gain an increase in revenue when his corporate connections assume a greater share of the plastics market.[2]

[2] In a companion motion, ECM requests leave to amend its final witness list to include Dr. Steven Grossman. Dr. Grossman is a Professor of Plastics Engineering at UMass Lowell. He teaches at the University level in the same Department as Dr. McCarthy. He would testify

The bias, conflict of interest, and independence of Complaint Counsel's experts are germane to their qualifications and opinions. *See* 16 C.F.R. 3.31(c); Fed. R. Evid. 702; *Behler v. Hanlon*, 199 F.R.D. 553, 561 (D. Md. 2001). The right to establish the bias of a witness, particularly an expert witness, is well-established in state and federal courts. *See, e.g., Keystone Mfg. Co. v. Jaccard Corp.*, 394 F.Supp. 2d 543, 568 (W.D.N.Y. 2005); *Behler*, 199 F.R.D. at 537; *Tuttle v. Perry*, 82 S.W.3d 920, 922 (Ky. 2002); *Powell v. St. John Hosp.*, 614 N.W.2d 666, 670 (Mich. Ct. App. 2000). Moreover, under evidentiary principles, bias is not collateral, meaning that counsel may "prove" bias through extrinsic evidence. *See, e.g., Wealot v. Armontrout*, 948 F.2d 497, 500 (8th Cir. 1991) ("[p]otential bias is not a collateral issue"). "[T]he nature and extent of a witness's motives and his interest in the outcome of the case bear importantly upon an evaluation of the witness's objectivity, his bias, and the weight to be accorded his testimony." *United States v. IBM Corp.*, 66 F.R.D. 215, 219 (S.D.N.Y. 1974) (granting Rule 26 motion to permit discovery of financial interests). "[O]ne of the purposes of discovery is to obtain information and to establish the nature and extent of … biases." *Id.* (collecting cases). ECM cannot fully explore Dr. McCarthy's bias in this case without the court permitting ECM the document discovery it seeks.

Evidence revealed during Dr. McCarthy's deposition establish beyond per adventure of doubt that Dr. McCarthy has a vested financial interest in the outcome of these proceedings. ECM is entitled under Rule 3.31(c)(1) to probe the full extent of that bias.

BACKGROUND

concerning Dr. McCarthy's bias and the lack of scientific integrity in Dr. McCarthy's report arising from that bias.

Respondent ECM Biofilms served subpoenas *duces tecum* on Complaint Counsel's identified experts on April 7, 2014. On May 19, 2014, ECM moved to compel production under Rules 3.31 and 3.38. This Court ruled that ECM's subpoenas were deficient in that they lacked the Commission's seal of authenticity. *See* June 2, 2014 Order. ECM followed that Order with a Motion for Leave to Serve Subpoenas bearing the Commission's seal (June 4, 2014). On June 10, 2014, this Court denied ECM's motion for leave *without prejudice*. His Honor explained that Rule 3.31A(d) provides for document discovery of expert witnesses, but only after depositions. *See* June 10, 2014 Order at 3; *see also* 16 C.F.R. 3.31A(d) ("Upon motion, the Administrative Law Judge may order further discovery by other means, subject to such restrictions as to scope as the Administrative Law Judge may deem appropriate."). His Honor rejected Complaint Counsel's position that subpoenas were *per se* improper, but held that the ruling did not restrict ECM from subsequently moving for leave upon good cause after expert depositions. *See* June 10, 2014 Order at 4 ("this ruling is without prejudice to Respondent's right to move for further discovery from Complaint Counsel's designated expert witness pursuant to Rule 3.31A(d), after completion of other expert discovery…").

ARGUMENT

A. ECM Has Evidence that Dr. McCarthy Has a Financial Interest in the Outcome of this Litigation

McCarthy invented a patent for a technology that competes directly with ECM's biodegradable additive. *See* Exh. RX-A (U.S. Patent No. 5,883,199 (issued Mar. 16, 1999)). He profits from that patent. *See* Exh. RX-B at 47:18-25, 51:17-57:7 (June 27, 2014) (Dr. McCarthy's deposition testimony (rough, condensed)). The University of Massachusetts, Lowell ("UMass"), McCarthy's employer, is the patent's assignee. *See* Exh. RX-A; RX-C-1 (Metabolix

Website Article). Metabolix, Inc. is the exclusive licensee of the technology. *See* Exh. RX-C-1. Metabolix's potential royalties from licensing UMass patents surpass $100,000 per year. *See* Exh. RX-C-2 (UMass Website Article). Dr. McCarthy testified that he receives money directly from the '199 patent, which is licensed by Metabolix. *See* Exh. RX-B at 55:4-56:7 (explaining that, as an inventor, Dr. McCarthy gets ten percent (10%) of the royalties of the '199 patent if there is a profit). He acknowledged that Metabolix's products compete directly with ECM's technology for market share. *Id*. at 60:15-62:4 (acknowledging that it is a competitive marketplace and that products based on the '199 patent are in competition with other products marketed as biodegradable, compostable, and recyclable). If the Commission is successful against ECM in this matter (and by extension against similar additive products), Metabolix's market share increases along with the return to Dr. McCarthy from his royalty payments. Dr. McCarthy also collects a share of research grant money that he secures for UMass from Metabolix and other compostable product manufacturers, which comes from ECM competitors. *Id*. at 48:1-51:16 (explaining that a project account receives forty-six percent (46%) of the research grants Dr. McCarthy secures, and that he is in control of that account when he is the principal investigator).

Metabolix supplied grants to UMass of approximately $2.5 million, sponsored more than 50 students for their master's and doctorate degrees, and has made substantial equipment donations (over $500,000). *See* Exh. RX-C-2. Since 2008, Metabolix has been lobbying the FTC to act against ECM. *See* Exh. RX-D. Dr. McCarthy has worked with BPI, and collected substantial revenue (approximately $40,000) performing BPI "certifications" for trade customers. *See* Exh. RX-B at 92:11-24. Since 2008, Metabolix has lobbied the FTC to act against ECM. *See* RX-D (requesting FTC to investigate Good Earth and ECM for alleged

deceptive environmental claims). Metabolix is also a member of the Biodegradable Products Institute (BPI), a primary ECM competitor, and sells approximately a dozen products that are "BPI certified." *See* Exh. RX-E-1; RX-E-2. BPI is a vocal opponent of ECM, and has lobbied the FTC repeatedly since at least 2005 to act against ECM and ECM's customers. *See* Exh. RX-F-1 (BPI Correspondence to FTC of April 25, 2005).

The green plastics industry is divided into two competing camps, those who market "compostable" products and those who market "biodegradable" products. "Compostables" are a narrow subset of biodegradable plastics. *Compare* FTC's Revised Green Guides 16 C.F.R. § 260.7(b) (for compostability marketing, the marketer must have evidence that "all the materials in the item will break down into, or otherwise becomes part of, usable compost") *with* FTC's Revised Green Guides 16 C.F.R. § 260.8(b) (for degradability marketing, the marketer must have evidence that "the entire item will completely break down and return to nature" within one year o customary disposal). Advocates of compostables benefit by regulation that limits what may be advertised as "biodegradable" when that limit is based on rate, and they have successfully lobbied the Commission to achieve that restriction in the Green Guides. *See, e.g.*, Exh. RX-G (Comments of BPI from January 30, 2008) (recommending to FTC that, in order for a product to be advertised as biodegradable, the product must break down within 12-18 months); RX-F-1; RX-F-2 (BPI Correspondence to FTC of March 30, 2010) (convincing FTC to act against two additional companies marketing their products as biodegradable).

Companies like Metabolix, and many others supported by BPI, offer environmental solutions for plastics that compete directly against ECM. Many such technologies are more expensive than the additive methods sold by ECM (and many similar companies). The expensive plastic resins and polymers sold by ECM's competitors often require major manufacturing costs

to implement, making them less desirable for manufacturers. For ECM's competitors, therefore, this case is an opportunity to eliminate an area of strong competition by relying on government as a proxy. Dr. McCarthy is an agent of those ECM competitors.

His bias is apparent in that Dr. McCarthy has adopted positions that contradict prior work he performed for ECM's competitors. For example, his deposition testimony explains that in his expert report he states that radiological marker C testing is the only test that can dispositively prove that additives like ECM's cause biodegradation of plastics, but he himself has relied on extrapolation and other tests, such as one he created himself, UML-7645, and measures of weight loss, to prove biodegrability of polymer products. *See* Exh. RX-B at 69:20-70:19, 143:6-2; 159:8-165:22. Further, in his "Report on Bias and Capture in the Promulgation of the Green Guides and Enforcement Action Against ECM BioFilms," Dr. Volokh's addressed similar contradictions. Specifically, Dr. Volokh pointed out how Dr. McCarthy has said in his expert report that "evidence that a substance is biodegradable is not 'competent and reliable' unless the tested sample reaches 'at least 60% biodegradation,' and there is both a 'negative control' and a 'positive control,'" but the '199 patent made biodegradable claims "even though the rate of biodegradation was lower than 60%." *See* Exh. RX-H at 32 (Dr. Volok's report). He also mentioned how although Dr. McCarthy's expert report states that a conventional, non-biodegradable plastic does not become biodegradable after being melt-blended with ECM's additive because the conventional plastic's chemical structure remains unaltered, in a 1990 paper Dr. McCarthy proposed to test such a blend, which suggested a tension between his past and current views. *See id*. at 32-33.

B. ECM Requires Document Discovery to Uncover the Full Extent of Dr. McCarthy's Bias

Despite thus far not being afforded document discovery from Dr. McCarthy, ECM has been able to unearth substantial evidence of bias infecting Dr. McCarthy's testimony in this case. However, ECM's effort will not be complete unless and until this Court ensures that ECM's right to document discovery is not denied through administrative action. ECM has a right to explore the full extent of Dr. McCarthy's ties to ECM's market competitors, including access to every document that reasonably shows a connection between McCarthy and an ECM competitor. ECM seeks leave to serve the document attached as Exhibit RX-I, which is tailored to discover precisely those connections, seeking documents that expose Dr. McCarthy's ties with individuals and institutions that are ECM competitors, Dr. McCarthy's financial relationships with those individuals and institutions, and Dr. McCarthy's involvement in building compostable product alternatives to biodegradable plastics technologies. ECM completed its deposition of Dr. McCarthy on June 27, 2014. Before that deposition, ECM was aware of information in the public domain revealing that Dr. McCarthy's association with ECM's competitors, and that he may be contradicting himself to protect his financial interests. Dr. McCarthy's responses under oath confirmed those conclusions, and provided more than a sufficient basis to warrant complete examination of his financial and other relations with companies and individuals who compete with ECM (and, indeed, lobby this agency to act against ECM). *See, e.g.*, Exh. RX-B at 40:13-41:8, 58:7-62:4, 69:20-70:19, 91:5-10, 143:6-2; 159:8-165:22. While ECM has exhausted its discovery options permitted under this Court's June 10, 2014 Order governing subpoena practice, ECM still requires, at least, the following information to assess the full extent of Dr. McCarthy's bias: documents and correspondence between Dr. McCarthy and Metabolix, Inc.;[3]

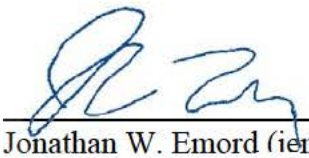
[3] Metabolix is an ECM competitor who directly lobbied FTC attorneys to take action against ECM. Metabolix is the exclusive licensee of Dr. McCarthy's patent technology concerning biodegradable plastics.

documents and correspondence exchanged between Dr. McCarthy and 3M Corporation;[4] documents concerning Dr. McCarthy's financial interests in his patents that were assigned to UMass; Dr. McCarthy's financial interests in grant or research money paid to him from ECM competitors; and Dr. McCarthy's documents and correspondence exchanged with BPI and its employees, affiliates, etc.[5] The subpoena attached hereto as Exhibit RX-I is tailored to produce that information, and ECM respectfully requests that this Court permit ECM to serve this duly authorized subpoena and to obtain the requested information promptly so as not to prejudice ECM in its hearing preparation.

RELIEF

ECM moves this Court for leave to serve Dr. McCarthy with a subpoena *duces tecum* attached as Exhibit RX-I hereto.

Respectfully submitted,



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DATED: July 7, 2014

[4] Complaint Counsel has designated 3M as a potential fact witness in this case. Dr. McCarthy performed biodegradability research for 3M.

[5] The Biodegradable Products Institute (BPI) is a trade group devoted to opposing products like ECM's additive. BPI has influenced attorneys at the FTC into taking enforcement action against ECM and similar products.

STATEMENT CONCERNING MEET AND CONFER

Pursuant to Rule 3.22(g), 21 C.F.R. § 3.22(g), the undersigned counsel certifies that, on July 3, 2014, Respondent's counsel conferred by conference call with Complaint Counsel in a good faith effort to resolve by agreement the issues raised in the foregoing Motion. The parties have been unable to reach an agreement on the issue raised in the attached motion.

Respectfully submitted,

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UNITED STATES OF AMERICA
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Washington, D.C.

In the Matter of **ECM BioFilms, Inc.,** **a corporation, also d/b/a** **Enviroplastics International,** **Respondent.**	**Docket No. 9358** **PUBLIC**

[PROPOSED] ORDER GRANTING RESPONDENT ECM BIOFILMS, INC.'S MOTION TO COMPEL

This matter having come before the Administrative Law Judge on July 7, 2014, upon a Motion for Leave to Serve Subpoena Duces Tecum ("Motion") filed by Respondent ECM BioFilms, Inc. ("ECM") pursuant to Commission Rule 3.21(c) and 3.31A(d).

Having considered ECM's Motion and all supporting and opposing submissions, and for good cause appearing, it is hereby ORDERED that ECM's Motion is GRANTED; ECM is permitted to duly serve its subpoenas *duces tecum* on Dr. Stephen McCarthy, as described in Exhibit RX-1 to ECM's Motion.

ORDERED:

_____
D. Michael Chappell
Chief Administrative Law Judge

Date:

CERTIFICATE OF SERVICE

I hereby certify that on July 7, 2014, I caused a true and correct copy of the foregoing to be served as follows:

One electronic copy to the **Office of the Secretary** through the e-filing system:

Donald S. Clark, Secretary
Federal Trade Commission
600 Pennsylvania Ave., NW, Room H-113
Washington, DC 20580
Email: secretary@ftc.gov

One electronic courtesy copy to the **Office of the Administrative Law Judge**:

The Honorable D. Michael Chappell
Administrative Law Judge
600 Pennsylvania Ave., NW, Room H-110
Washington, DC 20580

One electronic copy to **Counsel for Complainant**:

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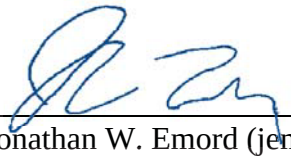
I certify that I retain a paper copy of the signed original of the foregoing document that is available for review by the parties and adjudicator consistent with the Commission's Rules.

Respectfully submitted,



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DATED: Monday, July 07, 2014

RESPONDENT EXHIBIT RX-A

US005883199A

United States Patent [19]

McCarthy et al.

[11] Patent Number: 5,883,199

[45] Date of Patent: Mar. 16, 1999

[54] **POLYACTIC ACID-BASED BLENDS**

[75] Inventors: **Stephen P. McCarthy**, Tyngsboro; **Richard A. Gross**, Chelmsford; **Wenguang Ma**, Lowell, all of Mass.

[73] Assignee: **University of Massachusetts**, Boston, Mass.

[21] Appl. No.: **825,810**

[22] Filed: **Apr. 3, 1997**

[51] **Int. Cl.**[6] **C08F 20/00**; B29D 22/00

[52] **U.S. Cl.** **525/437**; 525/450; 604/212; 604/370; 604/403; 604/408; 428/35.2; 428/35.7; 428/36.92

[58] **Field of Search** 525/437, 450; 604/403, 212, 358, 370, 408; 428/34.1, 35.2, 35.7, 36.92

[56] **References Cited**

U.S. PATENT DOCUMENTS

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5,216,050	6/1993	Sinclair	524/108
5,252,642	10/1993	Sinclair et al.	524/108
5,685,540	11/1997	Kakizawa	525/444

FOREIGN PATENT DOCUMENTS

96-231837	2/1995	Japan .	

OTHER PUBLICATIONS

Cai et al., "Effects of Physical Aging, Crystallinity, and Orientation on the Enzymatic Degradation of Poly(Lactic acid)", *J. Polymer Science*, 34:2701–2708 (1996).

Gajria et al., "Miscibility and biodegradability of blends of poly(lactic acid) and poly(vinyl acetate)", *Polymer*, 37:437–444 (1996).

Sheth et al., "Biodegradable Polymer Blends of Polylactic Acid (PLA) and Polyethylene Glycol (PEG)", *ANTEC '95*, 1829–1833 (1995).

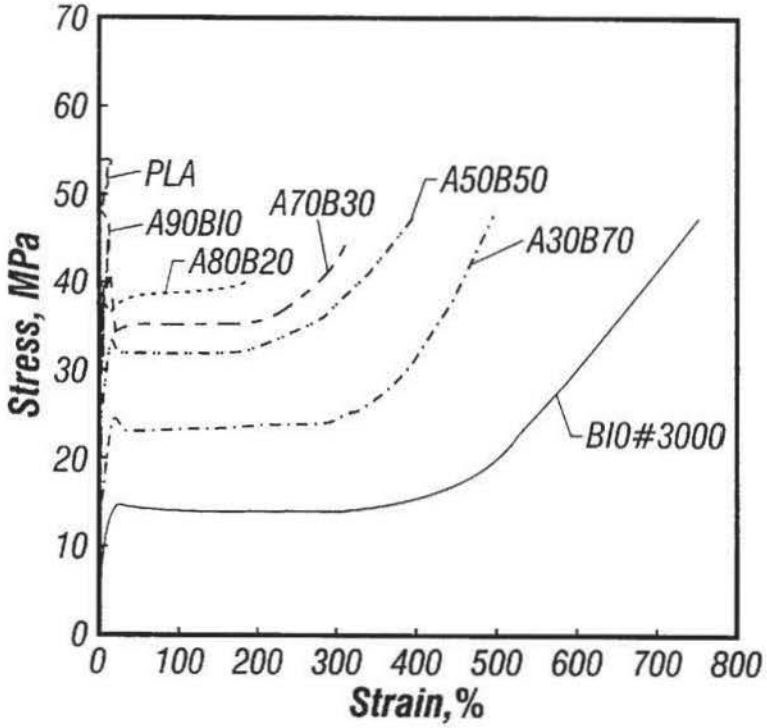
Younes et al., Phase Separation in Poly(Ethylene Glycol)/Poly(Lactic Acid) Blends, *Polym. J.*, 24(8):765–773 (1988).

Primary Examiner—Nathan M. Nutter
Attorney, Agent, or Firm—Fish & Richardson P.C.

[57] **ABSTRACT**

Biodegradable blends including a first, polylactic acid-based polymer or copolymer, and a second polymer or copolymer including one or more polyesters, e.g., an aliphatic polyester or a polyester of one aliphatic C_2 to C_{20} diacid or of a combination of two more different aliphatic C_2 to C_{20} diacids, wherein the first and second polymers are present in a ratio of 9:1 to 1:9, are described.

25 Claims, 7 Drawing Sheets


Stress, MPa
Strain,%
PLA
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40
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70
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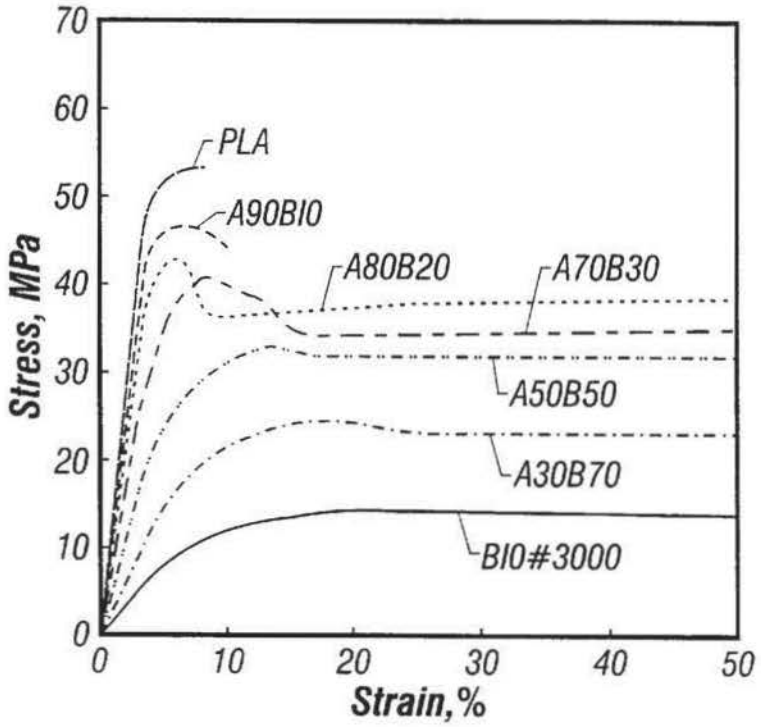
FIG. 1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Strain,%
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FIG. 2

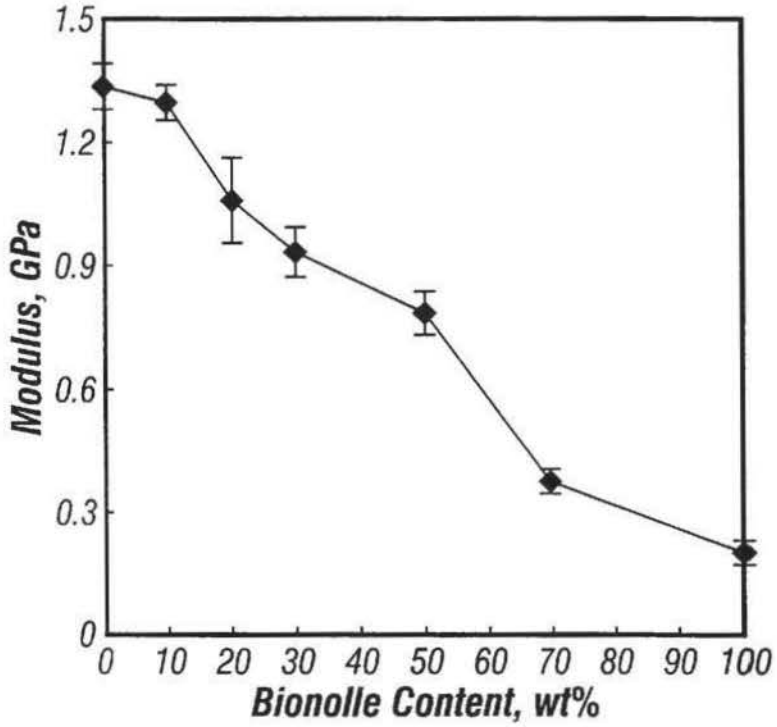

1.5
1.2
0.9
0.6
0.3
0
Modulus, GPa
0 10 20 30 40 50 60 70 80 90 100
Bionolle Content, wt%

FIG. 3

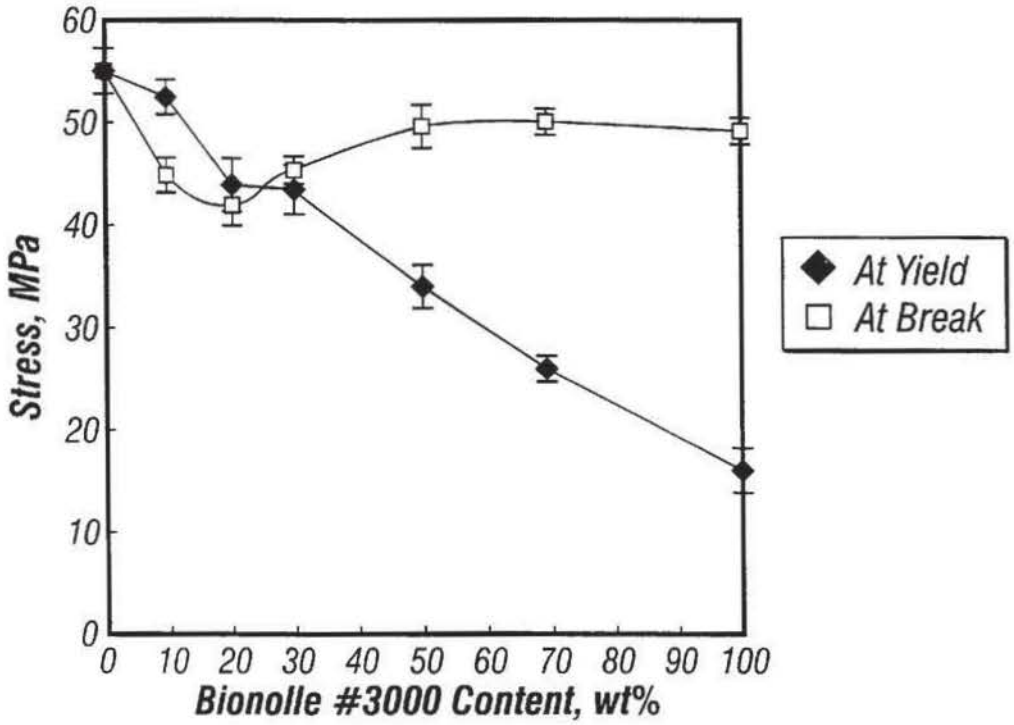

60
50
40
30
20
10
0
Stress, MPa
0 10 20 30 40 50 60 70 80 90 100
Bionolle #3000 Content, wt%
At Yield
At Break

FIG. 4

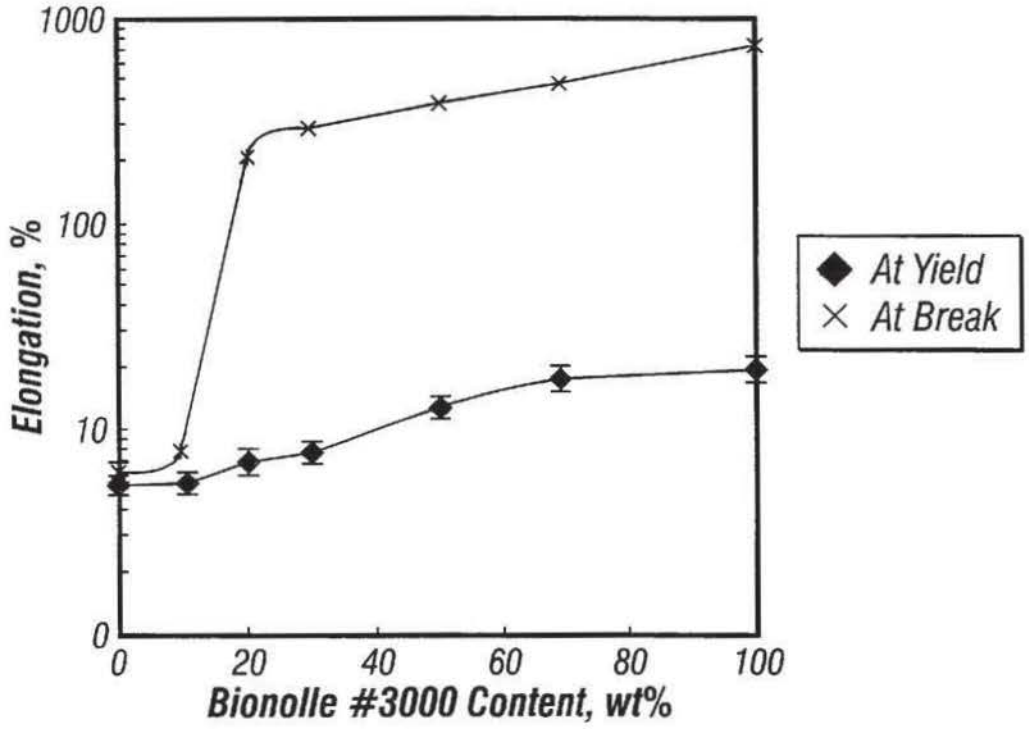


FIG. 5

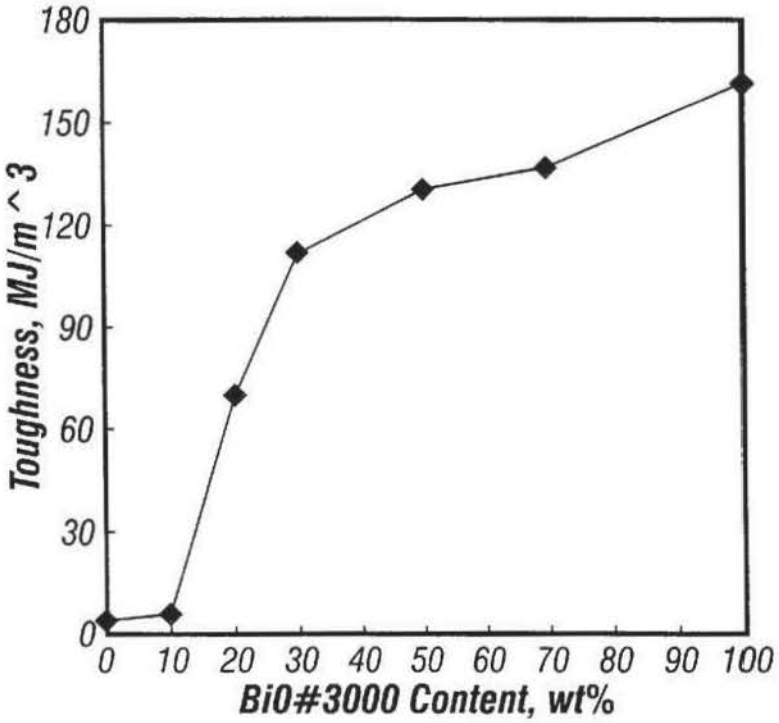


FIG. 6

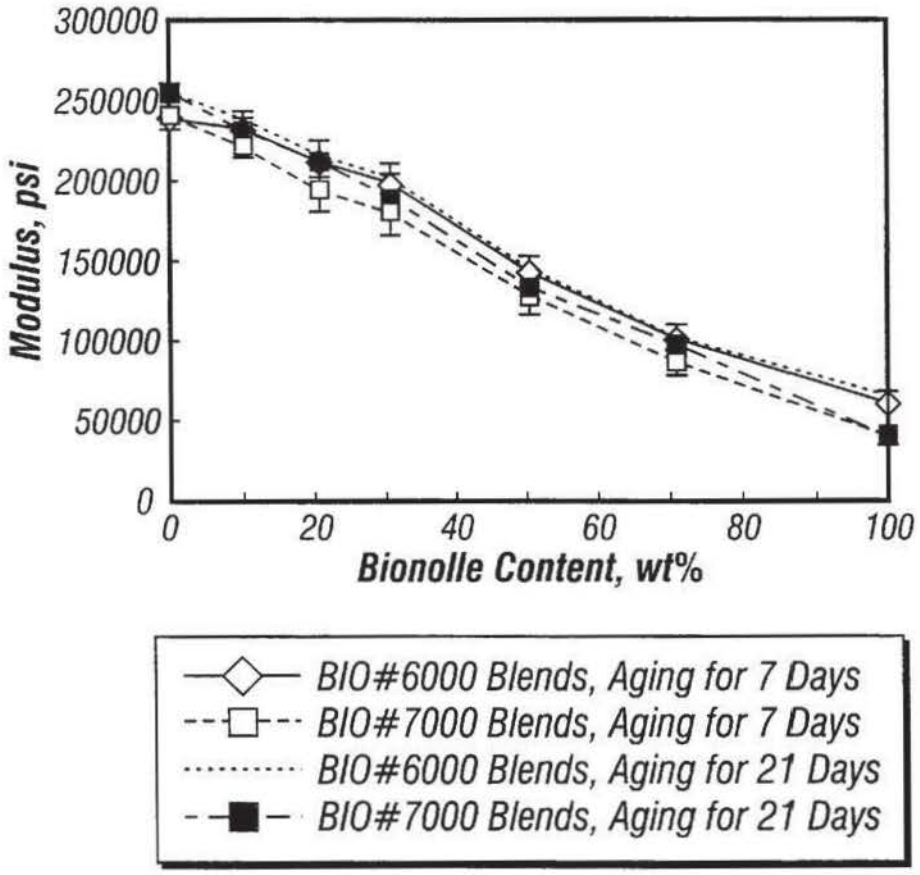


FIG. 7

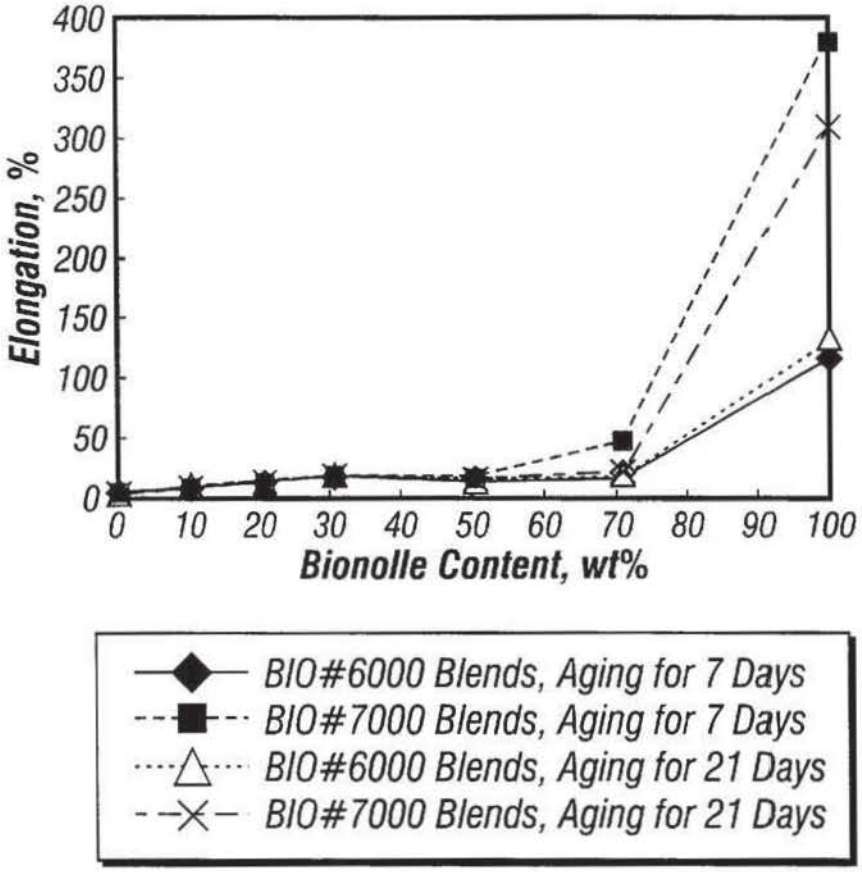


FIG. 8

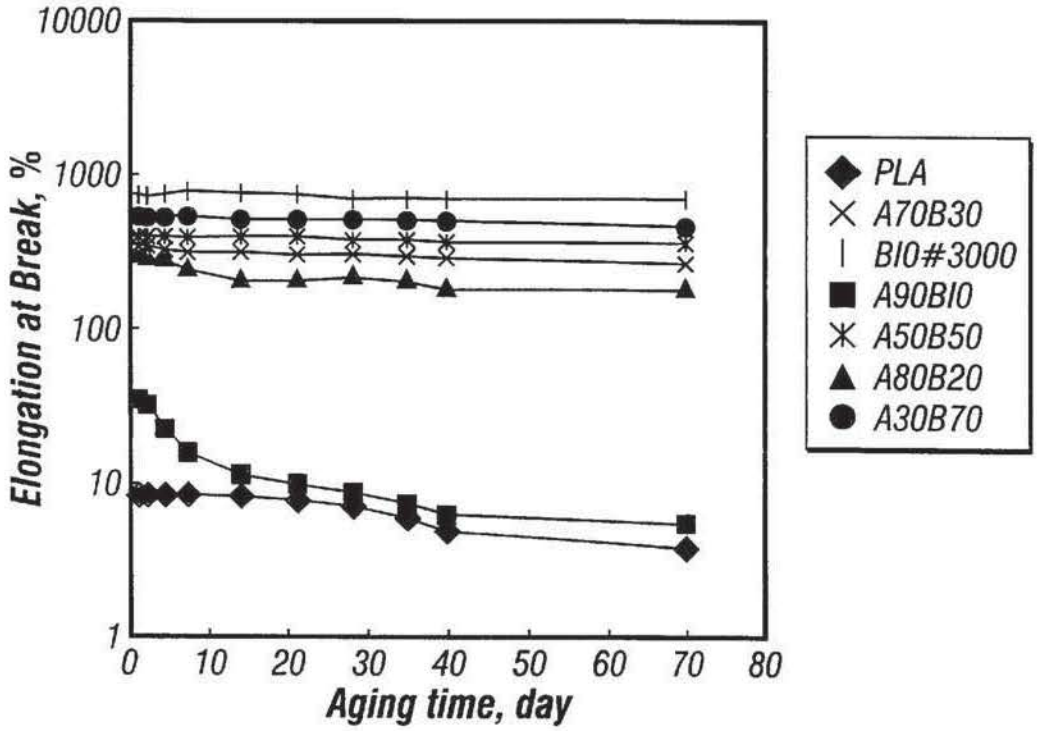


FIG. 9

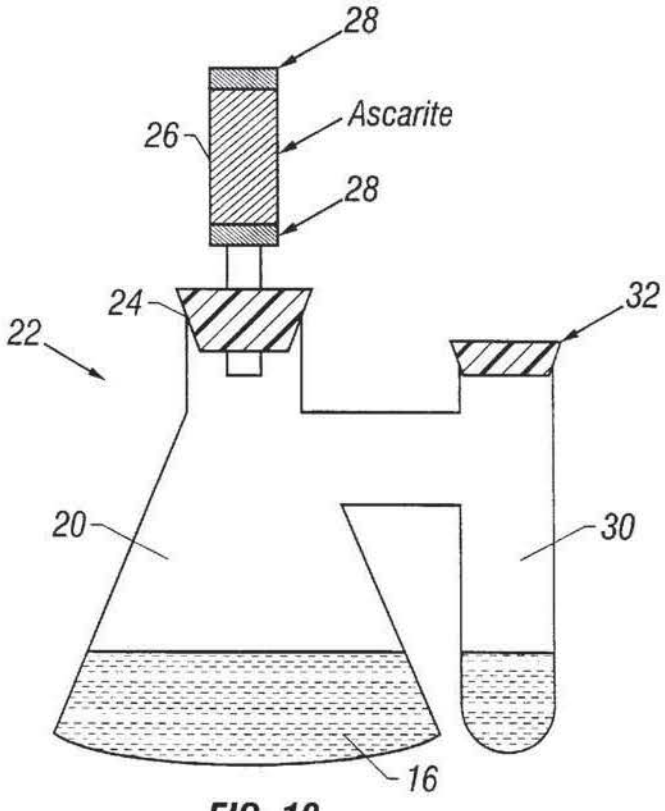


FIG. 10

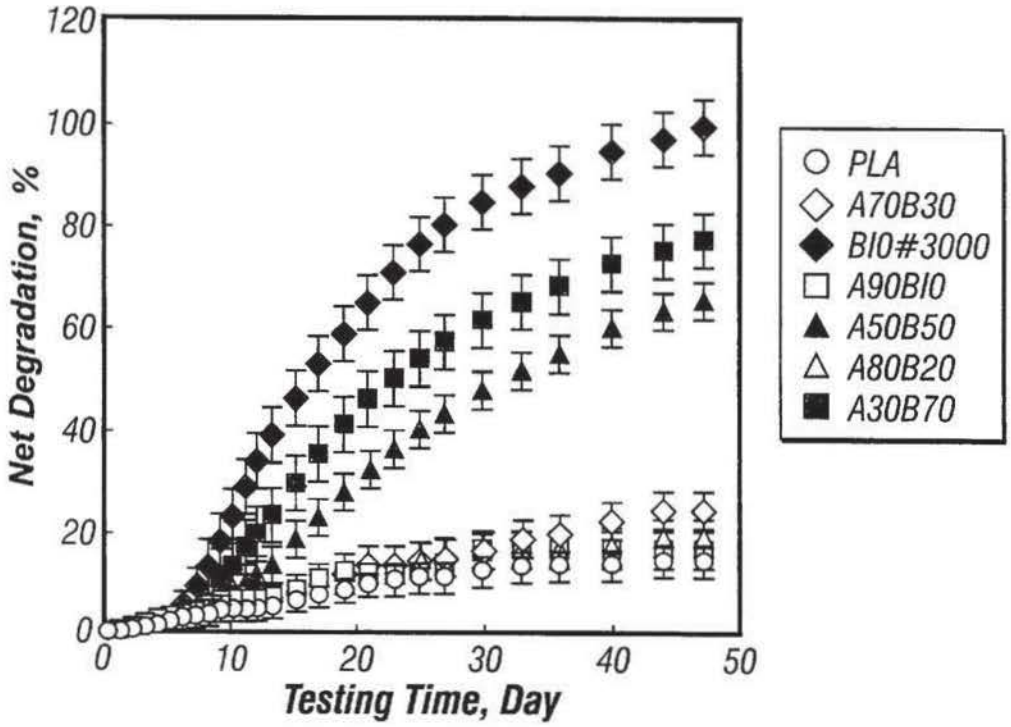


FIG. 11

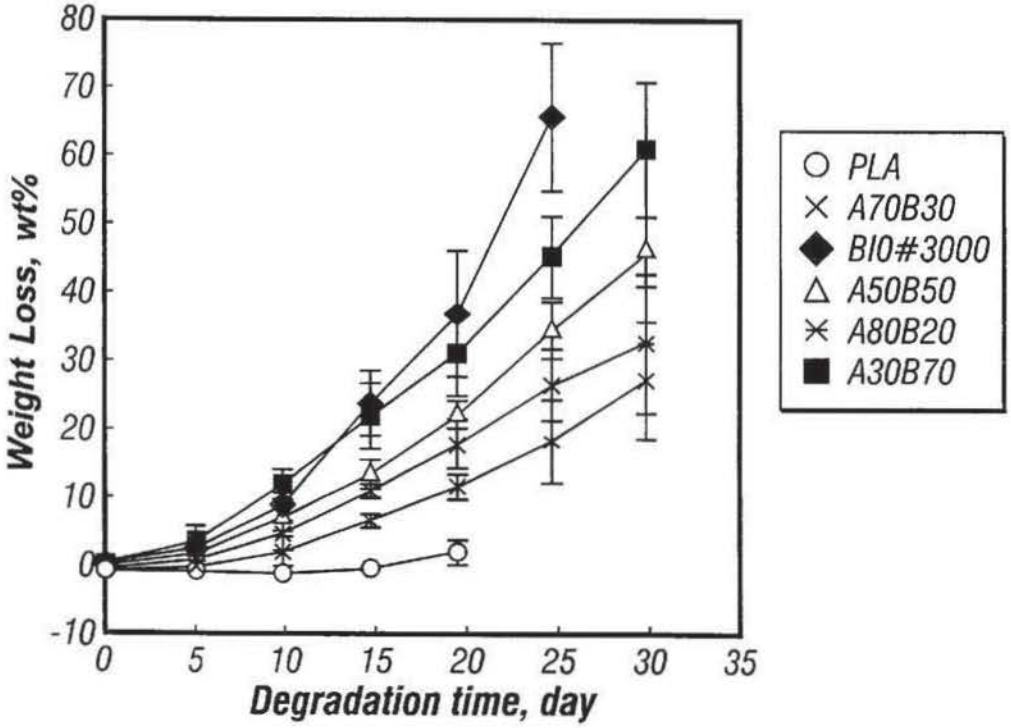


FIG. 12

POLYACTIC ACID-BASED BLENDS

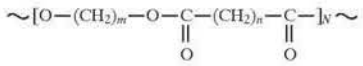
STATEMENT AS TO FEDERALLY SPONSORED RESEARCH

Funding for the work described herein was partially provided by the National Science Foundation under grant number EEC-9314562. The Government has certain rights in the invention.

BACKGROUND OF THE INVENTION

The invention relates to polylactic acid-based blends.

Succinic acid and diols can form biodegradable aliphatic polyesters and copolyesters through coupling and polycondensation reactions. The main unit structure resulting from these reactions is:



Examples of biodegradable aliphatic polyesters and copolyesters having the unit structure shown above are polybutylene succinate (PBSU), where m is 4 and n is 2, polyethylene succinate (PESU), where m is 2 and n is 2, a random copolymer of polybutylene succinate adipate (PBSU-AD) where m is 4 and n is 2 or 4, and polyethylene succinate adipate (PESU-AD) where m is 2 and n is 2 or 4.

These polyesters and copolyesters have interesting properties including biodegradability, melt processability, and thermal and chemical resistance. One of these, BIONOLLE®, a commercially available aliphatic succinate-adipate polyester, has excellent physical properties. For example, the thermal resistance of BIONOLLE is equivalent to that of polyethylene, but the yield strength is higher than polyethylene. The stiffness of BIONOLLE is between high density and low density polyethylene (LDPE). Particularly for BIONOLLE #3000, its impact strength is equivalent to that of LDPE, while its elongation at break is higher than that of LDPE.

Polylactic acid can be made from lactic acid (lactate). Lactic acid is a natural molecule that is widely employed in foods as a preservative and a flavoring agent. It is the main building block in the chemical synthesis of the polylactide family of polymers. Although it can be synthesized chemically, lactic acid is procured principally by microbial fermentation of sugars such as glucose or hexose. These sugar feed stocks can be derived from potato skins, corn, and dairy wastes. The lactic acid monomers produced by fermentation are then used to prepare polylactide polymers.

Lactic acid exists essentially in two stereoisomeric forms, which give rise to several morphologically distinct polymers: D-polylactic acid, L-polylactic acid, D,L-polylactic acid, meso-polylactic acids and any combinations of thereof. D-polylactic acid and L-polylactic acid are stereoregular polymers. D,L-polylactic acid is a racemic polymer obtained from a mixture of D- and L-lactic acid, and meso-polylactic acid can be obtained from D,L-lactide. The polymers obtained from the optically active D and L monomers are semicrystalline materials, but the optically inactive D,L-polylactic acid is amorphous.

Lactic acid has a hydroxyl group as well as a carboxylic group, and hence can be easily converted into a polyester. These polyesters have some potential advantages when compared to other biodegradable polymers such as polyhydroxybutyrate and polycaprolactone, as to their strength, thermoplastic behavior, biocompatibility, and availability

from renewable sources, and have been classified as "water sensitive," because they degrade slowly compared with "water soluble" or "water swollen" polymers. However, while polylactic acid is a biodegradable polymer with generally good processability, it is brittle, and the brittleness increases with time due to physical aging, i.e., densification of the polymer at a molecular level.

SUMMARY OF THE INVENTION

The invention is based on the discovery that polylactic acid (PLA)-based polymers or copolymers and polymers or copolymers of polyesters, e.g., polybutylenesuccinate, polybutylene succinate-adipate or polybutylene succinate-terephthalte (wherein the diacids of the polyester would be, for example, succinic acid, adipic acid, terephthalic acid, or any combinations thereof), can be used to make new biodegradable blends that, compared to PLA, have superior tensile and mechanical properties such as stiffness, toughness, and elongation to break, as well as excellent biodegradability and aging properties.

In general, the invention features a biodegradable blend including a first, polylactic acid-based polymer or copolymer, and a second polymer or copolymer including one or more polyesters, e.g., an aliphatic polyester or a polyester of one aliphatic C_2 to C_{20} diacid or of a combination of two more different aliphatic C_2 to C_{20} diacids, wherein the first and second polymers are present in a ratio of 9:1 to 1:9, by weight, e.g., 5:1 to 1:5, or 2:1 to 1:2, or 1:1. For example, the first polymer can be a homopolymer of polylactic acid, e.g., D-polylactic acid, L-polylactic acid, D,L-polylactic acid, meso-polylactic acid, and any combination of D-polylactic acid, L-polylactic acid, D,L-polylactic acid and meso-polylactic acid. In addition, the first polymer can be a copolymer having at least 50, 60, 70, or more, up to 100 percent, by weight, of polylactic acid.

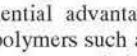
The second polymer or copolymer can be, for example, a polybutylenesuccinate homopolymer, polybutyleneadipate homopolymer, polybutylenesuccinate-adipate copolymer, polyethylenesuccinate homopolymer, polyethyleneadipate homopolymer, or a polyethylenesuccinate-adipate copolymer, or a copolyester of an aliphatic polyester and up to 50 percent, by weight, of an aromatic polyester, such as terephthalate, as long as the overall copolyester (and second polymer) is biodegradable.

The blend can further include a compatibilizer including one or more polyesters, polyethers, or polyvinyl alcohols.

The new biodegradable blends have an elongation at break of at least 10 percent, for example, at least 50, 100, 200, 300, 400, and up to 500 percent or more. The blends also have an elongation at break of at least 10 percent, e.g., 50, 100, 200, 300, 400, and up to 500 percent or more after 70 days of aging. In addition, the blends have a toughness of at least 10 MJ/m^3, e.g., 20, 40, 60, and up to 120 MJ/m^3 or more.

The second polymer can be present in the new biodegradable blends as a co-continuous phase with the first polymer, and at least the first or the second polymer or copolymer is present in a continuous phase in the blend.

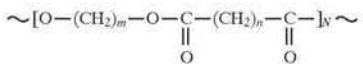
The first, polylactic acid-based polymer or copolymer can be a homopolymer of lactic acid or a block, graft, or random copolymer of lactic acid having the general formula:



wherein R_1 is a lactic acid unit, R_2 is caprolactone, glycolide, trimethylene carbonate, dioxanone, butyryl

lactone, or ethylene oxide, a is 10 to 10,000, e.g., 100 to 7,500, or 1000 to 5000, and b is 0 to 10,000, e.g., 100 to 7,500, or 1000 to 5000.

The polyester of the second polymer or copolymer can have the formula:



wherein m is 2 to 20, e.g., 4, 8, or 12; n is 2 to 20, e.g., 2 and 4, or 6, or 8; and N is 10 to 10,000, e.g., 500, 3,500, or 5000.

The new biodegradable blends can include the first, polylactic acid-based polymer or copolymer as a polylactic acid homopolymer, and the second polymer or copolymer as a polybutylenesuccinate homopolymer, polybutyleneadipate homopolymer, polybutylenesuccinate-adipate copolymer, polyethylenesuccinate homopolymer, polyethyleneadipate homopolymer, or a polyethylenesuccinate-adipate copolymer.

In another embodiment, the invention features articles manufactured from the new biodegradable blends. For example, the invention features sheets or films, bags, containers, such as bottles and disposable cups, disposable diapers, and other items including the new blends.

A "polylactic acid-based polymer or copolymer" is a homopolymer or a copolymer having at least 50% by weight of polylactic acid. As used herein, the term "polylactic acid," without further designation, includes any one or more of four morphologically distinct polylactic acid polymers: D-polylactic acid, L-polylactic acid, D,L-polylactic acid, and meso-polylactic acid. "D-polylactic acid" and "L-polylactic acid" are dextro-polylactic acid and levo-polylactic acid, respectively, and both of them are optically active polymers that rotate a light vector when transmitted through the polymer. "D,L-polylactic acid" is a racemic polymer, i.e., a copolymer of D-polylactic acid and L-polylactic acid having a well-defined conformation of D- and L-polylactic acid units. "Meso-polylactic" is a random copolymer of D-polylactic and L-polylactic. An "aliphatic polyester of a diacid and a diol" is a polyester formed by the reaction of a diacid and a diol.

The invention provides several advantages. Polylactic acid by itself is a brittle material having poor toughness and low elongation to break, and these properties worsen with time due to its physical aging behavior. Furthermore, the biodegradability of polylactic acid is slow. The new blends overcome these deficiencies of polylactic acid. Moreover, the new blends are environmentally friendly and commercially attractive for making biodegradable plastic films, sheets, and other plastic products made by conventional processing methods such as blown film, extrusion, and injection molding. These plastic products can be used for food packaging, compost bags, and other disposable items. The new blends provide an entry for polylactic acid in the potentially large market of biodegradable polymers.

Unless otherwise defined, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. Although methods and materials similar or equivalent to those described herein can be used in the practice or testing of the present invention, suitable methods and materials are described below. All publications, patent applications, patents, and other references mentioned herein are incorporated by reference in their entirety. In case of conflict, the present specification, including definitions, will control. In addition, the materials, methods, and examples described herein are illustrative only and not intended to be limiting.

Other features and advantages of the invention will be apparent from the following detailed description, and from the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a graph showing complete stress-strain curves of polylactic acid, BIONOLLE#3000, and their blends.

FIG. **2** is a graph showing stress-strain curves of polylactic acid, BIONOLLE#3000, and their blends in the strain range of 0 to 50%.

FIG. **3** is a graph showing stiffness (modulus) of polylactic acid, BIONOLLE#3000, and their blends.

FIG. **4** is a graph showing stress at yield and break of polylactic acid, BIONOLLE#3000, and their blends.

FIG. **5** is a graph showing percent elongation at yield and break of polylactic acid, BIONOLLE#3000, and their blends.

FIG. **6** is a graph showing toughness of polylactic acid, BIONOLLE#3000, and their blends.

FIG. **7** is a graph showing stiffness (modulus) of polylactic acid, BIONOLLE#6000, BIONOLLE#7000, and their blends.

FIG. **8** is a graph showing percent elongation at yield and break of polylactic acid, BIONOLLE#6000, BIONOLLE#7000, and their blends.

FIG. **9** is a graph showing percent elongation at break of polylactic acid, BIONOLLE#3000, and their blends as a function of aging.

FIG. **10** is a schematic of a biometer for soil biodegradation testing.

FIG. **11** is a graph showing net percent biodegradation of polylactic acid, BIONOLLE#3000, and their blends as a function of test time in soil.

FIG. **12** is a graph showing net percent weight loss due to biodegradation of polylactic acid, BIONOLLE#3000, and their blends as a function of test time in compost.

DETAILED DESCRIPTION

Polylactic acid-based polymers and polymers of polyesters, e.g., aliphatic polyesters of diols and diacids, can be used to make new blends that have surprisingly good mechanical and biodegradable properties compared to polylactic acid alone. The new blends provide tough, biodegradable plastics that can be used to make biodegradable plastic films, sheets, and other products made by conventional blown film, extrusion, and injection molding processing methods. These plastic products can be used for food packaging, compost bags, and other disposable items.

Compared to polylactic acid, the new blends provide a large increase in elongation (e.g., from 5% to 500%), toughness enhancement (from less than 10 MJ/m^3 to more than 120 MJ/m^3), and increased biodegradation rate. The modulus of these blends decreases with increasing amount of the aliphatic polyester, i.e., Bionolle#3000 (from 1.3 GPa of polylactic acid to 0.3 GPa of Bionolle#3000), and elongation to break increases with increasing amount of the aliphatic polyester (e.g., from 5% to 500%). The blends with more than 20% by weight of Bionolle#3000 possess toughness of more than 70 MJ/m^3, more than 200% elongation at break and other excellent tensile properties, which are retained even after the blends have aged for 70 days in the temperature range of −15° to 60° C. Compared to polylactic acid, these blends also have a relatively high degradation rates in soil and composting environment.

Materials

The main components needed to make the new blends are polylactic acid-based polymers and polyesters, e.g., aliphatic polyesters of diols and diacids. Optionally, a compatibilizer may be added to the blends.

The simplest polylactic acid-based polymer is polylactic acid, which can be obtained from, e.g., Cargill Inc. (EcoPla Division, Minnesota). The polylactic acid used for the experiments described herein had an 8% meso content (96% L) and a number average molecular weight of 70,100. Other polylactic-based polymers can also be used to make the new tough blends with aliphatic polyesters of diols and diacids.

For example, a polylactic-based polymers can be either a homopolymer of lactic acid or a block, graft, or random copolymer of lactic acid having the general formula:

$$—(R_1)_a—(R_2)_b—$$

wherein R_1 is a lactic acid unit and R_2 is caprolactone, glycolide, trimethylene carbonate, dioxanone, butyryl lactone, or ethylene oxide. When the polylactic acid-based polymer is a homopolymer, the b term is zero in the general formula.

Commercially available aliphatic polyesters of diols and diacids include the BIONOLLE family of polymers, e.g., BIONOLLE #1000, #2000, #3000, #6000, and #7000, which can be obtained from, e.g., Showa Highpolymer Co., Ltd, Japan. Bionolle #3000, #6000, and #7000, which have molecular weights (M_w) of 23,300, 250,000 and 270,000, respectively, and melting points of about 91°, 102°, and 89° C., respectively, were used to make the new blends which were tested as described below. Other aliphatic polyesters of diols and diacids can also be used.

Examples of diols in the aliphatic polyesters include any aliphatic diols including ethylene glycol and 1,4-butanediol. Examples of diacids in the aliphatic polyesters include any individual diacids or combinations of two or more aliphatic diacids, in the range of C_2 to C_{20}, in a weight percent from 0 to 100, e.g., oxalic acid, malonic acid, succinic acid, glutaric acid, adipic acid, n-butylmalonic acid, succinic acid, azelaic acid, sebacic acid, ethyl diethylmalonate and dibutyl succinate. Specific aliphatic polyesters include polybutylene succinate (PBSU), polyethylene succinate (PESU), random copolymers of polybutylene succinate adipate (PBSU-AD), and polyethylene succinate adipate (PESU-AD).

Among other features of the aliphatic polyesters used in the new blends are that these polyesters are biodegradable and that they impart ductility to polylactic acid-based polymers by forming a continuous or co-continuous phase in the morphology of the blends. The polylactic acid-based polymers and the aliphatic polyesters are immiscible, but synergistically compatible in the blends, i.e., the properties of the blends are greater than that of the mixtures of polylactic acid-based polymer and aliphatic polyester determined by the additive rule of mixture. The range of weight average molecular weights of the polylactic acid-based polymer and the aliphatic polyester that can be used is 5,000 to a million, for example 10,000 to 500,000 or 15,000 to 250,000. The range of melting points of the polylactic acid-based polymer and aliphatic polyester that can be used is 50° to 300° C., for example 60 to 200° C., e.g., 80° to 150° C.

Besides a purely aliphatic polyester of diols and diacids, a copolyester of an aliphatic polyester and an aromatic polyester can be used so long as the copolyester is biodegradable and imparts ductility to polylactic acid-based polymers. An example of an aromatic polyester that can be used (in up to 50 percent by weight) in the copolyester is polyethylene terephthalate. Other aromatic polyesters can be used.

Examples of compatibilizers include AB block or AB graft copolymers that consist of a polylactic acid-based polymer or a polymer which is miscible with the polylactic acid-based polymers, and an aliphatic copolyester of polymers based on diols and diacids or polymers which are miscible with these aliphatic copolyesters. These compatibilizers can be added to the blend in an amount ranging from, e.g., 0.1 to 10 percent, e.g., 2, 3, or 5 percent.

Preparing Polylactic-Based Polymer Blends

Standard melt processing equipment and processing conditions can be used to prepare the new blends. Examples of polymer melt processing equipment that can be used to make the new blends include melt mixers (Banbury mixer), blenders, extruders for sheet, film, profile and blown-film extrusion, vulcanizers, calenders, and spinnerets for fiber spinning, molding, and foaming.

The polylactic acid-based polymers and the polymers or copolymers of polyesters were carefully dried at 40° C. under vacuum for at least 24 hours to minimize hydrolytic degradation of polylactic acid-based polymer during the subsequent melt processing. Blending was done on a single screw extruder operating between 150° and 160° C. and a screw speed of 50 rpm. Each sample was extruded twice. This protocol can be varied as long as the polymers and polyesters form a continuous or co-continuous phase blend.

The composition and sample code for each blend made up of polylactic acid and BIONOLLE are reported in Table 1. The A in each sample code refers to the percentage of polylactic acid-based polymer in the blend, and the B refers to the polyester, BIONOLLE#3000, BIONOLLE#6000, or BIONOLLE#7000, which were used to make the new blends with polylactic acid.

TABLE 1

Sample Code	PLA	A90B10	A80B20	A70B30	A50B50	A30B70	Bio#_
PLA wt %	100	90	80	70	50	30	0
BIONOLLE wt %	0	10	20	30	50	70	100

Sample Preparation

Rectangular shaped samples of each blend were prepared to enable uniform testing of characteristics. The tensile test samples were made according to a modified specification in ASTM D 882. In particular, samples of about 0.3 mm thickness, 12.7 mm width, and 38.1 mm length between the grips of the tensile test machine holding the sample, i.e., gage length, were compression molded at 155° C. and cooled in a cooling press machine at 20° C. and 700 psi. Thin film samples were made by melt blending on an extruder and then compression molding to 0.3 mm thickness. The films

were cut into 20 mm×20 mm samples for testing biodegradation in soil and in composting environments.

Testing Methods

Tensile test properties of blends were obtained 1, 2, 4, 7, 14, 21, 35, 40, and 70 days after making the samples. During this interim time period between making and testing, the samples were physically aged at room temperature and atmospheric pressure. The tensile test was done according to ASTM D 882 with the following modifications. The grip separation used was 38.1 mm (1.5 inches) instead of 50 mm (2 inches), and the grip separation rate was 2 inches/minute even for samples with elongation at break greater than 100%, while ASTM D 882 specifies that the grip separation rate be 20 inches/minute for samples with elongation at break greater than 100%.

Biodegradation testing in an artificial soil environment was performed on films of the blends using the respirometric method developed at the NSF Biodegradable Polymer Research Center, University of Massachusetts Lowell and designated UML-7645. This test method covers the determination of the degree and rate of aerobic biodegradation of synthetic plastic materials (including formulation additives) in contact with moist soil under controlled laboratory condition. Carbon dioxide production, as a fraction of the measured theoretical carbon content of the test materials, is reported as a function of time. The test is designed to determine the biodegradability of plastic materials, relative to that of a comparative standard material, in an aerobic environment. The test applies to all plastic materials that do not inhibit bacteria and fungi present in soil.

Biodegradation testing in an artificial compost environment was conducted on film samples in a simulated municipal compost as described in Example 4.

In addition, morphology of the blends was observed under polarizing optical and scanning electron microscopy.

Uses of Polylactic Acid-Based Blends

Like wood and paper, these blends are stable in the atmosphere but biodegradable in compost, in moist soil, in water with activated sludges, and in the sea, where a large number of microorganisms are present. These blends can be incinerated with only slight damage to the furnace since the heat of combustion is relatively low, and no toxic gases are generated. The blends made by this invention can be used to make biodegradable plastic film, sheets, and other products by conventional processing methods such as blown film, extrusion, and injection molding methods. The resulting blends can be used to manufacture bags, food packaging, laminated papers, food trays, fishing line, net, rope, diapers, disposable medical supplies, sanitary napkins, shampoo, drug, cosmetic, and beverage bottles, cutlery, brushes, combs, molded and extruded foamed articles such as packing material and cups, and cushions for flexible packing. These blends provide not only the excellent processibility of polyethylene, but also posses excellent properties like those of polyethylene terephthalate. In addition, these blends can be processed into films that are heat-sealable, unlike polyethylene terephthalate.

EXAMPLES

The following examples further describe the invention without limitation.

Example 1

Tensile Testing

The tensile test was done according to ASTM D 882 with the modifications in the sample length between grip separation and the grip separation rate, as stated above. Specifically, tensile testing was done by using an Instron Tensile machine, model 1137, at grip separation rates of 0.5 and 2.0 inches/minute.

Tensile test properties of blends were obtained 1, 2, 4, 7, 14, 21, 35, 40, and 70 days after making the samples. During this interim time period between preparing and testing, the samples were physically aged at room temperature and atmospheric pressure.

The stiffness of the blends was determined from the slope of the initial linear portion of the stress-strain curve. Stress was measured as the nominal stress defined as force per unit original area. Strain and elongation are used as synonymous terms, and they were measured as percent change in length per unit length of a sample. The yield point of the blends, i.e., where a large inelastic deformation starts (yielding occurs), but the material continues to deform and absorb energy long beyond that point, was characterized as the intersection of the initial linear portion of the stress-strain curve and the flat horizontal portion of the stress-strain curve.

The toughness of the blends, which can be defined as the tensile energy to break according to ASTM D 822, was measured according to ASTM D 822 by integrating the area under the stress-strain curve.

Specifically, a load range such that a specimen would fail within its upper two thirds was selected. The cross sectional area of the specimen at several points along its length was measured to an accuracy of 0.0025 mm. The initial grip separation was at 38.1 mm. The rate of grip separation rate was set at 0.5 inches/minute for samples with less than 20% elongation at break, and at 2 inches/minute for samples with more than 20% elongation at break. The load cell of the Instron tester was balanced, zeroed, and calibrated for measuring and recording force. The rectangular test specimen was placed in the grips of the Instron testing machine, taking care to align the long axis of the specimen with an imaginary line joining the points of attachment of the grips to the machine. The grips were tightened evenly and firmly to the degree necessary to minimize slipping of the specimen during test. The Instron machine was started and stress versus grip separation was recorded.

Tensile stress (nominal) was calculated by dividing the load by the original minimum cross-sectional area of the specimen in the loading direction. The modulus value was determined from the initial slope of the stress-strain curve. Tensile strength (nominal) at break was calculated in the same way as tensile stress except that the load at break was used in place of the maximum load. Percentage elongation at break was calculated by dividing the extension (i.e., grip separation) at the moment of rupture of the specimen by the initial length of the specimen between the grips. Yield stress and percentage elongation at yield were determined by recording the stress and percent elongation at the yield point, which was established as noted above.

Tensile stress-strain curves of blends of BIONOLLE#3000 and polylactic acid are shown in FIGS. **1** and **2**. These blends were aged for 14 days. FIG. **1** shows the complete stress-strain curves of samples coded in Table 2 as PLA, A90B10, A80B20, A70B30, A50B50, A30B70, and BIO#3000. FIG. **2** is a expanded view of the initial portion of the stress-strain curves in FIG. **1**, i.e., up to a strain of 50%. The excellent strain hardening characteristics of these blends is exhibited in FIG. **1** by the rapid increase in stress prior to break. For example, strain hardening in **A30B70** occurred in the strain range of 300–500%, and the corresponding increase in stress was from about 25 MPa to about 50 MPa.

FIG. **2** shows that both stiffness and stress at yield decrease with increasing BIONOLLE#3000 content, while elongation at yield and at break increase with increasing BIONOLLE#3000 content Based on the data in FIGS. **1** and **2**, FIGS. **3** and **4** show modulus (i.e., stiffness) and stress at yield and break, respectively. The outstanding strain hardening behavior of these blends was further exemplified by the increasing difference in stress at break and stress at yield with increasing BIONOLLE#3000 content.

FIG. **5** shows that the elongation at both yield and break of polylactic acid/BIONOLLE#3000 blends increase with BIONOLLE#3000 content, with a dramatic increase at break above 10 percent BIONOLLE. FIG. **6** shows that the toughness of polylactic acid/BIONOLLE#3000 blends increases as a function of BIONOLLE#3000 content above 10 percent. Both FIGS. **5** and **6** show a surprising and unexpected increase in the elongation at break of the blends when the BIONOLLE#3000 content was increased to over about 10 weight percent to about 30 weight percent in the polylactic acid/BIONOLLE#3000 blends, and in toughness of the blends when the BIONOLLE#3000 content was increased to over about 10 eight percent to about 40 or 50 weight percent in the polylactic acid/BIONOLLE#3000 blends.

Tensile properties (modulus and elongation at break) after aging for 7 and 21 days as a function of BIONOLLE#6000 and BIONOLLE#7000 content are shown in FIGS. **7** and **8**. The modulus decreases (FIG. **7**) and the elongation at break increases (FIG. **8**) with increasing BIONOLLE#6000 and BIONOLLE#7000 content. As the aging time increases from 7 to 21 days, the modulus shows a slight increase (FIG. **7**), and the elongation at break shows a slight decrease (FIG. **8**). Since BIONOLLE#7000 is a softer polymer than BIONOLLE#6000, polylactic acid/BIONOLLE#7000 blends have a lower modulus and a higher elongation at break compared with those of polylactic acid/BIONOLLE#6000 blends.

Unlike BIONOLLE#3000, BIONOLLE#6000 and BIONOLLE#7000 do not increase the elongation at break significantly when 10 to 40% by weight of BIONOLLE#6000 or BIONOLLE#7000 is blended with polylactic acid. This may be due to the fact that pure BIONOLLE#6000 and BIONOLLE#7000 do not possess the same tensile properties of BIONOLLE#3000, and also more importantly, the compatibility of polylactic acid with BIONOLLE#6000 and BIONOLLE#7000 is not as good as that of polylactic acid and BIONOLLE#3000. However, the compatibility of polylactic acid with BIONOLLE#6000 and BIONOLLE#7000 can be improved with the addition of a suitable compatibilizer, such as a small amount of BIONOLLE#3000.

Example 2

Aging Effect

The effect of aging on the blends was measured by physically aging the samples at room temperature and atmospheric pressure, and subsequently testing the samples by tensile testing according to ASTM D 882 with the modifications already stated above.

FIG. **9** shows elongation at break of polylactic acid, BIONOLLE#3000, and their blends, as a function of aging. The elongation at break of polylactic acid was below 8%, and decreased to about 5% with aging. Similarly, the elongation at break of A90B10 was rather low (about 50%) and decreased to less than 10% with aging. However, blends having a BIONOLLE#3000 content of 20% or more by weight showed outstanding elongation at break (200% elongation for 20% BIONOLLE#3000, and similarly, 300% for 30%, 400% for 50%, and 500% for 70%, respectively). In addition, these BIONOLLE#3000 containing blends did not exhibit any significant reduction in elongation after aging.

Example 3

Biodegradation Testing in Soil

Soil testing in an artificial soil environment was performed on 0.3 mm thick films of the blends using the respirometric method developed at the NSF Biodegradable Polymer Research Center, University of Massachusetts Lowell and designated UML-7645. A standard soil mix (1:1:0.1 potting soil:sand:dehydrated cow manure by weight) was prepared and characterized. The soil test materials were exposed to the soil under controlled aerobic conditions at 30+±2° C. Carbon dioxide production, expressed as a fraction of the measured of theoretical carbon content of the test materials, was measured as a function of time. The degree of biodegradation of the test material is assessed by comparing the amount of CO_2 produced from the test material to that produced from a standard material, i.e., one that is known to biodegrade (here PLA was used for comparison).

Specifically, the soil biodegradation test was conducted as follows. Fifty grams (oven-dry weight basis) of soil was weighed into a large (14 cm) disposable weighing boat. Enough distilled water was added to the soil and mixed thoroughly to bring the soil to a moisture content of 60 to 70%. Approximately 15 g of the moist soil was set aside. The test specimen, or standard material, was added to the soil and the amended soil was mixed thoroughly. As shown in FIG. **10**, the amended soil **16** was transferred to a large chamber **20** of a 250-mL biometer flask **22**, packed to a uniform depth (about 2.5 cm), and covered by the 15 g of the moist soil set aside. The large chamber **20** was then closed with a rubber stopper **24** connected to a 3-mL plastic syringe **26** packed with a material **26** that removes any carbon dioxide from air entering the biometer during incubation, such as sodium hydroxide-coated silicon (e.g., Ascarite™), between plugs of a filter material **28**, e.g., glass wool or cotton, that allows air, but not the Ascarite™, to pass.

The combined weight of the flask, rubber stopper, and amended soil containing the test specimen was determined and recorded. Twenty mL of 0.4M sodium hydroxide was pipetted into the side-arm chamber **30** of the biometer flask **22** and the side-arm chamber **30** was sealed with a rubber stopper **32**. The biometer flask was placed in an environmental chamber at **30**° C and this chamber was kept dark.

The carbon dioxide analysis was done by reacting the carbon dioxide produced in the biometer with the sodium hydroxide in the side-arm chamber to form an aqueous solution of sodium carbonate. The amount of carbon dioxide produced was monitored by removing the sodium hydroxide from the trap and transferring it to a glass test tube to which 5 mL of 1.5M barium chloride was added. The barium chloride reacts with the sodium carbonate to form a precipitate of barium carbonate. The amount of carbon dioxide evolved was calculated by standard stoichiometric calculation.

The net degradation was measured as the ratio of carbon dioxide evolved to the amount of theoretical maximum carbon dioxide production possible by the test specimen. The theoretical maximum carbon dioxide production was determined by the total organic carbon content of the test material (by calculation, if the chemical composition was well established, or elemental analysis). The maximum amount of carbon dioxide that can be theoretically evolved was calculated by the equation:

$$\textit{Maximum carbon dioxide}=[(W\times C)/100]\times[44/12]$$

where W is the weight of the test specimen; C is the percent organic carbon in the test specimen, 44 is the molecular weight of carbon dioxide, and 12 is the equivalent weight of carbon.

The biodegradation testing in soil showed that the biodegradation rate of BIONOLLE#3000 by itself was extremely fast, while the biodegradation rate of polylactic acid by itself was relatively slow.

The soil degradation testing results of the two polymers and their blends are reported in FIG. **11**. After degradation for 45 days, BIONOLLE#3000 degraded almost 100%, while polylactic acid degraded only about 14% by loss in weight. For blends with 70 and 50% BIONOLLE#3000, the degradation rate was relatively fast. After 45 days, the A30B70, A50B50, and A70B30 blends degraded about 77%, 65% and 25%, respectively, by loss in weight. FIG. **11** shows that polylactic acid biodegrades in soil, but just not quickly, and the addition of the second aliphatic polymer, such as BIONOLLE#3000, increases the biodegradation rate.

The importance of the soil biodegradation curves shown in FIG. **11** is that a specific blend can now be designed such that this blend would have a certain net degradation in a given number of days within the soil.

Example 4

Biodegradation Testing in Compost

Biodegradation testing in an artificial compost environment was conducted on film samples in a simulated municipal compost. Biodegradation testing in an artificial compost environment was conducted on compression molded film samples of dimensions 20 mm×20 mm×0.3 mm in a simulated municipal compost mixture consisting of 60% by weight of water and the rest containing shredded leaves, shredded paper, mixed frozen vegetables, meat waste, urea, and commercial compost seeds. The carbon to nitrogen (C:N) ratio of the starting mix was 14:1. The composting process was carried out for 30 days at 55° C. Triplicate test samples were removed from the composting bioreactors at an interval of 5 days and weighed to measure the weight loss per surface area in the units of $\mu g/mm^2$.

After 20 days in the composting environment at 55° C., BIONOLLE#3000 had a high weight loss rate while polylactic acid had negligible weight loss. The weight loss rates in the blends of polylactic acid and BIONOLLE#3000 after 20 days in the composting environment were between the rates of polylactic acid and BIONOLLE#3000.

The compost degradation testing results of the two polymers and their blends are reported in FIG. **12**. After degradation for 20 days, BIONOLLE#3000 degraded almost 40%, while polylactic acid degraded only about 3%, by loss in weight. For blends with 70 to 20% BIONOLLE#3000, the degradation percentage was much greater (and the rate much faster) than that of polylactic acid, e.g., after 20 days, the A30B70, A50B50, and A70B30 blends degraded about 35%, 25% and 15%, respectively, by loss in weight. FIG. **12** shows that polylactic acid biodegrades in compost, but slowly, and the addition of even 20% by weight BIONOLLE#3000 increases this biodegradation rate dramatically.

The importance of the compost biodegradation curves shown in FIG. **12** is that a specific blend can now be designed such that this blend would have a certain net degradation in a given number of days in a composting environment.

Example 5

Morphologv

Samples were analyzed by microscopy to investigate the morphology of the phases of polylactic acid versus the phases of BIONOLLE#3000. The blends were exposed to acetone to dissolve the polylactic acid component without affecting the BIONOLLE#3000 component. For the blend containing 70% by weight of polylactic acid and 30% by weight of BIONOLLE#3000, 67% of the material, or approximately 95% of the polylactic acid, was dissolved. The remaining material was in a sheet form, and the BIONOLLE#3000 phase in the original blend formed a continuous or co-continuous phase, while the dissolved polylactic acid left behind holes in the sheet-like structure of BIONOLLE#3000. This continuous or co-continuous structure of the BIONOLLE#3000 phase in the original blend explained the outstanding toughness shown in the graph of FIG. **6**.

OTHER EMBODIMENTS

It is to be understood that while the invention has been described in conjunction with the detailed description thereof, that the foregoing description is intended to illustrate and not limit the scope of the invention, which is defined by the scope of the appended claims. Other aspects, advantages, and modifications are within the scope of the following claims.

What is claimed is:

1. A biodegradable blend comprising:

(a) a first polylactic acid-based polymer or copolymer, and

(b) a second polymer consisting essentially of one or more polyesters,

wherein said first and second polymers are present in a ratio of 9:1 to 1:9 by weight, and wherein the second polymer is a homopolymer or random copolymer that forms a continuous or co-continuous phase in the blend.

2. The biodegradable blend of claim **1**, wherein said one or more polyesters are of one aliphatic C_2 to C_{20} diacid or of a combination of two more different aliphatic C_2 to C_{20} diacids.

3. The biodegradable blend of claim **1**, wherein said first, polylactic acid-based polymer is a homopolymer of polylactic acid.

4. The biodegradable blend of claim **1**, wherein said first, polylactic acid-based polymer is selected from the group consisting of D-polylactic acid, L-polylactic acid, D,L-polylactic acid, meso-polylactic acid, and any combination of D-polylactic acid, L-polylactic acid, D,L-polylactic acid and meso-polylactic acid.

5. The biodegradable blend of claim **1**, wherein said first, polylactic acid-based polymer is a copolymer having at least 60% by weight of polylactic acid.

6. The biodegradable blend of claim **1**, wherein said second polymer or copolymer is selected from the group consisting of polybutylenesuccinate homopolymer, polybutyleneadipate homopolymer, polybutylenesuccinate-adipate copolymer, polyethylenesuccinate homopolymer, polyethyleneadipate homopolymer and polyethylenesuccinate-adipate copolymer.

7. The biodegradable blend of claim **1**, wherein said polyester is an aliphatic polyester.

8. The biodegradable blend of claim **1**, wherein said second polymer or copolymer is a copolyester of an aliphatic polyester and up to 50 percent, by weight, of an aromatic polyester.

9. The biodegradable blend of claim **8**, wherein said aromatic polyester is polyethylene terephthalate.

10. A biodegradable blend of claim **1**, further comprising (c) a compatibilizer consisting essentially of one or more polyesters or polyvinyl alcohols.

11. The biodegradable blend of claim 1, said blend having an elongation at break of at least 10%.

12. The biodegradable blend of claim 1, said blend having an elongation at break of at least 200%.

13. The biodegradable blend of claim 1, said blend having an elongation at break of at least 10% after 70 days of aging.

14. The biodegradable blend of claim 1, said blend having an elongation at break of at least 200% after 70 days of aging.

15. The biodegradable blend of claim 1, said blend having a toughness of at least 10 MJ/m^3.

16. The biodegradable blend of claim 1, said blend having a toughness of at least 70 MJ/m^3.

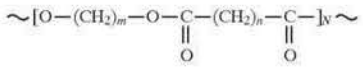
17. The biodegradable blend of claim 1, wherein said second polymer is present in said blend as a co-continuous phase.

18. The biodegradable blend of claim 1, wherein said first, polylactic acid-based polymer or copolymer is a homopolymer of lactic acid or a block, graft, or random copolymer of lactic acid having the formula:

$$-(R_1)_a-(R_2)_b-$$

wherein R_1 is a lactic acid unit, R_2 is caprolactone, glycolide, trimethylene carbonate, dioxanone, butyryl lactone, or ethylene oxide, a is 10 to 10,000, and b is 0 to 10,000.

19. The biodegradable blend of claim 1, wherein said polyester has the formula:



wherein m is 2 to 20, n is 2 to 20, and N is 10 to 10,000.

20. The biodegradable blend of claim 1, wherein said first, polylactic acid-based polymer or copolymer is a polylactic acid homopolymer, and wherein said second polymer or copolymer is a polybutylenesuccinate homopolymer.

21. The biodegradable blend of claim 1, wherein said first, polylactic acid-based polymer or copolymer is a polylactic acid homopolymer, and wherein said second polymer or copolymer is a polybutylenesuccinate-adipate copolymer.

22. A film comprising a biodegradable blend comprising:

(a) a first polylactic acid-based polymer or copolymer, and

(b) a second polymer consisting essentially of one or more polyesters,

wherein said first and second polymers are present in a ratio of 9:1 to 1:0 by weight, and wherein th second polymer is a homopolymer or random copolymer that forms a continuous or co-continuous phase in the blend.

23. A bag comprising a biodegradable blend comprising;

(a) a first polylactic acid-based polymer or co-polymer, and

(b) a Second polymer consisting essentially of one or more polyesters.

wherein said first and second polymers are present in a ratio of 9:1 to 1:0 by weight, and wherein the second polymer is a homopolymer or random copolymer that forms a continuous or co-continuous phase in the blend.

24. A container comprising a biodegradable blend comprising:

(a) a first polylactic acid-based polymer or copolymer, and

(b) a second polymer consisting essentially of one or more polyesters,

wherein said first and second polymers are present in a ratio of 9:1 to 1.0 by weight and wherein the second polymer is a homopolymer or random copolymer that forms a continuous or co-continuous phase in the blend.

25. A disposable diaper comprising a biodegradable blend comprising:

(a) a first polylactic acid-based polymer or copolymer, and

(b) a second polymer consisting essentially of one or more polyesters,

wherein said first and second polymers are present in a ratio of 9:1 to 1:0 by weight, and wherein the second polymer is a homopolymer or random copolymer that forms a continuous or co-continuous phase in the blend.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 5,883,199
APPLICATION NO. : 08/825810
DATED : March 16, 1999
INVENTOR(S) : McCarthy et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

On the title page item (54), and col. 1, line 1, – replace "Polyactic" with -- Polylactic --

Signed and Sealed this

Twentieth Day of February, 2007

JON W. DUDAS
Director of the United States Patent and Trademark Office

UNITED STATES PATENT AND TRADEMARK OFFICE

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PATENT NO.	: 5,883,199
APPLICATION NO.	: 08/825810
DATED	: March 16, 1999
INVENTOR(S)	: McCarthy et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

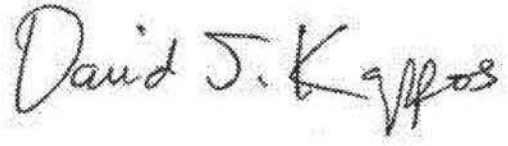
Column 14, Claim 22, Line 4
Delete "1:0" and Insert --1:9--

Column 14, Claim 23, Line 15 (Approx)
Delete "1:0" and Insert --1:9--

Column 14, Claim 24, Line 27 (Approx)
Delete "1.0" and Insert --1:9--

Column 14, Claim 25, Line 39
Delete "1:0" and Insert --1:9--

Signed and Sealed this
Eighth Day of March, 2011



David J. Kappos
Director of the United States Patent and Trademark Office

RESPONDENT EXHIBIT RX-B

In the Matter of:

June 27, 2014
Stephen T. McCarthy, Ph.D.

Condensed Transcript with Word Index

For The Record, Inc.
(301) 870-8025 - www.ftrinc.net - (800) 921-5555

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its molecular mass down to the formation of CO2, H2O, CH4, and other low molecular-weight products under the influence of microorganisms in both aerobic and anaerobic conditions aided by abiotic chemical reactions like photodegradation, oxidation and hydrolysis (14)"

Now, as editor of the journal, did you ever tell the authors that you thought the section entitled Definition of Biodegradation should be changed in any way?

A. No, because I was not a reviewer.

Q. But you approved the article for publication, I think you said?

A. Based on the reviews.

Q. Now, did you tell the authors that they ought to alter the section Entitled Definition of Biodegradation to specify that the term required complete break down and return to nature within one year of customary disposal?

MS. JOHNSON: Objection.

A. If any of the reviewers had changes that they wanted made, I would have then relayed that to the -- and in order for it to be accepted, I would have relayed that back to the author. So that could be construed as me asking the author to

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make changes.

Q. But did you specifically ask either the authors or any of the reviewers to include within the definition of biodegradation the requirement that there be a complete break down and return to nature within one year of customary disposal?

A. No.

Q. Let's take look at another article of yours that is entitled biodegradability and mixability of blends containing poly-hydroxy-butyrate co-hydroxyvalerate in the ANTECH 90 journal at 1439.

MR. EMORD: We'll mark this as Exhibit Number 4.

(Whereupon, Respondent's Deposition Exhibit No. 4, ^ DESCRIPTION, marked.)

BY MR. EMORD:

Q. We're going to skip that for the moment. What is PET?

A. Do you mean what does the abbreviation PET stand for with respect to a polymer?

Q. Right?

A. Polyethylene terephthalate.

Q. In your report, as I understand it, you say that PET is not biodegradable, correct?

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A. Do you want me to check?

MS. JOHNSON: Are you referring to something specific?

Q. Do you consider PET biodegradable?

A. I do not consider PET to be biodegradable in normal composting.

Q. Is there any additive that you know, made by any company, that causes PET to become biodegradable?

MS. JOHNSON: Objection. What do you mean by biodegradable? What definition are you using?

A. I don't think so.

Q. Now, how much have you been paid by the FTC in this proceeding?

A. So far?

Q. Yes.

A. $7500.

Q. And what is your financial arrangement with the FTC?

A. It is $100 an hour, plus the deposition.

Q. You're the director of the U Mass Lowell Bioplastics Institute and Medical Plastic Research Center?

A. Bioplastics Medical Plastic Research

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Center, yes.

Q. With your permission, so I don't have to say that entire name and all of its parts every time I'm referring to, shorten that to Bioplastics Research Center or research center. Is that okay?

A. Yes.

Q. So that were both on the same page, if I use the term Bioplastics Research Center or research center I'm referring to U Mass Lowell Bioplastics and Medical Plastic Research Center, okay?

A. Okay.

Q. Now, when was the Bioplastics Research Center established?

A. You're talking the bioplastics and medical plastics?

Q. Yes.

A. Do you want me to go through the history of --

Q. No.

A. I would say two and a half years ago.

Q. 2011?

A. Yes.

Q. Now, you created it, right?

A. Yes.

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Q. Does the Research Center include members?
A. Yes.
Q. What companies are industry members?
A. Metabolix, Echo Verde -- let me back up. They aren't really members.
Q. What are they?
A. There are companies that sponsor research.
Q. These are the companies that sponsor research, Metabolix, Echo Verde. Who else?
A. MMM, Densified Solutions. Are you talking about just the bioplastics and medical plastics?
Q. Correct.
A. There might be some others.
Q. What's the annual operating budget of the center?
A. I'm not sure exactly.
Q. That's all right. A close approximation?
A. About $70,000 a year. I mean, that's total. That's what the university gets.
Q. I'm going to have you take a look at a document from Mass Lowell.
MR. EMORD: We'll mark this as exhibit.
(Whereupon, Respondent's Deposition

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Exhibit No. 4, document entitled Center for Biograd able Polymer Research, marked.)
BY MR. EMORD:
Q. Now, do you recognize this document?
A. Yes.
Q. To your knowledge, is it accurate in its description of the Research Center?
A. No.
Q. It's not accurate. Where is it inaccurate?
A. This is not the Research Center.
Q. This is another center, Biodegradable Polymer Research Center is not the same as the center we were just talking about?
A. Right. That's why I asked you if you wanted me to go through the history.
Q. I appreciate that. This is a predecessor to it?
A. This is a predecessor to it.
Q. When was the Biodegradable Polymer Research Center established?
A. I believe it was `93.
Q. 1993. Did you establish the center?
A. I established it with a colleague.
Q. Who is the colleague?

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A. Richard Gross.
Q. He was your mentor?
A. Is that a question?
Q. Yes.
A. No.
Q. You studied in collaboration with him?
A. No.
Q. He has a background in biochemistry, right?
A. In chemistry.
Q. And he wrote articles in which you were also the co-author, right?
A. Yes.
Q. He did research on polymers, right?
A. Yes.
Q. And you worked with him on that research and published with him on that research. Were you the more junior person in that association?
MS. JOHNSON: Objection.
A. No.
Q. You were the senior person?
A. Yes.
Q. When did he retire?
MS. JOHNSON: Objection. That assumes facts not in evidence.

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Q. Has he not retired. Is he still at U Mass?
A. No, he's not at U Mass.
Q. But he's at another institution now?
A. Yes.
Q. What institution is that?
A. Rensselaer Polytechnic Institute.
Q. In France?
A. In Troy, New York.
Q. How much was the annual budget of the Biodegradable Polymer Research Center?
A. In what year?
Q. `93 to 2011?
MS. JOHNSON: Objection.
Q. Annual operating budget.
A. It varied.
Q. Give me the range.
A. I would say it varied from $30,000 to possibly maybe close to $200,000.
Q. A year?
A. Per year.
Q. Is Exhibit 4 a complete and accurate description of the Biodegradable Polymer Research Center, do you think?
A. It looks like this was a description as

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of 2008.
Q. And as of that year, is it accurate?
MS. JOHNSON: Objection.
A. I believe so.
Q. Let's take a look at another one of these. This one is an updated version. No. This one is the preceding version. We'll find out. We'll mark this as Exhibit 5?
(Whereupon, Respondent's Deposition Exhibit No. 5, document entitled Center for Biogradable Polymer Research, marked.)
BY MR. EMORD:
Q. Can you tell me what is the, if you know, what is the year, this one, of this document? The other one was 2008.
MS. JOHNSON: Is this an excerpt of something? Where is the rest of the document?
MR. EMORD: He can tell us.
MS. JOHNSON: It's your exhibit.
MR. EMORD: This is all we have. I don't -- I have these two documents. Whether there are other documents related to it, I'm sure there probably are.
MS. JOHNSON: Did you pull this off the website?

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MR. EMORD: It's in our discovery materials. That's all I know.
MS. JOHNSON: There's no Bates number on it.
MR. EMORD: Right.
A. I'm not sure what this is.
Q. You don't know what year it is?
A. I mean, there is an indication that it's 2007.
Q. Is this an accurate description of the functioning and purpose of the center, that is Exhibit 5?
A. At that time?
Q. At that time, roughly 2007/2008.
A. I'm not sure.
Q. You say in 2011 the center changed its name?
A. Yes.
Q. And is the purpose of the center since 2011 the same as it has been previously, or has it changed?
A. In 2011, we expanded it to include medical plastics.
Q. So prior to that time, it didn't include medical plastics?

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A. Not officially.
Q. Any other change of note in 2011 from the prior functioning of the organization?
A. Yes. It was a new location.
Q. Previously, it was located where?
A. 333 Aiken Street.
Q. And now it's located?
A. 1001 Pawtucket.
Q. Did you expand the size of the facility?
A. No.
Q. Roughly the same size?
A. No.
Q. Smaller?
A. Yes.
Q. What is your salary as a professor at U Mass?
A. Approximately $150,000.
Q. Do you have any other income related to biodegradable plastics?
A. In terms of anything?
Q. Anything.
A. The royalty.
Q. Royalty income from?
A. From a patent that's owned by the university.

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Q. Now, you have been responsible for bringing several research grants to U Mass Lowell, right?
A. Yes.
Q. And as I understand it, it is the policy of U Mass Lowell, when a professor brings in a grant, to assign a portion of that grant money to do the research. That's the vast majority of it?
MS. JOHNSON: Objection. What's the foundation?
Q. He can answer. The vast majority of it goes to the Research Center or whatever, the fund for the research. And then a portion goes to the university. Do I have that right? Correct me if I'm mistaken.
A. Let me maybe recharacterize the statement so that it's more factual.
Q. Thank you.
A. So there is the total amount of the money is split between direct costs and indirect costs. So there's an overhead rate of 54 percent that's applied to the research monies on the majority of grants.
Q. Now, the overhead rate, that goes to the university?

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A. The university.
Q. And the remainder of the 100 percent, the --
MS. JOHNSON: 46.
Q. The 46 percent.
A. The remainder is spent on the research.
Q. Now, it goes into a research fund, right?
A. No.
Q. What account receives that 46 percent?
A. The project account.
Q. Who controls the project account?
A. The principal investigator or principal investigators.
Q. And are you in control of that account for research that you bring into the universe?
MS. JOHNSON: Objection. What account?
Q. The project account you just mentioned.
A. For projects in which I'm one the principal investigators, I have some control over that.
Q. Do you have signatory authority over the account?
A. In some cases.
Q. Do you receive a salary out of funds that go into that account?

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A. No.
Q. Do you receive any personal financial remuneration whatsoever from the funds that go into that account?
A. No.
Q. Now, in connection with the research money that you are able to land as grants from an institution, does the university ever give you an increase in salary based on its review of those grants?
A. So there are two promotions where there are raises. One is for associate professor and one is for full professor. And there are three areas that are important to achieve in order to get that promotion. One is teaching, one is service, and one is research. And in the research part, that would be where the sponsored research would be important.
Q. I see. So it's a factor taken into account in determining salary?
MS. JOHNSON: Objection. Mischaracterizes his testimony.
A. Not in determining salary. In determining the promotion to associate or full professor.

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Q. I see. Now, once you become a full professor, if you continue to get grant monies brought into the university, does that in any way effect the determination of whether to increase your pay?
A. No.
Q. It has no effect whatsoever?
A. Up until like this last year, it didn't really have an effect. It's not a good thing. It's because the union was -- it's a faculty union. Up to two years ago, I think there's .5 percent increase in salary. I'm just guessing. I'm not sure exactly. But I think right now there's .5 percent increase in salary that's possible from merit. And merit, that would enter into merit.
Q. The university has a policy about professors inventing something and getting a patent for it, don't they?
MS. JOHNSON: Objection. Vague.
A. They encourage it.
Q. They have a policy related to patents?
A. They have many policies related to patents.
Q. If you invent something at the lab at the

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university, and you wanted to secure a patent for the invention, what would the university require?
A. If I wanted to secure a patent, it would probably have to not be done in the lab, and it would have to be something that's not related to any of my research.
Q. But if you did discover something in the lab, what would the university do? Would they say -- under the policy that exists -- would they say we'll get the patent, you can be co-owner of the patent. How does that relationship work?
A. If it was something in the lab related to my research, I would not be allowed to get a patent on it.
Q. The university would get the patent?
A. The university -- if there was a patent to be issued, the university would own it. Or if I did get a patent, they would probably take me to court or something.
Q. Let's take a look at patent number 5,833,199, which we'll mark as Exhibit 6?
(Whereupon, Respondent's Deposition Exhibit No. 6, patent number, 5,833,199, marked.)
BY MR. EMORD:
Q. Do you recognize this patent?

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A. Do you want me to go through the whole thing?
Q. Go through each page and make sure it's a true and correct copy of your patent.
A. The question is -- I forgot?
Q. Is this your patent?
A. No, it's not my patent.
Q. Whose patent is it?
A. The university of Massachusetts.
Q. You're listed as one of the inventors?
A. Yes.
Q. The university of Massachusetts is listed as the assignee on the patent?
A. The assignee?
Q. Who assigned the patent to the assignee?
A. The university.
Q. The university assigned the patent to itself?
A. Again, the policy is if it's something that's invented at the lab and related to research, the university owns the rights to that.
Q. Is there an agreement between you and the university concerning this patent?
A. Yes.
Q. Is it in writing?

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A. Yes.
MR. EMORD: May we have a copy of the agreement?
MS. JOHNSON: I think he's referring to the general policy. I don't think there's a written signed agreement between the parties.
Q. Is there a written signed agreement between you and the university?
MS. JOHNSON: Not that I'm aware of.
A. You mean regarding the patent?
Q. Assignment of the patent, yes.
A. Yes.
MR. EMORD: Could we have that.
A. The university has it.
Q. And in addition, there are written policies that the university has that pertain to patents such as this?
A. Yes.
Q. And do you have access to those policies?
A. Yes.
MR. EMORD: May we have copies of those written policies?
MS. JOHNSON: Sure.
Q. What are the terms of the assignment agreement, as best you can remember, between you and the university?
A. That they have exclusive rights to it, to do whatever they want.
Q. Now you receive royalties under the patent, right?
A. I receive a portion of the royalties.
Q. The royalties are assigned to the university?
A. The royalties are paid to the university.
Q. And the university pays you a portion of the royalties?
A. The university pays a portion of the royalties to me.
Q. What percentage royalty, do you know, that the university gets?
A. The university gets 70 percent of the royalties, and 30 percent is split between the inventors. And that is only on the profit. So there's a long time where you're paying back the lawyer's fees, the prosecution, the maintenance fees, before you see a penny.
Q. And the three people who split the 30 percent are the inventors listed in the patent?
A. That's correct.
Q. And they each receive what, 10 percent?

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A. About that.
Q. How much money did you receive, let's say, in 2011, from your patent royalties? Let's make it a little easier, 2013.
A. Altogether it's been about $28,000.
Q. And in 20 --
A. No, for all time.
Q. Approximately, how much do you get a year, the range?
A. It varies. One year, I didn't get any, because it was a challenge and lawyers got involved. Nothing against lawyers. I think I got in the range of 4 to $5,000 this year.
Q. How much has Metabolix given to U Mass Lowell in grants for sponsored research that you did? Is the name Metabolix?
A. Yes, Metabolix.
Q. What did I say? As in metabolic function.
A. Yes. That's exactly why they chose the name.
Q. Exactly how much money has Metabolix given to the center?
A. I'd say approximately 1.7 million dollars.

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Q. And are they committed --
A. I mean, that's in sponsored research.
Q. Yes.
A. Okay.
Q. Is there another form of support they give?
A. Royalties.
Q. And any other form?
A. There was a -- there was also a grant that was written, whereby, they paid the university for equipment that was purchased by the university. So it was sort of a repayment for equipment that the university purchased.
Q. Are you paid as a consultant by Metabolix?
A. I was paid for the expert witness testimony.
Q. How much were you paid?
A. For the two cases, approximately $5,000.
Q. For both cases or independently?
A. Both cases.
Q. And are you paid in any other way by Metabolix?
A. No.
Q. Are you paid by any other company

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personally?
A. Well, I'm compensated for the expert witness.
Q. Yes. But as a consultant to any other company, are you paid?
A. I don't think so.
Q. With Metabolix, are they going to continue to supply research grants to the center?
A. Honestly, I don't think so.
Q. Do you know today?
A. I don't know today.
Q. How many years have they supplied research grants to the center?
A. I don't know specifically, but I would estimate it to be over 20 years.
Q. And have they given funding annually over that 20 years?
A. There may have been some years when they didn't fund anything.
Q. When you mentioned the 1.7 million, that's the total over that 20-year period?
A. Over the 20 years, yes.
Q. Now, this patent that we've marked for identification as Exhibit 6, is Metabolix the exclusive license holder?

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A. Yes. They are the exclusive licensee with the option to sublicense.
Q. Have they sublicensed?
A. Yes.
Q. To which parties?
A. The ones I know about are the ASF, Natureworks. Those are the ones that I definitely know about. I know they were talking to Georgia-Pacific, the Dixie people.
Q. Solo Cup?
A. If it's Solo.
Q. Maybe it's Dixie Cup.
A. International Paper.
Q. Are there biodegradable products on the market made under the 199 patent, Exhibit 6?
A. I believe so.
Q. What products are on the market?
A. I don't know specifically.
Q. Do you have general idea?
A. I believe it's mainly compost -- plastic compost bags.
Q. Any other products?
A. I don't know. That's all Metabolix.
Q. Do you know whether those products are -- have labels or labeling associated with them that

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identifies them as compostable or biodegradable?
A. I do not.
Q. You've never seen the finished product?
A. No.
Q. And Metabolix has never supplied you with samples of finished product?
A. No.
Q. Have you ever seen advertising by Metabolix related to your patent?
A. No.
Q. Or products that are made under your patent?
A. No.
Q. Now, customers in the market for biodegradable plastics, compostable products have a lot of choices out there?
MS. JOHNSON: Objection. Lacks foundation.
Q. Do you know?
A. They have -- I mean, there are more than a couple choices. It's not a huge amount.
Q. So you're not saying there's a monopoly associated with your 199 patent, it's a competitive marketplace, right?
MS. JOHNSON: Objection.

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Mischaracterizes his testimony.
Q. To your knowledge.
A. I mean, the 199 patent is primarily based on Natureworks' product. And so if -- it would be a monopoly -- there could be other people who may produce polylactic acid, but they're minor compared to Natureworks.
Q. But that particular product is in competition with other compostable and biodegradable products in the market, right?
A. Sure.
Q. So you wouldn't have to buy plastics bags that were compostable from Natureworks, you could go to another company that uses another invention?
A. Yes.
Q. And you could get biodegradable plastic bags, compostable plastic bags, recyclable plastic bags, you have a quite an array of products to chose from?
MS. JOHNSON: You mean products that are being marketed, biogradable compostable, not that they are in fact biodegradable compostalbe.
Q. That are marketed as biodegradable compostable, recyclable, there's quite an array that you can choose from, right?.

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A. Yes.
Q. In other words, it's a competitive marketplace?
A. Yes.
MR. EMORD: Let's go off the record.
(Off the record.)
BY MR. EMORD:
Q. Now, have you seen any complaint or -- by complaint, I'm using that term broadly, not just a legal complaint in a court. I'm using the term really as a letter or an objecting document. Have you ever seen such a document before this case was filed that related to ECM Biofilms?
A. Before this case was filed, no.
Q. For example, you did not see an e-mail to Janice Frankel, an FTC attorney, from Brian Igoe?
MS. JOHNSON: Objection. Lacks foundation.
Q. Do you know Brian Igoe?
A. Yes.
Q. Is he with Metabolix?
A. No.
Q. Is he a lawyer?
A. He was with Morrell, when they first spun our Morrell.

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Q. When they first what?
A. When Metabolix first spun out Morrell.
Q. Before that, was he with Metabolix?
A. No.
Q. Are you familiar with or have you ever seen an e-mail to Janice Frankel from Brian Igoe complaining about ECM's claims and urging FTC to take action against ECM?
A. No, I don't believe so.
Q. Have you ever see any other document, any communication, from Metabolix to the Federal Trade Commission concerning ECM?
A. I've seen the documents that were provided to me by complaint counsel. So I don't believe anything was from Metabolix.
Q. Have you ever seen a document complaining about ECM Biofilms or its claims from Metabolix to the Federal Trade Commission?
MS. JOHNSON: Objection. Asked and answered.
A. Again, if it was in the documents supplied to me by complaint counsel.
Q. Do you have any specific recollection of a document from Metabolix to the FTC complaining about ECM BioFilms?

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A. No.
Q. Do you know that Metabolix filed a complaint with the FTC about ECM BioFilms?
A. No.
Q. You haven't had any discussion with Metabolix about the filing of such a complaint?
A. No.
Q. They didn't ask you to review any content of the complaint or consult with you at all concerning the complaint?
A. No.
Q. What is Solutia?
A. I believe it's a spin out from Monsanto.
Q. And has Solutia -- forgive me if I'm mispronouncing it -- has Solutia given grants to your center?
A. I'm not sure. Under the original incarnation of the center, Monsanto was a member of the center. They might have changed. I think the portion -- I don't think Solutia ever gave anything to the center. They donated a patent to the university.
Q. Now, in your 199 patent --
A. You mean the university's?
Q. Yes. When I use that term, we'll

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understand however I refer to Exhibit 6 that actually it is held by the university. Now, let me back up just a little bit here. Have you ever informed any of the parties that give grants to your center that you didn't consider plastics biodegradable, unless they completely break down and return to nature?

A. I don't believe so.

Q. Have you ever told them that you don't consider plastics biodegradable unless they do that, completely break down and return to nature within one year after customary disposal?

A. I don't believe so.

Q. Have you ever informed any of the corporate funders for the center that additives to plastics won't cause biodegradation?

MS. JOHNSON: Objection. Vague. Plastics?

A. So we did a lot of work on additives, and typically we wanted them to be biodegradable to maintain the biodegradability of the total system.

Q. And in each of those instances, did you establish with proof that the additive caused the plastics to completely break down and return to nature, that is, decompose into elements found in

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nature, within one year after customary disposal?

A. I don't believe so.

Q. Let's take a look at paragraphs 17 and 37 of your expert report. Paragraph 17 is on page 7. Go ahead and read 17 and 37, if you will, first 17 and 37, to yourself.

A. Okay.

Q. Now, is it the case that if we take a look at 17 and 37, it's your position that the additive in the ECM product is no more susceptible to a -- the plastic is no more susceptible, conventional, no more susceptible to microbial attack after it's blended with the ECM additive than before?

A. As long as it's added to a nonbiodegradable polymer.

Q. So if it's nonbiodegradable polymer, under what you've identified in the report and the additive is added to it, it's no more biodegradable after its been added than it is before; that's your opinion?

A. Yes.

Q. Now, can I be -- is this an accurate statement, that conventional plastics are not biodegradable?

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A. That would be an accurate statement.

Q. What are conventional plastics?

A. Well, the majority of plastics polyethylene, polypropylene, PVC, Teflon, PET, Azdel.

Q. And for all of those, is it your position that they're no -- that they are not susceptible, any more susceptible to microbial attack after the ECM additive is added to them than before?

A. Yes.

Q. Is it further your position that there is no additive that you know of that could transform a conventional plastic into a biodegradable plastic?

MS. JOHNSON: Objection. Mischaracterizes his testimony. Assumes facts not in evidence.

A. One that degrades completely in one year?

Q. Right.

A. I don't know of one.

Q. Let's take a look at the patent again, Exhibit 6. As I understand the invention, and you can help me understand it better, or correct my misunderstanding, you start with polylactic acid PLA and you blend it with any other polyester, and

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the result is a biodegradable polymer; is that correct?

A. No.

Q. Tell me where I have that mistaken.

A. Do you want me to explain to you what the patent is?

Q. Sure.

A. The patent is a polylactic acid-based polymer or copolymer, and the polyester is an aliphatic diacid. So the first one is polylactic acid, and the second one is -- a number of them, could be C2 to C20 diacid with two more different aliphatic diacids. The group --

Q. I might draw your attention to paragraph 12 of the patent, under other embodiments, that might help?

A. Column 12?

Q. Yes. Under other embodiments. You see there are a listing that proceeds from 1 through 10?

A. Yes. Proceeding onto the next page to 25. Does that give an accurate summation of the claims.

A. Yes.

Q. And of the blends?

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A. Yes.
Q. So that would be a complete and accurate summation of the blends?
A. This would be the -- what is claimed in the invention.
Q. In particular, if you look at column 6, lines 9 to 12. There it is stated an example of an aromatic polyester that can be used in up to 50 percent by weight in the copolyester is polyethylene terephthalate. Other aromatic polyesters can be used. That polyethylene terephthalate, that's PET, right?
A. It would be co-PET.
Q. Does it say that there?
A. It's a copolyester.
Q. Yes, copolyester is biodegradable?
A. So it would be something like polyethylene buterate co polyethylene terephthalate.
Q. As I understands it, the protocol that you've used -- let me back up just a little bit. The protocol that you used here, that is described in the patent to establish the biodegradability of the blend, blends, five blends, is your own testing methodology that you developed at U Mass

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Lowell, right?
MS. JOHNSON: Objection.
Q. It was your own testing methodology that you developed?
A. It was developed within the center, yes.
Q. And as I understand it, under column 10 of the patent, you have a description of that testing methodology; is that correct, example 3?
A. Yes.
Q. And that testing methodology is described as UML-7645?
A. Yes.
Q. The results of your testing are shown at figure 11; is that right?
A. Yes.
Q. As I have read through this, I don't see any proof of biodegradation being supplied through use of 14C radiologic testing; is that correct?
A. That's correct.
Q. Also, I do not see any representation in the patent that you established that the product -- the blends would completely break down and return to nature, that is, decompose into elements found in nature, within one year after customary disposal; is that right?

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A. This was not intended to -- yes, that's right.
Q. So your claim for this biodegradable plastic in the patent doesn't depend on proof of satisfaction of the definition of biodegradation or biodegrade in footnote 1 of your expert report?
MS. JOHNSON: Objection.
A. So one of these is polylactic acid, and I think I responded earlier to say that polylactic acid I believe would completely degrade in one year in the correct environment.
Q. One of them is, but not all of them?
A. The vinyl goes to 100 percent within 50 days.
Q. Right, but all five of the ones that are listed under figure 11, you have established would biodegrade within one year completely?
A. I believe they would.
Q. You believe so. Did you prove that? Did you test them to establish that?
MS. JOHNSON: Objection.
A. If the vinyl goes by itself and the PLA goes, then any blend would go.
Q. My question is more specific. Did you test your product to establish within a year that

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it would completely biodegrade?
A. No.
Q. You're extrapolating then from the 50 days in the study to the conclusion that they will eventually completely biodegrade?
MS. JOHNSON: Objection. Mischaracterizes his testimony.
A. No. I'm using the pure Bionolle to establish that that goes to a hundred percent.
Q. The pure Bionolle. But as far as the remaining blends are concerned -- let me back up a little bit. There are a total of five blends, right?
A. Yes.
Q. For those five blends, you did not perform a test to determine if they would completely biodegrade within a year?
MS. JOHNSON: Objection, relevance.
A. I did not.
Q. If you look at Claim 1 of the patent, you can read along with me and correct me if I'm wrong, a biodegradable blend comprising of first polylactic acid-based polymer or co polymer and a second polymer consisting essentially of one or more polyesters wherein said first and second

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Q. And when a company receives the BPI certification are they, to your knowledge, authorized then to place a logo or other form of certification on the products?
A. I believe so.
Q. What does that certification or logo provide; do you know?
A. It provides a certification that it meets the standard of the D64 -- that it has met.
Q. And does it indicate that it's compostable or biodegradable?
A. Compostable.
Q. And is there any other, to your knowledge, information on the logo other than BPI certified and compostable?
A. I don't know.
Q. Earlier we had discussed Metabolix grants to the center. And I want to present you with a copy of a document that's from UML Education News.
(Whereupon, Respondent's Deposition Exhibit No. 7, article dated 06/30/2010, marked.)
BY MR. EMORD:
Q. What I would like to do is have you take a look at that. It's a short one-page document. And inform me if the content presents an accurate

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depiction or is inaccurate in any respect?
A. Could I correct prior testimony?
Q. Go ahead.
A. I apparently misspoke when I said that Brian Igoe was an employee of Morrell. He was actually an employee of Telles, which was a spinoff of Morrell into bioplastics.
Q. Thank you for that.
A. Anything else about this -- anything about this that is an inaccurate representation, to your knowledge.
A. I think the 2.5 million is wrong. It should be 1.5. That's about it.
Q. Any other change you would make to ensure its accuracy?
A. No.
Q. Let's look at another similar document.
(Whereupon, Respondent's Deposition Exhibit No. 8, UMLEDU News document, marked.)
BY MR. EMORD:
Q. Take a moment. This is a two-page document. It is a UMLEDU news document again. Take a moment and look at that and inform me if there's anything to your knowledge that's inaccurate about the content of that article.

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A. I don't see anything wrong. The patent holder is not me.
Q. Other than that?
A. No.
Q. Who is Steve mow Joe?
A. Steve Mojo is the, I believe, the head of BPI.
Q. Do you have a good relationship with Steve?
A. Yes.
Q. How frequently do you guys talk by phone, for example?
A. Not often.
Q. E-mail, how frequently do you exchange e-mails?
A. Not often.
Q. In the last month, how many times have you interacted with Steve Mojo?
A. Zero.
Q. Last year?
A. Zero.
Q. Is there anyone else at BPI that you interact with regularly?
A. No.
Q. Are you on BPI's international advisory

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board?
A. I don't believe so.
Q. If they list you on their international advisory board, that would be news to you?
A. That would be news to me.
Q. Are you a member of BPI?
A. No.
Q. Are you or have you of been an officer of BPI?
A. No.
Q. Previously you said you have not done consulting work for BPI?
A. I did certification that we went through.
Q. So that was consulting work?
A. That was --
Q. Were you paid?
A. I was reimbursed for that.
Q. How much were you paid?
A. For the whole certification of each company it was $1,000.
Q. Per company or for every company?
A. Per company.
Q. How many companies did you certify?
A. About 30, over the ten years or so.
Q. Do you continue to perform that function?

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A. No.
Q. When did you discontinue performing that function?
A. I believe it was two years ago.
Q. So from what period to what period did you perform the certification for BPI?
A. Probably 2001 to 2011.
Q. Who did you interact with at BPI related to that?
A. Steve Mojo.
Q. How frequently did you interact with Steve concerning the certification issues?
A. It would be on average about three per year. So it would have been like probably four times per certification.
Q. Did you contact Steve or did Steve contact you first in relationship to this job?
A. Steve contacted me. He had a series, a whole list of reviewers.
Q. Do you know who recommended you for that position?
A. No.
Q. Steve didn't mention that?
A. No.
Q. Has Steve ever recommended you for other

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work?
A. I don't believe so.
Q. Has Steve ever been responsible for referring companies to give grants to your center?
A. No.
Q. Have you ever referred companies to Steve for certification or for becoming member of BPI?
A. No.
Q. Do you speak at BPI conferences?
A. No.
Q. Have you ever spoken at any event involving BPI?
A. I spoke the an a conference in India that Steve Mojo also spoke at.
Q. Were you paid in association with that?
A. No.
Q. Did they pay for your transportation to and from?
MS. JOHNSON: Objection.
A. BPI?
Q. BPI.
A. No.
Q. Anyone else, a corporation?
A. I think that I had to pay for the air fare to India, and then they covered the hotel,

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the Indian SIPIT they called it, sponsored conference.
Q. What is BEPS?
A. That's a society for promoting biodegradable and environmentally degradable polymers, not promoting them, but to discuss the science around biodegradable and environmentally degradable polymers.
Q. Did BPI create the BEPS?
A. No.
Q. It's independent?
A. In independent.
Q. Are you a founding member of BEPS?
A. Yes.
Q. When was that created?
A. That's a good question.
A. I think it was `93. No. `92 or `93.
Q. Is Metabolix a member or supporter of BEPS?
A. No.
Q. I think previously I asked you about complaints with regard to your knowledge of whether BPI had filed complaints against ECM. Do you know whether BPI filed comments concerning the FTC's green guides?

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A. Comments in -- no.
Q. You weren't involved with the filing of any comments by BPI, if it did file them, with the FTC?
A. That's correct.
Q. Let's take a look at paragraph 22 of your report. Now, there you refer to hydraulic cleavages. What are hydraulic cleavages?
A. Actually, it should be hydrolytic.
Q. There you explain that microorganisms secrete enzymes that adhere to the surface of the organic materials and cause fissures in the molecular chain known as hydraulic cleavages, and you meant to say?
A. Hydrolytic.
Q. These cleavages make long-chain molecules shorter, resulting in the release of carbon and energy heat. Now, assuming I'm a student or whatever, I would like for you to do the same thing, can you take a piece of paper for me and draw the chemical reaction pathway with chemical structures that would illustrate the chemical process that you're defining here in paragraph 22?
A. Yes.
Q. Let's get a piece of paper. Can you draw

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Synthetic Polyesters Enzymes as Potential Catalysts for Polyester Recycling and Process Biochemistry?

MS. JOHNSON: Objection. Do you have a copy of the article?

MR. EMORD: No. I'm just seeing if he knows that as a familiar source.

A. Yes.

Q. You're familiar with that article?

A. Yes.

Q. What does that article stand for?

A. Basically what you read as the title, that he found an enzyme that was able to hydroliticly cleave PET.

Q. Okay. Thank you. Do you think synthetic plastics biodegrade in and of themselves?

A. Some of them.

Q. Have you read the peer-reviewed article by Shaw et al. entitled Biological Degradation of Plastics, a Comprehensive Review in Biotechnology Advances, 2008?

A. I believe so.

Q. Do you recall the substance of that article?

A. I think it was another review like these

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reviews.

Q. Do you recall what the gist or proposition of that article?

A. It was just reporting on what other people have reported.

Q. About the biological degradation of plastics?

A. Yes.

Q. Now, does low density PE biodegrade?

A. High molecular weight low density polyethylene does not biodegrade.

Q. Have you read the peer-reviewed article by P-A-R-M-I-L-A et al. entitled Biodegradation of Low Density Polyethylene by Fungi Isolated from Municipal Landfill Areas in the Journal of Microbiological Biotechnology Research 2011?

A. I think so.

Q. Do you remember what that was about?

A. I think it was a report of small amounts of degradation.

Q. Does low density polyethylene biodegrade?

A. I don't believe so.

Q. You mention in your report raid --

A. Do you mean biodegrade at all?

Q. Biodegrade at all. Do you want to answer

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again?

A. In all these polymers there's molecular weight distribution and there could be some low molecular weight chains that could be oxidized that may be able to be degraded.

Q. I appreciate that. Radiological marker C testing. Now, in your report you identify that -- you said there's one test that you would deem essentially -- and correct me if I'm wrong -- dispositive as to whether additives like ECMs cause biodegradation of plastics containing them, and that test is 14C?

A. Carbon 14, yes.

Q. And just for context, in paragraph 60 on page 24 you write, absent an approved ASTM specification, it is my opinion that to scientifically prove a claim that the plastic -- not merely the additive and inoculum -- is biodegrading, the claimant must support its claim with at least one test with positive results from 14C labeling of the conventional plastic, right?

A. Yes.

Q. And are you aware of any peer-reviewed journal article that identifies radiological marker C testing as the only definitive test to

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establish biodegradation of plastics?

MS. JOHNSON: Objection.

A. So when Eastman was introducing their copolyester that's PET with the aliphatic polyester, they did get some results that there was biodegradation. And it was believed that PET did not degrade. And so they labeled the benzene ring in the PET and then did the degradation test and proved that the -- because they didn't want the benzene rings to be just not degrading in the environment. So they proved that the benzene rings degraded.

Again, as long as it was enough -- I think it was 50 percent aliphatic polyester. And that was a very affordable test.

Q. My question really is different, in that I'm looking for whether there is -- whether you're aware of a peer-reviewed journal article that has identified radiological marker C testing as the only definitive test to establish biodegradation of plastics?

A. Yes, I think that resulted in a peer-reviewed article.

Q. Did it identify radiological C testing as the only definitive test?

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A. Yes.
Q. Let's get the citation for that. When was it published?
A. I'm not sure.
Q. Do you have that article?
A. Let me see. It was around the time of my patent. Not my patent. The university's patent. Yes, around '98 or '97.
Q. Where was it published?
A. I don't know.
Q. In a peer-reviewed journal?
A. Yes.
Q. Do you have a copy of it?
A. Not on me.
Q. Do you have it back in Lowell?
A. Probably.
Q. May we have a copy of that article? Did you say it was Eastman?
A. Yes.
Q. Do you remember who the authors were?
A. Charles Buchanan.
Q. B-U-C-H-A-N-A-N?
A. Yes.
Q. Anyone else?
A. I'm sure there were others.

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Q. Where is Charles Buchanan?
A. I'm just guessing. He's probably on his farm in Tennessee because he's retired. Or he's in Florida where everybody else goes.
Q. Has the 14C radiological marker that you recommended as a confirmatory test already been used to prove that polyethylene biodegrades?
A. It's been used to prove that a small portion of polyethylene biodegrades.
Q. Do you remember what the source is for that information?
A. That's the Albertsson paper.
Q. Are you familiar with that article?
A. Yes.
Q. Let's take a look at it.
(Whereupon, Respondent's Deposition Exhibit No. 14, ^ DESCRIPTION, marked.) 14
BY MR. EMORD:
Q. Now, did you become familiar with that article before this litigation or after?
A. Before.
Q. And what's going on here? She's got polyethylene film. She does what with it, and how does this C14 process work? What were the results?

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A. So they bought carbon 14 labeled ethylene and then polymerized it to polyethylene. And then studied the release of carbon 14 labeled carbon dioxide from that polyethylene.
Q. They're really studying the gas release, the carbon dioxide release?
A. That's correct.
Q. What did they determine?
A. They determined that they get .4 percent degradation in 800 days.
Q. If we look at the synopsis, and can you tell me if the synopsis is in any way not an accurate reflection of the remainder of the article. It says both the soil and the different mold cultures reflected with very good agreement, a definite liberation of 14 CO2 from the 14C labeled polyethylene film. Significantly above produced abiotically from aging samples. This is interpreted as due to an enzymatic cleavage and oxidative conversion of synthetic polymeric or oligomeric alkanes with limited chain length, accessible for biodegradation, right?
A. Yes.
Q. In your judgment did that 14C marker provide definitive proof in this study of that

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effect?
A. .5 percent in two years?
Q. Right. Of biodegradation?
MS. JOHNSON: Objection. Do you mean to completion?
Q. No. Of biodegradation.
A. Right. Again, as I stated earlier, there's a distribution of molecular weight. There probably is some low molecular weight that could then be oxidized and then degraded to a very small extent.
Q. That's your theory there. But that theory isn't supported in the article itself, is it?
MS. JOHNSON: If you need to read the whole thing, feel free.
A. Yes. It says the source of the 14C metabolization in these degradational experiments must have been mainly low molecular weight polyethylene.
Q. Can you show me the page for that?
A. Sure. 3432.
Q. And where are you?
A. The last paragraph.
Q. However, that's not stated as a specific

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Q. I'm going to give you another article.
(Whereupon, Respondent's Deposition Exhibit No. 16, ^ DESCRIPTION, marked.)
BY MR. EMORD:
Q. Let's take a moment to refresh your recollection. This is one of your articles, right?
A. Yes.
Q. Do you recall whether in this article you said that single test method would not provide all of the answers to time period, loss of priorities and formation of toxic intermediaries, complete mineralization and variable environmental exposure conditions. Take a look at page 294.
A. Okay.
Q. Now, is it your position in this article that a single test method does not provide all the answers to those questions you delineate in the first full paragraph on page 294, and you enumerated questions?
MS. JOHNSON: What was the question?
Q. The question is whether it is his position in this article that a single test method would not provide all of the answers to the questions that he specifies enumerated in the

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first full paragraph on page 294.
A. It would not -- this could not be, that's correct.
Q. That in fact stated there as the last sentence, furthermore, a single test method will not provide all of the answers to the questions above.
A. That's correct.
Q. And you still stand by that view today?
A. Yes.
Q. Let's take a look at another of your articles. This one is Exhibit 18.
(Whereupon, Respondent's Deposition Exhibit No. 18, ^ DESCRIPTION, marked.)
BY MR. EMORD:
Q. Now, in this study you measured soil degradation rates of polylactic acid, right? It looks like, and you can tell me, it looks like this may have something to do with your patent. Am I mistaken, I mean the U Mass Lowell's patent based on your invention?
A. The question was?
Q. It looks like in this study you measured soil degradation rates of polylactic acid, and is this the study that is the principal study

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underlying your 199 patent?
A. No.
Q. This is one in a series of them?
A. This is the biodegradability with the Proteinase K, the soil and the composting for the blends which are the basis of the patent that U Mass owns.
Q. As I understand it, under this study you base your determination of biodegradation principally upon a measure of weight loss; is that right?
A. I believe the Proteinase -- it's true for the Proteinase K and the composting. I don't recall how we did it for the soil.
Q. If you look on page 72 under biodegradability the second paragraph. It looks like the patent description in the 199 patent with regard to biodegradation testing in the soil. I'm going to have the court reporter put into the transcript at this point the second full paragraph under the title biodegradability on page 72 of Exhibit 18 as a point of reference.
"The biodegradation testing in soil, Figure 10, shoed the biodegradation rate of Bio#3000 was extremely fast, while the rate of PLA

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was relatively slow. After degrading for 45 days, Bio#3000 degraded almost 100%, while PLA only degraded about 14%. For the blends with 70 and 50 wt % Bio#3000, the degradation rate is relatively fast. After 45 days, the A30/B70 blend degraded about 77%, the A50/B50 blend degraded about 65%. These values are equal to those expected on the basis of additivity rule. However, for blends with less than 30 wt% Bio#3000, the degradation percentage values are less than those expected on the basis of additivity rule."
Now, as I understand it from this study, you did not use 14C radiological testing, right?
A. That is true.
Q. And I also do not see anywhere in here reliance upon an ASTM standard test method?
A. That is correct.
Q. Did you use your own laboratory test method here?
A. It was the test method of the center. I'm not sure there was an ASTM test method at that time.
Q. What was the test method at the center?
A. There's three of them. One is the compost; one is the enzymatic; and one is the

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soil.
Q. You concluded that the biodegradation did occur in the test sample plastic, and it is listed there, is it not, in the second paragraph under the title biodegradability on page 72, for each of the blends and for the PLA?
A. The question is the numbers are listed?
Q. Right. Is that an accurate summarization of the biodegradability or biodegradation results of the study listed on page 72 in paragraph 2 under the title biodegradability?
A. Yes. That's what we found.
Q. And you stand by those test results today?
A. Well, at the time, those were the best results that we had. It would have been better to do a measurement of carbon dioxide.
Q. But as for the tests that you did do, they're satisfactory for establishing the biodegradation of the test sample?
MS. JOHNSON: Objection.
A. I mean, at the time -- I mean, they're not the best tests. The weight loss is problematic, as we later found out.
Q. Now, when it comes to proof in this

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thing, you didn't prove that the test sample plastic completely biodegrades within one year of customary disposal, right?
A. Not with this test.
Q. Let's take a look at another one of your articles. This one is Exhibit 19.
(Whereupon, Respondent's Deposition Exhibit No. 19, Biodegradable Polymer Blends of Poly(lactic acid) and Poly(ethylene glycol), marked.)
BY MR. EMORD:
Q. Now we've marked for identification an article of Dr. McCarthy's respondent's Exhibit 19 Biodegradable polymer blends of polylactic acid and polyethylene glycol. This is one of your articles?
A. Yes.
Q. Part of the article explains and enzymatic degradation test, right?
A. Part of the material was exposed to an enzyme.
Q. Correct me if I'm wrong, but it looks to me that you measured enzymatic degradation on pages 1500 and 1501 based on a weight loss calculation; is that correct?

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A. Yes.
Q. Did you rely on any other measure for determining the degradation in this study, other than weight loss?
A. No.
Q. And you didn't use in this study an ASTM standard; is that correct?
A. I don't think one existed at the time.
Q. And you didn't use 14C radiological testing?
A. No.
Q. And let me ask you, do you extrapolate from your lab tests to conclusions about the actual environment in landfills?
A. Do I currently?
Q. Have you ever?
A. I don't know.
Q. You don't remember?
A. I don't remember.
Q. Let's take a look at another article here. I'll mark this as Exhibit 20.
(Whereupon, Respondent's Deposition Exhibit No. 2, Degradation Ranking of Plastics in a Landfill Environment, marked.)
BY MR. EMORD:

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Q. This article is entitled Degradation Ranking of Plastics in a Landfill Environment. You appear to be one of the authors; is that correct?
A. Yes.
Q. If we look at page 867, and that's right on front in the second full paragraph, you appear to define the purpose of the study, right?
A. Yes.
Q. And you write, the purpose of this paper is to compare on a relative scale the degradatrion of various plastic materials in an accelerated test, which is correlatable to the actual degradation in actual landfills, right?
A. Yes.
Q. So it's fair to say from this study that the accelerated control tests you performed in the lab in this study you correlated to actual landfill conditions in the outside world, right?
A. No. We didn't. We weren't able to. I mean, we tried to. That was the purpose of it, but it never happened.
Q. Now, in this study you didn't use 14C radiological testing?
A. No.

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Q. And what method did you use to measure biodegradability?
A. It looks like weight loss?
Q. In the third full paragraph of the study on the front, you write, in the preprint we present preliminary results which correlate plastics degradation with a biological environment in the simulator and provide comparative rates for degradation of plastics and materials typically placed in landfills, right?
A. Right.
Q. Are you extrapolating here from the lab tests to the real world environment of landfills?
MS. JOHNSON: Objection.
A. No.
Q. In the third paragraph, you describe the method you used here, it's not 14C radiological testing, to present it as a quote a methodology for the routine analysis for plastics degradation under a leachate recycled landfill conditions, end quote. Do you see that?
A. Yes.
Q. So you believe that that methodology, at the time you wrote this article, you believed that the methodology you used, is that a fair

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statement, for the routine analysis for plastics degradation under leachate recycle landfill conditions?
A. That was what we had hoped.
Q. But the method used you describe as the routine analysis for plastic degradation?
MS. JOHNSON: Objection. Asked and answered.
Q. As routine?
A. No.
Q. At the time you wrote this, you didn't believe it was routine?
A. No. We presented a methodology that we had hoped could be used in routine analysis, and it ended up not being able to do it.
Q. Now, you also evaluated the appearance of samples to determine if they looked weathered; is that correct?
A. Do you know where that is?
Q. If you look under results and discussion, the second full paragraph, cellophane and PHVD appeared extensively weathered from exposures in simulators G, E and H. Cellophane turned black and disintegrated into small fragments. In fact, none could be recovered from simulator G. PHBV

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became brittle, opaque and extensively eroded on the surface. Only small remnants of PHBV could be recovered after exposure 127 days. In all simulators, polypropylene become discolored and somewhat embrittled but films showed no signs of surface erosion.
A. This was the problem with the weight loss is that they fragmented, and it was not accurate.
Q. Exhibit 10, page 293, if you look there in the first paragraph, 293, it reads, there is increased recognition that biodegradable plastics can serve an important role in the design of an intelligent, integrated solid waste disposal scheme. Do you believe that statement to be true when you made it?
A. Yes.
Q. And is it true today?
A. I believe so.
Q. The same article on the same page right column, you write, biodegradable disposal plastic articles can be designed such that they will be entirely converted by microbial activity in a biologically active environment to biogas CO2 and CH4 CO2 under aerobic and anaerobic conditions respectively biomass and biological byproducts.

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Do you believe that statement to be true when you made it?
A. Yes.
Q. Do you believe it to be true today?
A. If I was to write it today I would say just use aerobic and add biomass.
Q. Now, two years after you wrote these words and two years later would 1995 and you wrote in another article, Laboratory-Scale composting Test Methods to Determine Polymer Biodegradability: Model Studies on Cellulose Acetate, which we will mark as Exhibit 21.
(Whereupon, Respondent's Deposition Exhibit No. 21, ^ DESCRIPTION, marked.)
BY MR. EMORD:
Q. Look at that. This is one of your articles, right?
A. This is an article and I'm one of the authors.
Q. If you'll look an page 614, the first full paragraph under the title Introduction, there is an increased recognition that biodegradable plastics can serve an important role in the design of an intelligent, integrated, solid waste disposal scheme. When you wrote this article did

RESPONDENT EXHIBIT RX-C-1

Metabolix Grants a Patent License to NatureWorks LLC for New Biopolymer Blends

03/14/2012

CAMBRIDGE, Mass.--(BUSINESS WIRE)-- Metabolix, Inc. (NASDAQ: MBLX), a bioscience company focused on bringing environmentally sustainable solutions to the plastics, chemicals and energy industries, today announced that it has granted a non-exclusive license to NatureWorks LLC for the U.S. patent No. 5,883,199, titled "Polylactic Acid-based Blends," to make, use and sell blends of polylactic acid (PLA) with certain other polymers including polybutylene succinic polymers (PBS). The University of Massachusetts Lowell is the owner of the '199 patent, and Metabolix, Inc. is the exclusive licensee in the relevant field. NatureWorks and the biochemicals company BioAmber recently announced a joint venture which will support NatureWorks in bringing to market new performance Ingeo polymer compositions.

"This research greatly expands the uses of PLA in biodegradable plastics because the blends allow for a stronger, more flexible form. The basis of my research is to improve the potential uses for PLA because it is made from renewable natural resources rather than oil, and is environmentally friendly," said inventor and patent-holder Stephen McCarthy, a professor of plastics engineering at UMass Lowell and director of the university's Bioplastics Research Center. The exclusive license agreement was negotiated on behalf of the university with Metabolix by UMass Lowell's Office of Commercial Ventures and Intellectual Property.

"As a leader in the development of biobased polymer technology, we have assembled a broad intellectual property portfolio covering key elements of making and using advanced biomaterials, including biopolymer blends," commented Richard P. Eno, President and CEO of Metabolix. "For areas outside of our technical and commercial focus, we are amenable to licensing arrangements that provide Metabolix the opportunity for a financial participation and pave the way for the introduction of new materials to the marketplace."

About NatureWorks LLC
NatureWorks LLC is a company dedicated to meeting the world's needs today without compromising the earth's ability to meet the needs of tomorrow. NatureWorks LLC is the first company to offer a family of commercially available, low-carbon footprint Ingeo biopolymers derived from 100 percent annual renewable resources with performance and economics that compete with oil-based plastics and fibers. In October 2011, Thailand's largest chemical producer, PTT Chemical Public Company Limited, entered into an agreement to make a $150 million equity investment in NatureWorks. The transaction remains subject to regulatory clearances. For more information on NatureWorks and Ingeo, visit www.natureworks.com.

About University of Massachusetts Lowell
UMass Lowell is a comprehensive, national research university located on a high-energy campus in the heart of a global community. The campus offers its 15,000 students bachelor's, master's and doctoral degrees in education, engineering, fine arts, health and environment, humanities, liberal arts, management, sciences and social sciences. UMass Lowell delivers high-quality educational programs, vigorous hands-on learning and personal attention from leading faculty and staff, all of which prepare graduates to be ready for work, for life and for all the world offers.

www.uml.edu.

About Metabolix
Founded in 1992, Metabolix, Inc. is an innovation-driven bioscience company focused on providing sustainable solutions for the world's needs for plastics, chemicals and energy. The Company is taking a systems approach, from gene to end product, integrating sophisticated biotechnology with advanced industrial practice. Metabolix is developing biobased industrial chemicals and plastics, as well as a proprietary platform technology for co-producing plastics, chemicals and energy, from crops. For more information, please visit www.metabolix.com. (MBLX-E)

Metabolix: Safe Harbor for Forward-Looking Statements
This press release contains forward-looking statements which are made pursuant to the safe harbor provisions of Section 27A of the Securities Act of 1933, as amended, and Section 21E of the Securities Exchange Act of 1934, as amended. The forward-looking statements in this release do not constitute guarantees of future performance. Investors are cautioned that statements in this press release which are not strictly historical statements, including, without limitation, statements regarding future licensing opportunities, constitute forward-looking statements. Such forward-looking statements are subject to a number of risks and uncertainties that could cause actual results to differ materially from those anticipated and are detailed in Metabolix's filings with the Securities and Exchange Commission, including its 10-K for the year ended December 31, 2011, which was filed on March 12, 2012. Metabolix assumes no obligation to update any forward-looking information contained in this press release or with respect to the announcements described herein.

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RESPONDENT EXHIBIT RX-C-2

UMass Lowell, Metabolix/Telles Celebrate Partnership

More Than $2.5 Million in Funded Research Conducted

Chancellor Marty Meehan, center, Prof Stephen McCarthy, second from right, and Executive Vice Chancellor Jacqueline Moloney, far right, with executives from Metabolix/Telles

06/30/2010
By Edwin L. Aguirre

UMass Lowell recently hosted a reception for Metabolix/Telles to celebrate the company's 15 years of sponsored research and licensing partnership with the University. More than 30 students, faculty, University administrators and company officers attended the gathering, which was held at the newly renovated UMass Lowell Bellegarde Boathouse.

Attendees included Chancellor Marty Meehan, Executive Vice Chancellor Jacqueline Moloney, Administration and Finance Vice Chancellor Joanne Yestramski, Provost Ahmed Abdelal and Engineering Dean John Ting as well as Metabolix/Telles President and CEO Richard Eno, Chief Scientific Officer Oliver Peoples, Telles General Manager Robert Engle and Strategy & Commercial Development Vice President Johan van Walsem.

In his welcome remarks, Meehan thanked Metabolix/Telles for its support through the years.

"Bioplastics and green technology are important to the future of the University and the new Emerging Technologies and Innovation Center being built on campus," he said.

"We are very pleased with our partnership with UMass Lowell," said Eno. "It is one of the best universities in the country."

Cambridge-based Metabolix is an innovation-driven bioscience company focused on providing sustainable solutions for the world's needs for plastics, chemicals and energy. For example, the company is now developing and commercializing Mirel™ bioplastics, a renewable and biodegradable alternative to petroleum-based plastic made from sugarcane.

"Research in bioplastics is vital to UMass Lowell," said plastics engineering Prof. Stephen McCarthy. "Metabolix located the headquarters of Telles in Lowell because of its partnership with the University."

McCarthy said Metabolix has funded more than $2.5 million in sponsored research with UMass Lowell and more than 50 students for their master's and doctorates. It has also donated more than a half million dollars' worth of bioplastic processing equipment.

"Metabolix has licensed UMass Lowell patents for bioplastic blends, with potential royalties of $100,000 a year," said McCarthy.

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University Relations - Cumnock Hall, 31 University Ave., Lowell, MA 01854
Phone: 978-934-3224 Fax: 978-934-3033 Contact Us

RESPONDENT EXHIBIT RX-D

From:	Brian Igoe
To:	jfrankle@ftc.gov
Cc:	Kristi Guillemette; Steve Mojo
Subject:	FW: Good Earth and ECM
Date:	Thursday, June 26, 2008 4:55:47 PM
Attachments:	goodearthproductclaims.pdf ECM Exhibits July 17.pdf Comments on ECM Documents Fnal.pdf

Dear Janice,

Please check out the claims this company is making about a microbial additive to traditional plastics, including PVC and EPS which makes them biodegradable and harmless to the environment. http://www.goodearthpkg.com/ It is clear they are making vague and intentionally deceptive claims about environmental benefits and ASTM certifications with no corroborative data. This is a clear violation of the FTC guidelines for environmental marketing claims. Also, in the Good Earth "Certification" section on their website they reference ASTM 5338, which is a test method (which yields a rate of mineralization), and not a certification.

I am attaching copies of Good Earth and ECM's selling materials and some comments from the Bioplastic Products Institute regarding the material. When you review the Good Earth PPT presentation (on their website), and ECM's material you'll see these products use ECM's additive technology. Most of the photos in the powerpoint document on the Good Earth website (and signatures) match that of the ECM info attached.

I hope this helps in your pursuit of false claims by these companies.

Sincerely,
Brian Igoe

Brian Igoe
VP and Chief Brand Officer
978-513-1850

Metabolix®
650 Suffolk Street, Suite 100
Lowell, MA, 01854 USA

www.metabolix.com

RESPONDENT EXHIBIT RX-E-1

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Wednesday, May 7, 2014

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Mirel™ Bioplastics by Metabolix

Member profile details

Membership level	Resins
Organization	Mirel™ Bioplastics by Metabolix
First name	Dave
Last name	Scarlett
e-Mail	scarlett@metabolix.com
Phone	978-513-1870
Product Image	mirel

Contact data

Affiliation	Materials Supplier
Directory listing text	Manufactures and sells a broad family of Mirel™ bioplastic including injection molding materials P1003, P5001, F1005, P1004/F1006, and M.vera™ B5002 film.

Personal information

Address	650 Suffolk Street; Suite 100
City	Lowell

Additional information

Province/State	MA
Postal code	01854-3639
Country	USA
FAX	617-492-1796

BPI Custom Fields

Website	www.mirel.com
Company Logo	mirel
Certified Biodegradable Products	Resins
Compostable Products	Compostable Resins

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Biodegradable Products Institute, Inc.

888c 8th Ave #141

New York, NY 10019

1-888-BPI-LOGO (274-5646) [North America] - International +1-646-845-0776

Click here to Contact the BPI

RESPONDENT EXHIBIT RX-E-2

PUBLIC DOCUMENT

4080 Products listed as of
Wednesday, May 7, 2014

(http://www.metabolix.com)

Metabolix
21 Erie St
Cambridge, MA 02139
P:978-513-1800
F:978-513-1886
http://www.metabolix.com (http://www.metabolix.com)

Company Description:

Manufacturers and sells a broad family of degradable plastics under the Mirel and Mvera tradenames.

This Company's Products - Manufactured or Licensed

Download CSV (http://products.bpiworld.org/companies/8205/px/csv) Download XLS (http://products.bpiworld.org/companies/8205/px/xls)

Subcategory: injection molding resins

Brand	SKU	Title	Category	Subcategory	Color
Mirel	P1004	Mirel-brand natural-color Injection Molding Resins 488 microns (19.21 mils) thick	Resins	injection molding resins	natural
Mirel	P1003	P1003 Injection Molding Resin	Resins	injection molding resins	natural
Mirel	F1006	Mirel-brand natural-color Injection Molding Resins 500 microns (19.69 mils) thick	Resins	injection molding resins	natural
Mirel	F1005	F1005 Injection Molding Resin	Resins	injection molding resins	natural

Subcategory: resins

Brand	SKU	Title	Category	Subcategory	Color
Mirel	M000	Mirel® resin grade M000	Resins	resins	natural
Mirel	M4300	Mirel® resin grade M4300	Resins	resins	natural
Mirel	M2100	Mirel® resin grade M2100	Resins	resins	natural
Mirel	M2200	Mirel® resin grade M2200	Resins	resins	natural
Mirel	M4100	Mirel® resin grade M4100	Resins	resins	natural
Mirel	P4004	Uncolored resins	Resins	resins	natural

Subcategory: film resins

Brand	SKU	Title	Category	Subcategory	Color
Mvera®	B5011	Resin for blown and cast films (197 µm)	Resins	film resins	natural

Find a Certificate

Member

Certificate Description

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Company	
Metabolix	M2100, M2200 and M4100 Resins
Metabolix	Natural colored resin with a maximum thickness 0.69 mm .
Metabolix	Uncolored resins, sold under the tradename Mirel®, for max. approved thickness of 0.69mm [P4004]
Metabolix	Injection Molding Grades P1003/P1004 (max. thickness 0.48mm)
Metabolix	Injection Molding Grades F1005/F1006
Metabolix	M0000 and M4300 resins, approved up to 0.69 mm
Metabolix	Uncolored resins for the production of blown and cast films with a max. thickness of 197 µm

RESPONDENT EXHIBIT RX-F-1

BPI Biodegradable Products Institute
promoting biodegradable products throughout the world

April 25, 2005

Ms. Janice Frankle
Federal Trade Commission
601 New Jersey Ave NW
Rm 2122
Washington D.C., 20001

Dear Janice:

It was good to speak with you again. As we discussed, I would like to bring to the FTC's attention that there are a growing number of "biodegradable" claims, especially by manufacturers of plastic bags for collecting pet waste. These manufacturer's actions are misleading, inappropriate (and in some cases knowingly illegal).

The BPI is designed to be a multi-stakeholder group, involving people and companies that produce, use or recover biodegradable products. Our goal is to include organizations and individuals ranging from resin suppliers and converters to industry suppliers to waste haulers and composters as well as government officials, scientists and leading academics.

The organization has shown steady growth over the past few years. Current members include leading biodegradable resin suppliers, such as BASF, NatureWorks LLC, DuPont, Novamont and Procter & Gamble, converters and distributors, such as Heritage Bag, Polargruppen A/S, Farnell Packaging, Georgia Pacific and Biota Spring Water, along with the United States Composting Council, The Massachusetts Department of Environmental Protection, and R. Narayan, Chairman of ASTM D20.96-Subcommittee on Degradable Plastics.

The issues that the BPI believes need to be addressed are

- Claiming to "biodegradable", even when the bags (and pet waste) are customarily landfilled.
- Failure to support "biodegrades in landfill" claims with scientific data.
- Knowingly breaking the laws in the State of California.

The 2 products that are emblematic of these offenses are "Oops I Pooped" and "Bags on Board". These products are sold throughout the United States via large retailers, like Petsmart and REI, as well as smaller outlets.

The BPI supports the FTC's *Guides for the Use of Environmental Marketing Claims*. Moreover, the BPI objects to the use of "biodegradable" without any qualifications as to where this occurs; how long it takes and not having the data to support this claim.

> *"An unqualified claim that a product or package is degradable, biodegradable or photodegradable should be substantiated by competent and reliable scientific evidence that the entire product or package will completely break down and return to nature, i.e., decompose into elements found in nature within a reasonably short period of time after customary disposal." Section 206.7 b of the FTC Guides for the Use of Environmental Marketing Claims.*

Additionally, there are few, if any, benefits derived from putting "biodegradable" materials in a landfill, which are designed to be arid tombs according to RCRA. For this reason, the BPI believes that a claim of "biodegrades in landfills" is an exaggeration of an environmental benefit.

> "Overstatement of environmental attribute: *An environmental marketing claim should not be presented in a manner that overstates the environmental attribute or benefit, expressly or by implication. Marketers should avoid implications of significant environmental benefits if the benefit is in fact negligible."* Section 206.6 c *of the FTC Guides for the Use of Environmental Marketing Claims*

In fact, in some countries, including Britain, Germany and Canada, regulations are being enacted to keep biodegradable materials out of the landfill as a way of reducing methane gas generation (a significant contributor global warming).

The BPI believes that the claims made by "Oops I Pooped" are misleading (see attached page from their website (Exhibit 1) because they are not supported by scientific data. Further, biodegradation in landfills provides no meaningful environmental benefit and thus this is an overstatement of an environmental benefit.

- "biodegradable waste bags for ..your dog"
- "will completely degrade in a landfill and leaves behind no harmful residue"
- Under benefits, "Steady degradation rate, typically 2 years."
- "1 to 5 years pending landfill conditions"
- "Our bags will biodegrade in landfills in every State but California"

When asked by the BPI, "Oops I Pooped" provided the attached data (Exhibit 2), which discusses the test results of polyethylene resins with an additive produced by ECM. The document was reviewed by Dr. Ramani Narayan a noted expert in the field of plastics and biodegradation. Dr Narayan's findings can be summarized as follows (see Exhibit 3 for complete comments):

- Only 24% of the material was mineralized (or biodegraded). According to the test results, seventy six percent of the material remains.
- The biodegradation process plateaued prior to the end of the test, indicating that the process had stopped. (There is no indication that it will continue).
- These levels are comparable to those achieved by the first round of "biodegradable plastics" 20 years ago, which generated the initial FTC lawsuits in this area.

Clearly, there is no support for complete biodegradation in a landfill, even in 5 years, as stated by the supplier and shown on a retailer website (See Exhibit 4). Also, attached is a partial listing of retailers carrying this product, according to the manufacturer's website (Exhibit 5)

Additionally, the last claim, "Our bag will biodegrade in landfills in every state except California", shows that the manufacturer knows that it is not complying with applicable state laws. As background, the State of California regulations state that any claims of "biodegradable, compostable or degradable" by plastic films must comply with a current ASTM Specification (Exhibit 6). California enacted this law in order to stop the misleading claims made by plastic bag manufacturers, which were on the increase. The California law does not create an exemption for products that a customarily landfilled. Moreover, there are no ASTM Specifications for landfill biodegradation.

In the case of "Bags On Board", the BPI objects to their "100% Biodegradable Bags, except as defined by California" claim for 3 reasons (Exhibits 7 & 8):

- The attached independent analysis shows that the bags are essentially polyethylene with no additives to promote degradation (Exhibit 9).
- Promoting biodegradation of a product that is landfilled is inappropriate and an overstatement of an environmental benefit.
- The packaging clearly shows that the producer is not in compliance with the laws of California.

The plastics industry is working hard to develop tests and criteria for determining acceptable biodegradation performance in appropriate disposal routes. ASTM D6400 for Compostable Plastics and ASTM D6868 for Compostable Packaging are good examples. Claims such as those used by "Oops I Pooped" and "Bags on Board" harm the credibility of all manufacturers that seek to comply with the FTC Environmental Marketing Guides. More importantly, their statements mislead consumers by claiming to have environmental benefits when in fact they do not.

Janice, this note requests that the FTC order these 2 companies to cease their misleading advertising. Further, the BPI hopes that FTC would recognize and support California's effort to use ASTM Specifications as the basis for making biodegradable, compostable and degradable claims. Finally, the FTC should reiterate that claims of biodegradability for products customarily disposed in landfills is an overstatement of an environmental benefit.

Sincerely,

Steven A. Mojo
BPI Executive Director

Attachments

List of Exhibits

#1: Oops I Pooped claims from their website. You will find
- "Will completely biodegrade in landfill and leave behind no harmful residue"
- "Steady degradation rate typically 2 years"
- "1 to 5 years pending landfill conditions"
- "Our bags will biodegrade in landfills in every State but California!"

#2: Document supplied by Oops I Pooped, providing their substantiation
- "Ecological Assessment of ECM Plastic"

#3 Analysis and comment of Exhibit #2 by Dr. R. Narayan.

#4 : Samples from REI's (retailer) website promoting biodegradation in landfills

#5 Partial list of retailers from Oops I Pooped website

#6 Text of California Labeling Legislation

#7 Sample of "Bags on Board" product purchased at retail, claiming 100% Biodegradable Bags, except as defined in California"

#8 Materials from retailer website, claiming "100% Biodegradable"

#9 Analysis by Polimeri Europa, showing that the bags are polyethylene

RESPONDENT EXHIBIT RX-F-2

BPI Biodegradable Products Institute

March 30, 2010

Mr. Michael Davis
Federal Trade Commission
CRC-240
600 Pennsylvania Ave, NW
Washington, D.C. 20580

Dear Mike,

Enclosed you will find 2 examples of the continuing stream of "biodegradable" products. What is interesting about these is that in both cases they use the same additive, EcoPure from BioTec (per the packages), and are making somewhat similar claims:

1) **Biodegradable Easter Grass** (also labeled as Green)
This product claims to meet ASTM D5511 (an anaerobic test). The back of the package states that this product will biodegrade in a landfill and achieves 3% biodegradation in 20 days, where ordinary Easter Grass does nothing. I don't know if they are saying that 3% is enough to warrant a "biodegradable" claim. Or if they believe that the process will continue until the product reaches close to 100%. In which case, they should have extended the testing period.

2) **Green Genius Biodegradable Bags**
According to the company's website (http://www.thegreengenius.com)

> *"Well, at least not for a thousand years or so. That's why we invented Green Genius bags. We figured the world was ready for a biodegradable plastic trash bag. They're just as strong as regular plastic bags, but unlike their more stubborn cousins, they meet ASTM D5511, an industry standard for biodegradability."*

I would urge you to review the video on their site. This clearly gives the impression that the product will fully biodegrade in a landfill.

Also, they provide consumers and customers with a letter from UL (attached).

> *"Product is biodegradable in landfills where anaerobic digestion is occurring. Based on 36 day ASTM D5511 test results, it is estimated that the Green Genius trash bags will biodegrade within a one to ten year time frame, depending on the exact conditions*

> *and operation of the landfill environment into which it is disposed."*

It is clear that UL nor the manufacturer have done the tests to demonstrate that the entire product will biodegrade as called for in the Environmental Marketing Guides. Further, based on the technology, it is reasonable to expect that the overall rate of biodegradation would be comparable to what was achieved in the Easter Grass example and well short of "complete".

While I believe that each of the companies bears some responsibility in making these misleading claims, it is the additive supplier BioTec, who is the real culprit in this situation. You can see from the commonality in claims, that the link is the additive supplier, not necessarily the manufacturers of the products themselves.

BioTec is a New Mexico based company with the following address:

Bio-Tec Environmental, LLC
7009 Prospect Ave NE #202
Albuquerque, New Mexico
87110 USA
Website: http://www.bio-tec.biz/aboutus.html

Regards

Steve Mojo
BPI Executive Director

RESPONDENT EXHIBIT RX-G

BPI Biodegradable Products Institute
promoting biodegradable products throughout the world

January 30, 2008

Federal Trade Commission
Office of the Secretary
Room H-135 (Annex B)
600 Pennsylvania Ave, NW
Washington, D.C. 20580

RE: Green Guides Regulatory Review, 16 CFR Part 260, Comment,
Project No. P954501

To Whom It May Concern:

This provides the comments of the Biodegradable Products Institute (BPI) with regards to the FTC's Environmental Marketing Guides.

The BPI is a multi-stakeholder trade association, involving people and companies that produce, use or recover compostable products. The BPI strongly supports the recovery of organic materials via composting and many of the members are actively involved in the production of materials from renewable feedstocks. All BPI approved products meet stringent scientifically based standards for compostability. Currently the organization has 42 members including leading suppliers of compostable resins, compostable bags, compostable food service items and compostable packaging. Member organizations include BASF, NatureWorks LLC, Metabolix, Novamont, Cereplast, BiobagUSA, Heritage Bag and Poly-America. The BPI's "Compostable Logo" is used by organizations in the US, Canada, China, Australia, Europe and Brazil. Moreover, it is recognized by composting facilities from San Francisco to Prince Edward Island. Also the BPI's efforts are recognized by the US EPA and the Canadian Plastics Industry Association. A complete list of BPI approved products and members can be found on our website: www.bpiworld.org.

It is important to note that membership in the BPI has grown dramatically over the past couple years. I believe that our membership growth parallels the increasing interest in environmental claims driven in part by Wal-Mart's Sustainable Packaging Program and increased awareness in global warming. In concert with this interest in the environment, the BPI has seen an increasing level of "biodegradable" claims, especially in landfills. These are largely unsupported by conclusive scientific data and importantly lead consumers to believe that "biodegradation" in landfills is an environmental benefit, when it is not. Appendix 1 is a recent example of this trend (Jan 14, 2008 Dispoz-o Plate Press Release).

Overall Comments:
The BPI and its members believe that the current FTC Environmental Marketing Guides have provided significant direction to manufacturers since they were first developed in the early 1990's. Moreover, the BPI fully supports the overall directions of the Guides, especially the reliance on sound science to support claims. However, since the last revision in the Guides in the late 1990's, there have been two developments that should be incorporated in your next revision, pertaining to the definitions for "biodegradable" and "compostable".

1. The American Chemistry Council (ACC) fielded a national survey to better understand consumer attitudes with regards to the terms "biodegradable" and "compostable" and "renewable" in September 2006. Over 1000 consumers were surveyed in a statistically sound manner. This study, one of the first that I am aware of, probes consumers' knowledge of these terms. The ACC and BPI have already discussed the findings of this work with the FTC and provided a complete copy of the results and questionnaire[1]. I will reference the relevant sections of this work in this letter and attach a copy of presentation from 2007.

2. Development of two specifications by the American Society of Testing and Materials (ASTM) that speak to the identification of compostability of plastics and plastic coated paper products. These 2 specifications are
    - ASTM D6400: "Standard Specification of Compostable Plastics"
    - ASTM D6868: "Standard Specification for Biodegradable Plastics Used as Coatings on Paper and Other Compostable Substrates"

    Products meeting these specifications are in commerce today. They are being processed by the growing number of professionally managed composting facilities throughout North America and Europe today. Moreover, the ASTM Specifications are similar to those used in Europe and its key requirements will be incorporated in the ISO standard now under development (#17088).

The BPI's comments will focus on the terms in the current Guides: "biodegradable", "compostable" and "degradable as well as the terms relating to "renewable or biobased content".

"Biodegradable" Comments:
Based on the ACC's research, most consumers do not really understand the scientific process behind biodegradation. Rather, they believe that something that is labeled as "biodedgradable" will somehow disappear into nothing within a year, regardless of location. Quoting from the report's findings:

- *"For most people, this term ("biodegradable") means that the material is able to decompose or break down naturally (on its own).*
- *Most people believe the material would break down in 1 year or less.*

[1] Email correspondence to J. Frankle Podoll FTC) from J. Killinger (ACC) on June 25, 2007.

- *One key attribute assigned to biodegradable by most people is that when it breaks down the material disappears completely - there is nothing left behind.*

When asked how long something should take to "biodegrade", 60% of the respondents stated a year or less.

Further, over 80% of the people surveyed believed that "biodegradable" products would break down in a landfill or in the natural environment.

Given this level of consumer understanding, the BPI recommends

1) The term "biodegradable" should have a separate definition from that of 'degradable' and 'photodegradable'. Consumers expect that a 'biodegradable' material will be totally eliminated from the environment. The only way that this can be accomplished is via microbial assimilation, where these products are used as a food source.

   Conversely, 'degradable' and 'photodegradable' are forms of fragmentation, where the polymers become friable, yet remain in the environment. While each has value, the end result of the process differs from what occurs during biodegradation.

2. The FTC should reinforce returning "entirely to products found in nature" and **cite a specific timeframe for the process**. The BPI has seen claims from manufacturers, whose materials achieve an overall 5% rate of biodegradation and their sales literature states that it will "Fully biodegrade in 9 months to 5 years" or "Fully biodegrade wherever it is disposed". These materials have been sent to the FTC[2]

   ASTM has developed tests, which conclusively measure the rate and extent of biodegradation, for major solid waste disposal avenues, including composting, soil burial and even landfilling. These should be referenced as part of any new definitions.

3. It is recommended that the FTC reinforce the limited environmental benefits of landfilling "biodegradable" products. Work conducted and published by Prof. William Rathje in the 1980's & 90's demonstrated that readily biodegradable materials, such as food scraps and newspapers, remain in landfills for many years if not decades. Further, the US EPA's Solid Waste Hierarchy establishes landfilling and incineration as the least desirable forms of disposal. Manufacturers should be discouraged from claiming that "biodegradation" is the panacea to solid waste disposal, when their products are landfilled.

With these factors in mind, the BPI recommends that the FTC definition for "biodegradable" be revised to read:

> *An unqualified claim that a product or package is biodegradable should be substantiated by demonstrating that the entire product or package can be*

[2] Email correspondence to Janice Frankle Podoll (FTC) from Steve Mojo (BPI) on July 17, 2007

completely converted to carbon dioxide, methane, water and biomass via microbial assimilation within 12-18 months by using the appropriate ASTM Test Methods which reflect customary disposal conditions. A claim is deceptive if it leads consumers to believe that there is an benefit provided when the product is disposed of in a landfill.

Additionally the FTC should create an example under the definition to address biodegradable claims for products that are normally landfilled.

Example 1
A trash bag is marketed as "biodegradable". The marketer relies on soil burial tests to show that the product will decompose in the presence of water and oxygen. The trash bags are customarily disposed of in incineration facilities or at sanitary landfills that are managed in a way that inhibits biodegradation by minimizing moisture and oxygen. Biodegradation is irrelevant for those trash bags that are incinerated and, for those disposed of in landfills. Also, the marketer does not possess adequate substantiation that the bags will completely biodegrade in 12 to 18 months, using ASTM Test Methods, which replicate landfill conditions. The claim is therefore deceptive.

"Compostable" Comments:
According to the ACC research, consumers view compostable materials as ones that are able to be returned to the soils after composting as a useful soil amendment.

- *"Compostable" means that the material can be put back into the ground to make soil, mulch, or fertilizer that can be used in a garden or around your home.*
- *The chief attribute of compostable materials is that the decomposition is beneficial to the earth. This stands in opposition to biodegradable material which most believe disappears completely.*
- *Compostable materials are natural or organic materials and include leaves, twigs, grass clippings, food products (fruit peels, vegetable parts, etc.) and other materials.*
- *These materials are expected to break down and be usable in a matter of months (3 months to a year).*

Consumer perceptions are in line with the requirements found in the 2 ASTM Specifications that are in place today.

Specifically ASTM D6400 and D6868 include criteria which insures that materials will disintegrate rapidly; biodegrade completely within a 6-12 months; do not harm the resulting compost and do not introduce unwanted levels of regulated metals. Products that meet these specifications are being successfully composted in professionally managed, large scale facilities, as our found in the US, Canada and Europe. Importantly, ASTM D6400 and D6868 are consistent with specifications in Europe as well as those under development by ISO.

Additionally, these ASTM specifications are recognized by the US Environmental Protection Agency, on its Organics page found at the link below: http://www.epa.gov/epaoswer/non-hw/organics/reduce.htm

> Quoting from the website:
> ***"Biodegradable and Compostable Plastics***
> *Plastic products are items you use everyday like bags, bottles, packaging, and containers. Conventional plastics used for these products include HDPE, PET, and LDPE. These plastics can be easily reused or recycled.*
> *Other materials that have been developed are biodegradable and compostable plastics. This type of packaging will safely disintegrate and biodegrade in a well-managed composting site. Many, but not all, of these materials are produced from renewable resources (i.e. corn, switch grass, grain).*
> *Two specifications that identify plastics as biodegradable and compostable have been developed by the American Society for Testing and Materials:*
> - *ASTM D6400 (Standard Specification for Compostable Plastics) and*
> - *ASTM D6868 (Standard Specification for Biodegradable Plastics Used as Coatings on Paper and Other Compostable Substrates).*
>
> *Composting biodegradable or compostable packaging or products is an effective form of recycling.*
> *The Biodegradable Products Institute provides more information."*

Further, the State of California has created two regulations that govern the use of the terms "biodegradable", "degradable" and "compostable". These are found in CA's Public Resources Code Sections: 42359-42359.6 and 42355-42357 and clearly state that plastic products must meet ASTM Specifications. These regulations were put in place to help minimize the growing confusion in this area.

For these reasons the BPI, recommends that the FTC strengthen its current definition for "compostable" to include the ASTM Specifications as follows:

> ***Compostable:*** *It is deceptive to misrepresent, directly or by implication, that a product or package is compostable. A claim that a product or package is compostable should be substantiated by competent and reliable scientific evidence that all the materials in the product or package will break down into, or otherwise become part of, usable compost (e.g., soil-conditioning material, mulch) in a safe and timely manner in an appropriate composting program or facility, or in a home compost pile or device. Manufacturers must meet the requirements found in ASTM D6400 or ASTM D6868 to demonstrate compostability. Claims of compostability should be qualified to the extent necessary to avoid consumer deception. An unqualified claim may be deceptive if: (1) the package cannot be safely composted in a home compost pile or device; or (2) the claim misleads consumers about the environmental benefit provided when the product is disposed of in a landfill. A claim that a product is compostable in a municipal or institutional composting facility may need to be*

qualified to the extent necessary to avoid deception about the limited availability of such composting facilities.

Additionally, the BPI recommends that Example 2 under the definition in the Guides be modified as follows to recognize California's labeling regulations.

Example 2:
A plastic lawn and leaf bag is labeled and sold in California as "Compostable in Municipal Yard Trimmings Composting Facilities." The bag does not meet ASTM D6400. The claim is deceptive as it does not meet the current regulations in the State where it is sold.

Today, over 60% of the yard trimmings collected in the US are composted according the US EPA's Municipal Solid Waste Characterization for 2005[3]. This is one of the highest diversion rates for any solid waste category. Further, according to *BioCycle,* there are over 3000 leaf and yard waste composting sites. So professionally managed composting facilities are well established in the US.

However, the same EPA report states that food scraps recovery and diversion is approximately 2%. And while the number of food scrap organics diversion programs grows, the BPI believes that it is still necessary to urge consumers to check to see if programs exist in their neighborhoods. However, the BPI believes that a more positive qualification would also be appropriate. For example:

"*Check to determine if a professionally managed composting facility exists in your community."*

This phrase will continue to alert consumers as to check to determine if appropriate programs are available. Also, by being shorter, it will be easier to use on packaging.

Renewable Content" Comments:
According the ACC survey, eight out of ten consumers thought that products made from natural materials are also 'biodegradable'. Some manufacturers are capitalizing on this idea to convey inappropriate environmental benefits. For example, there is cutlery on the web that makes the following claims:

"Xxx products are made with a GMO free bio based starch and 100% biodegradable.

The BPI had this product analyzed in early 2007 using 2 outside labs. The tests showed that the product contained only 28% renewable content (based on ASTM D6866) and large amounts of polypropylene and polyethylene. Neither of these resins is biodegradable and there is no mention that the percentage of the product from renewable resources is less than 30%.

[3] Source: http://www.epa.gov/epaoswer/non-hw/muncpl/pubs/msw06.pdf

Additionally, work conducted on biobased cutlery and films for USDA's BioPreferred Program showed that the content coming from renewable resources ranged as follows:

- 36% to 100% for cutlery[4] &
- 2% to 96% for films[5]

The BPI believes that "renewable", "biobased" or "natural" content claims are similar to "recycled" content in the early 1990's. Direction should be provided by the FTC as to how manufacturers should measure and communicate renewable content and their environmental benefits.

With this in mind, the BPI recommends the following directions:

- All renewable content claims should be verified using ASTM D6866: "*Standard Test Methods for Determining the Biobased Content of Natural Range Materials Using Radiocarbon and Isotope Ratio Mass Spectrometry Analysis*". This test cost effectively provides definitive quantification as to the percentage of the material that derives from non-petroleum sources. Moreover, the BPI is aware of at least 3 laboratories that run this test today.
- Unqualified "renewable" or "natural content" claims should be limited to products with greater than 95% non-petroleum resources.
- Products containing less than 95% renewable content should be required to clearly state that percentage.

Respectively submitted,

Steven A Mojo
BPI Executive Director

cc. BPI Board Members

Attachments

[4] http://www.biopreferred.gov/files/Item_Designation_Cutlery.pdf
[5] http://www.biopreferred.gov/files/Biodegradable_Films.pdf

RESPONDENT EXHIBIT RX-H

REPORT ON BIAS AND CAPTURE IN THE PROMULGATION OF THE GREEN GUIDES AND ENFORCEMENT ACTION AGAINST ECM BIOFILMS

Alexander Volokh

June 18, 2014

I. INTRODUCTION

A. Author

My name is Alexander Volokh. As described further in my curriculum vitae, which is attached as an exhibit to this report, I received a Ph.D. in economics from Harvard University and a J.D. (*magna cum laude*) from Harvard Law School. Currently a tenured associate professor at Emory Law School, I am an expert in administrative law, the regulatory process, and the economic analysis of legal change.

I have taught courses in Administrative Law, Constitutional Law, Law and Economics (both introductory and specialized), Torts, and other fields. My Administrative Law course and the specialized course I have taught on the Law and Economics of Regulation and Antitrust relate directly to the regulatory process. In Law and Economics of Regulation and Antitrust, I discuss the public choice theory of decisionmaking by government bodies; and in Administrative Law, I discuss regulatory capture and public choice and cover the caselaw of agency bias in administrative agencies.

I have published articles in leading law journals, including the *Harvard Law Review* (student writing), *Stanford Law Review*, *NYU Law Review*, *University of Pennsylvania Law Review*, *Michigan Law Review* (co-authored), *Emory Law Journal*, *Alabama Law Review*, *UC Davis Law Review*, *Ohio State Law Journal*, *Houston Law Review*, and *Harvard Journal of Law and Public Policy*.

I have an extensive discussion of agency bias in *The New Private-Regulation Skepticism: Due Process, Non-Delegation, and Antitrust Challenges*, 37 HARV. J.L. & PUB. POL'Y 931 (2014), as well as in the amicus brief I submitted to the Supreme Court in April in *DOT v. Ass'n of American Railroads* (No. 13-1080).

I have also published articles in peer-reviewed journals, including the *American Law and Economics Review* and *International Journal of Law and Economics*, as well as various book chapters and encyclopedia entries.

I have testified about my work (on the constitutionality of a medical malpractice reform bill) before the Georgia legislature.

I have been a peer reviewer for the following scholarly journals: *American Journal of Political Science*, *Criminology*, *International Review of Law and Economics*, *Journal of Legal Studies*, *Journal of Policy Analysis and Management*, *Law and Social Inquiry*, and *Public Choice*.

Additionally, I have clerked for Judge Alex Kozinski, now chief judge of the Ninth Circuit Court of Appeals, and Supreme Court Justices Sandra Day O'Connor and Samuel Alito.

B. This Report

I have been retained by ECM BioFilms, Inc. to assess issues of bias and regulatory capture in the enforcement action against it, as well as in the promulgation of the Green Guides, the FTC's policy statement on which the enforcement action is partly based. I have not previously participated in any cases as an expert witness. I am being paid $20,000 for my participation in this case.

Part II of this report discusses the nature of bias (and the closely related concept of regulatory capture) as it is understood in regulatory economics and administrative law. Part III discusses how one can prove the presence of bias, and lays out a ("Bayesian") probabilistic theory that shows how one may prove the existence of bias or capture, even if—having neither participated in it nor sponsored it—one relies on circumstantial evidence.

The subsequent Parts apply this theory to the promulgation of the Green Guides and the facts of the enforcement action against ECM as I understand them. Part IV discusses the role played in the promulgation of the Green Guides and the enforcement action against ECM by ECM's competitors. Part V discusses issues of in the testimony of two of complaint counsel's expert witnesses and in a scholarly paper that complaint counsel is using as scientific evidence.

II. WHAT IS BIAS?

Bias is any tendency on the part of an actor to take actions contrary to "the merits"—for instance, by taking into account irrelevant factors like his own self-interest or that of another party. Legal bias—for instance, the bias of an agency in administrative proceedings, or the bias an expert witness—may result in the vacating of the administrative proceedings[1] or the exclusion of the witness's testimony.[2] (Henceforth, I will use the term "bias" to refer to this sort of legally relevant bias.)

Bias is roundly condemned in administrative law, both in specific bias-related doctrines[3] and, more implicitly, in the general rule of hard-look review that an administrative decisionmaker must not have considered irrelevant factors.[4]

Bias also plays a central role in how economists and political scientists discuss the work of agencies. One particular form of bias is "regulatory capture." The concept of regulatory capture[5] had, by the late 1960s, come to be regarded as "the universal condition of the administrative state,"[6] and it is still influential today.[7] Michael Livermore and Richard Revesz explain:

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[1] *See, e.g.*, Cinderella Career & Finishing Schools, Inc. v. FTC, 425 F.2d 583 (D.C. Cir. 1970); D.C. Fed. of Civic Ass'ns v. Volpe, 459 F.2d 1231 (D.C. Cir. 1971); Grant v. Comm'r, 111 F. Supp. 2d 556, 559 (M.D. Pa. 2000).

[2] *See, e.g.*, Van Blargan v. Williams Hospitality Corp., 754 F. Supp. 246, 248–49 (D.P.R. 1991) (denying qualification as an expert witness, in part because "his testimony would not possess the professional safeguards ensuring objectivity"); Edgar v. K.L., 93 F.3d 256, 261–62 (7th Cir. 1996).

[3] *See, e.g.*, FTC v. Cement Inst., 333 U.S. 683 (1948); Withrow v. Larkin, 421 U.S. 35, 47 (1975); Cinderella Career & Finishing Schools, Inc. v. FTC, 425 F.2d 583 (D.C. Cir. 1970); Ass'n of Nat'l Advertisers, Inc. v. FTC, 627 F.2d 1151 (D.C. Cir. 1979).

[4] Citizens to Preserve Overton Park, Inc. v. Volpe, 401 U.S. 402, 416 (1971); Motor Vehicle Mfrs. Ass'n v. State Farm Mut. Auto. Ins. Co., 463 U.S. 29, 43 (1983).

[5] Some important early works on regulatory capture include George J. Stigler, *The Theory of Economic Regulation*, 2 BELL J. ECON. & MGMT. SCI. 3, 3 (1971); ROGER G. NOLL, REFORMING REGULATION (1971); Richard A. Posner, *Theories of Economic Regulation*, 5 BELL J. ECON. & MGMT. SCI. 335, 336 (1974); Sam Peltzman, *Toward a More General Theory of Regulation*, 19 J.L. & ECON. 211, 212 (1976); Gary S. Becker, *A Theory of Competition Among Pressure Groups for Political Influence*, 98 Q.J. ECON. 371, 372 (1983). Much of this theory is heavily indebted to MANCUR OLSON, THE LOGIC OF COLLECTIVE ACTION: PUBLIC GOODS AND THE THEORY OF GROUPS (1965).

[6] Thomas W. Merrill, *Capture Theory and the Courts: 1967–1983*, 72 CHI.-KENT L. REV. 1039, 1060 (1997).

[7] According to Merrill, the capture paradigm in administrative law has given way to the public choice paradigm; "what I call capture theory would be regarded today as a quaint species of public choice theory." *Id.* at 1069. But "there is no sharp analytical break between capture theory and public choice theory," *id.*; public choice theory merely generalizes the insights of capture theory to a greater variety of actors beyond just administrative agencies.

> Capture describes situations where organized interest groups successfully act to vindicate their goals through government policy at the expense of the public interest. For groups that are repeat players before specialized agencies, investments in long-term relationships can have substantial returns in terms of influence, raising capture concerns.[8]

As Judge Skelly Wright put it in his influential opinion in *Home Box Office, Inc. v. FCC*,[9] the concern is over "undue industry influence over Commission proceedings" and over rules being shaped "by compromise among contending industry forces, rather than by exercise of the independent discretion in the public interest the Communications Act vests in individual commissioners."[10]

What is the difference between bias and capture? Capture is often used to refer to bias in favor of the regulated community and against the (more diffuse) interest of consumers or citizens, but there is no reason why it cannot also be used to refer to bias in favor of one set of regulated firms against other, less well-organized regulated firms. Moreover, the term "bias" is broad enough to include isolated instances—such as the bias that may be present in an expert witness's report or in a scholarly paper—while "capture" is generally used to refer to a more general and permanent condition that stems from long-term interaction. Also, "bias" is broad enough to include decisionmaking in line with one's own ideology or idiosyncratic preferences, while "capture" generally refers to acting in the (usually economic) interest of some favored group. Nonetheless, the concepts are similar enough that they should be discussed together, and I will often use them together in this report.

How does capture occur? One method is campaign contributions to legislators, who pressure agencies for policy that benefits the contributors.[11] Another is the revolving door[12]—or, phrased in more general terms that need not encompass purely career concerns, "thick, interlocking personal and professional networks that

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[8] Michael A. Livermore & Richard Revesz, *Regulatory Review, Capture, and Agency Inaction*, 101 GEO. L.J. 1337, 1340 (2013).

[9] 567 F.2d 9 (D.C. Cir. 1977).

[10] *Id.* at 53.

[11] Livermore & Revesz, *supra* note 8, at 1343–44; Rachel E. Barkow, *Insulating Agencies: Avoiding Capture Through Institutional Design*, 89 TEX. L. REV. 15, 22–23 (2010).

[12] Barkow, *supra* note 11, at 23.

include both agency personnel and outsiders."[13] Another is the compromises born of the agency's need to cooperate with the regulated community in the long term.[14]

Another source of capture or bias is through the control of information. Agencies rely on outside parties for much of their information about the world—the notice-and-comment process is one example of how agencies become informed through the efforts of outsiders—and targets of regulations, or any parties that hope to benefit from regulation, can bias the agency's perspective by providing information favorable to their perspective.[15] Having access to many perspectives is good, but "bias" emerges when some parties are better organized or better connected than others. This is one reason why, for instance, ex parte communications are generally barred in the context of pending cases,[16] why transparency[17] and public participation[18] are favored, or why a requirement of notice-and-comment rulemaking is desirable:[19] enhancing the ability of different parties to get information to the agency on more equal terms might be expected to alleviate these biasing effects. Even so, a pattern of meeting with one set of parties more than another, or receiving information from one set of parties more than from another, can lead to capture or bias even in the absence of legal hindrances to more equal participation.[20]

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[13] *Id.* at 1344; *see also* JAMES KWAK, CULTURAL CAPTURE AND THE FINANCIAL CRISIS 11, http://tobinproject.org/sites/tobinproject.org/files/assets/Kwak%20Cultural%20Capture%20%281.16.13%29.pdf (discussing "cultural capture," where "[r]egulators are more likely to adopt positions advanced by people whom they perceive as being in their in-group," "whom they perceive to be of higher status," or "who are in their social networks").

[14] *See* Richard B. Stewart, *The Reformation of American Administrative Law*, 88 HARV. L. REV. 1667, 1685–86 (1975); Barkow, *supra* note 11, at 22.

[15] *See id.* at 1686; *see also* Barkow, *supra* note 11, at 23; Nicholas Bagley & Richard L. Revesz, *Centralized Oversight of the Regulatory State*, 106 COLUM. L. REV. 1260, 1285 (2006) ("These explanations look to how agencies cooperate with interest groups in order to procure needed information, political support, and guidance; the more one-sided that information, support, and guidance, the more likely that agencies will act favorably toward the dominant interest group."); Melissa F. Wasserman, *The Changing Guard of Patent Law:* Chevron *Deference for the PTO*, 54 WM. & MARY L. REV. 1959, 2013–14 (2013) (arguing that the PTO has a pro-patentee institutional bias because "no third party is present to argue that a patent should not be issued").

[16] *See, e.g.*, 5 U.S.C. §§ 554(d), 557(d)(1).

[17] *See* Livermore & Revesz, *supra* note 8, at 1356–58.

[18] *See id.* at 1358–59.

[19] *Cf.* Stewart, *supra* note 14, at 1688 (listing "a requirement that agencies crystallize their exercise of discretion through standards" as one proposed solution to the problem of agency bias).

[20] *See* Livermore & Revesz, *supra* note 8, at 1358 (noting an "imbalance of participation" that "raises at least the appearance" that an agency is "more solicitous" to one set of concerns); Wasserman, *supra* note 15, at 2015–16 (arguing that appellate courts are subject to institutional bias in

(continued next page)

Notably, a *requirement* of notice-and-comment rulemaking[21] is more helpful in counteracting bias than merely a decision to engage in notice-and-comment rulemaking when it is optional: courts are more likely to police whether the agency adequately responded to the substance of critical comments if notice-and-comment was required.[22] When agencies engage in rulemaking knowing that they will be subject to somewhat demanding judicial review (even if it is relatively deferential *Chevron* review[23]), one can have more confidence that they will make more of an effort to not be overtly biased.[24]

The orientation of an agency toward a particular set of issues also increases the risk of capture (relative to decisionmaking being housed in more generalist institutions, like OIRA or the courts), because when an agency's docket includes more issues, it becomes harder to control by specialized interest groups. For instance, Livermore and Revesz write, in discussing why centralized review of agency decisionmaking through OIRA is superior to decisionmaking in individual agencies:

> Generalist institutions are typically harder to capture than issue-specific agencies. Because OIRA's docket includes all federal regulatory issues, the return on the investment of any particular interest group to build a relationship with OIRA is lower than for a specialized agency, reducing capture risks. Additionally, disparate interests and free-rider problems stand in the way of having different groups form coalitions to control OIRA.[25]

Similarly, more generalist organizations can be less subject to capture to the extent that they include "political appointees and career staff from several different backgrounds, and with different institutional perspectives and interests,"[26] and to the extent they

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patent cases because "patent bar associations file amicus briefs in favor of patentees at a significantly higher rate than the government or high-tech companies").

[21] *See* 5 U.S.C. § 553(b), (c).

[22] *See* United States v. Nova Scotia Food Products Corp., 568 F.2d 240 (2d Cir. 1977).

[23] *See* Chevron U.S.A., Inc. v. Natural Resources Defense Council, Inc., 467 U.S. 837 (1984).

[24] *See* Livermore & Revesz, *supra* note 8, at 1360–61 ("Because judicial review is open to all affected parties, it can operate as a counterweight to the influence of organized special-interest groups in political and regulatory processes.").

[25] *Id.* at 1341.

[26] *Id.*

use relatively transparent modes of decisionmaking such as, in Livermore and Revesz's view, cost-benefit analysis.[27]

It is clear that most bias or capture need not be conscious. Cases where regulators knowingly shape the content of regulation to suit the demands of a contributor to the campaign of a powerful legislator on the relevant oversight committee are (one hopes) relatively rare. The same goes for regulators who knowingly shape the content of regulation to maximize their future career prospects: this is (one hopes) not as common as regulators who, while believing they are serving the public interest, craft regulations that serve particular entities' material interests because they have been biased by the facts they have been exposed to, by resource constraints that have subtly made them unwilling to oppose certain well-organized entities on all fronts, and by shared cultural and ideological common ground with these entities. Capture and bias affect features "that purport to be, and that we experience as, independent, volitional, and benign."[28]

III. PROVING BIAS: A PROBABILISTIC APPROACH

A. The Difficulties of Direct Proof

It is very difficult to *prove* that an agency decisionmaker was biased,[29] either in rulemaking or in adjudication, short of being in the decisionmaker's head or finding a smoking gun.[30] The classic case of *Cinderella Career & Finishing Schools, Inc. v. FTC*[31] concerned an FTC action alleging false representations by an organization purporting to offer "courses of instruction which qualify students to become airline stewardesses and buyers for retail

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[27] *Id.*; *see also* Stewart, *supra* note 14, at 1688 (listing "adoption of allocational efficiency as a substantive yardstick for agency decisions" as a proposed solution for the problem of agency bias).

[28] Jon Hanson & David Yosifon, *The Situation: An Introduction to the Situational Character, Critical Realism, Power Economics, and Deep Capture*, 152 U. PA. L. REV. 129, 218 (2003).

[29] *See, e.g.*, Wasserman, *supra* note 15, at 2016; Mark A. Perry, Comment, *Municipal Supervision and State Action Antitrust Immunity*, 57 U. CHI. L. REV. 1413, 1441 (1990).

[30] *See* Jason D. Vendel, *General Bias and Administrative Law Judges: Is There a Remedy for Social Security Disability Claimants?*, 90 CORNELL L. REV. 769, 773 (2005) ("Because general bias involves prejudgment, proving it from the record of a single case requires statements or overt actions on the part of the adjudicator that shed light on his internal decisionmaking. Unless an adjudicator is reckless with his words or actions, such evidence is rarely available.").

[31] 425 F.2d 583 (D.C. Cir. 1970).

stores."[32] While the action was pending, the FTC Chairman made a public speech in which he said:

> What kind of vigor can a reputable newspaper exhibit? . . . What standards are maintained on advertising acceptance? . . . What about carrying ads that offer college educations in five weeks, fortunes by raising mushrooms in the basement, getting rid of pimples with a magic lotion, or becoming an airline's hostess by attending a charm school?[33]

But most public officials probably refrain from commenting on pending cases in their public speeches. Similarly, impermissible bias can result from political pressure, as illustrated by the Secretary of Transportation's decision to approve a bridge (that had been previously dropped by his highway plan) after intense pressure from a powerful Congressman;[34] but this is an unusual case because usually intense pressure occurs behind the scenes. In another case, one Social Security administrative law judge had a habit of denying benefits to "no-goodniks."[35] How did he decide that someone was a no-goodnik?

> [He] had a theory about blacks, Hispanics, [and] poor white people that he had developed while he was in California, and that typically these people are drug addicts or alcoholics or have decided to adopt a lifestyle where they just will not work no matter what, that they preferred living on public monies, including welfare payments, Worker's Compensation if they could get it if they had a work history, and Social Security Benefits. He said that he did not care what the evidence showed, that he did not care if his Decision was reversed by the Appeals Council or the Courts, that he had no intention of paying the case based on what he had.[36]

This ALJ's case is likewise unusual because he stated his bias to a staffer, who then testified about his statement. Obviously, this sort of evidence is hard to come by.[37]

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[32] *Id.* at 584 n.1.
[33] *Id.* at 589–90.
[34] D.C. Fed. of Civic Ass'ns v. Volpe, 459 F.2d 1231 (D.C. Cir. 1971).
[35] Grant v. Comm'r, 111 F. Supp. 2d 556, 559 (M.D. Pa. 2000).
[36] *Id.* at 560–61.
[37] Even when there is evidence that a decisionmaker had strong views in favor of a particular party, that evidence may not rise to the level necessary to meet the legal standard for disqualification based on bias. *See, e.g.*, FTC v. Cement Inst., 333 U.S. 683 (1948); Ass'n of Nat'l Advertisers, Inc.

(continued next page)

Direct financial interest would suffice to show bias,[38] but (absent outright corruption) this path is generally unavailable for federal administrative officials, whose salaries, by design, usually do not incorporate incentives. If we had access to a large sample of decisions, one could make a strong argument for bias by showing that a decisionmaker's actions were sympathetic to a particular party even after controlling for the merits.[39] This was possible in the Social Security ALJ's case because of the large number of cases he had decided.[40]

When certain factors are more likely to appear in the presence of bias, their actual appearance should make one think bias is a *more likely* explanation than one previously thought. This is essentially an intuitive application of Bayes's Law, developed by the 18th-century English statistician Thomas Bayes (1701–61). The rest of this Part explains the mathematics behind this approach and shows how it relates to showing the bias of agencies or other parties involved in administrative proceedings.

B. Probabilities, Unconditional and Conditional

To understand Bayes's Law, first denote the probability of an event X happening as $\Pr(X)$. For instance, if one flips a fair coin and labels the two possible outcomes H (for "heads") and T (for "tails"), then one usually assumes that $\Pr(H) = ½$ and $\Pr(T) = ½$.

A "conditional probability" is the probability that something happens or is true *given that* something else has happened or is true. For instance, according to the Social Security Administration's 2009 Period Life Table,[41] out of a starting population of 100,000 men, 1340 are expected to survive to age 99 and 888 are expected to survive to age 100. This can be rephrased that in terms of probabilities: a newborn boy has a 1.34% chance of surviving to age 99 and a 0.888% chance of surviving to age 100. And these

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v. FTC, 627 F.2d 1151 (D.C. Cir. 1979); Withrow v. Larkin, 421 U.S. 35, 47 (1975) (noting a presumption of honesty and integrity).

[38] *See* Gibson v. Berryhill, 411 U.S. 564 (1973).

[39] *See* Vendel, *supra* note 30, at 773 & nn.20–23.

[40] *Grant*, 111 F. Supp. 2d at 558–59.

[41] This exercise assumes that the death probabilities reported in this table are accurate for someone born today. Of course, the Social Security tables tabulate probabilities based on past mortality, so—given improvements in health over time—the assumption of constant probabilities is inaccurate. I am merely using these numbers for purposes of illustrating probability concepts.

numbers also allow us to express a conditional probability: the probability that a man survives to 100 *given that he has already survived to 99* is 888/1340 = 66.3%.[42]

Let's define the concept of conditional probability more formally. If we assign the label S_{100} to the event "male surviving to 100" and the label S_{99} the event "male surviving to 99," we can write: $\Pr(S_{100}) = 0.888\%$ and $\Pr(S_{100}|S_{99}) = 66.3\%$. This last expression, with the vertical bar, is the probability of a male's surviving to 100 *conditional on* surviving to 99.

In general, the formula for the probability of event A conditional on event B is:

$$\Pr(A|B) = \frac{\Pr(A \cap B)}{\Pr(B)}.$$

where the "$\cap$" symbol represents "and." Thus, to calculate $\Pr(S_{100}|S_{99})$ using this formula, the numerator is $\Pr(S_{100} \cap S_{99})$, the probability that a male survives to 100 *and* he survives to 99. Of course, this is just the same as the probability that a male survives to 100, which is 0.888%. The denominator is $\Pr(S_{99})$, the probability that a male survives to 99, which is 1.34%. So the formula tells us that $\Pr(S_{100}|S_{99})$ is 0.888%/1.34% = 888/1340 = 66.3%, just as we found earlier.

C. Reversing the Conditional Probability

Often it is convenient to reverse the condition. That is, we know the probability of A given B, but what we want to know is the probability of B given A.

For instance, suppose we've flipped a coin twice and gotten two heads. Suppose we know somehow that there are only two possibilities: the coin could be fair (call this possibility F), or it could be two-headed (call this possibility $-F$), but we're not sure which.[43]

Say we thought originally that $\Pr(F) = ½$ (and therefore that $\Pr(-F) = ½$). Those were our initial beliefs. But now, observing

[42] Even some of the previous probabilities could be expressed conditionally: 1.34% is the probability that a newborn survives to age 99 *given that it is male*, and ½ is the probability that a coin lands on heads *given that it is fair*.

[43] There are many types of conceivable coins, including two-tailed coins, or coins that are specially weighted so the probability of heads is 60%, and so on, but suppose for purposes of this exercise that all cases can be ruled out except (1) a fair coin and (2) a two-headed coin.

two heads should make us more worried that the coin is two-headed. The question is, how much more worried? Now that we've observed two heads from two flips (call this event *HH*), what's our new estimate of Pr(*F*)? What we're looking for is the new probability, Pr(*F*|*HH*), the probability that the coin is fair given that two heads have occurred.

If we had gotten *HT*, this exercise would be easy: since we got tails once, clearly this isn't a two-headed coin and so it must be a fair coin. We can easily say Pr(*F*|*HT*) = 1. But since we saw *HH*, we can't proceed so easily, because unfortunately *HH* is consistent with both a fair coin and a two-headed coin.

Now, it's trivial to know Pr(*HH*|*F*), the probability of getting 2 heads from flipping a fair coin twice. Intuitively, we know it's ¼—but let's express it using the formula. The definition of a conditional probability tells us that:

$$\Pr(HH|F) = \frac{\Pr(HH \cap F)}{\Pr(F)}.$$

The numerator is the probability that the coin is fair *and* we get two heads from two flips. Even if we don't know the probability that the coin is fair (Pr(*F*)), we can say that the probability that the coin is fair *and* we get two heads from two flips is equal to:

$$\Pr(HH \cap F) = \Pr(F) \times \frac{1}{2} \times \frac{1}{2} = \frac{1}{4}\Pr(F).$$

So:

$$\Pr(HH|F) = \frac{\Pr(HH \cap F)}{\Pr(F)} = \frac{\frac{1}{4}\Pr(F)}{\Pr(F)} = \frac{1}{4}.$$

We didn't have to use our belief that Pr(*F*) = ½ here, since in this case Pr(*F*) simply canceled out of the fraction.

Unfortunately, this result for Pr(*HH*|*F*) is trivial; moreover, it's not what we were looking for, which is Pr(*F*|*HH*).

Fortunately, Bayes's Law tells us how to switch from Pr(*HH*|*F*) to Pr(*F*|*HH*). By stating the definition of Pr(*F*|*HH*) and doing some algebra, we get:

$$\Pr(F|HH) = \frac{\Pr(F \cap HH)}{\Pr(HH)} = \frac{\Pr(HH \cap F)}{\Pr(F)}\frac{\Pr(F)}{\Pr(HH)}$$
$$= \Pr(HH|F)\frac{\Pr(F)}{\Pr(HH)}.$$

In turn, the denominator of the last term—Pr(*HH*), the probability of two heads—can be decomposed into two components: (1)

the probability of two heads if the coin is fair and (2) the probability of two heads if the coin is two-headed:

$$\begin{aligned}\Pr(HH) &= \Pr(HH \cap F) + \Pr(HH \cap -F)\\ &= \Pr(HH|F)\Pr(F) + \Pr(HH|-F)\Pr(-F)\\ &= \frac{1}{4}\Pr(F) + \Pr(-F) = \frac{1}{8} + \frac{1}{2} = \frac{5}{8}.\end{aligned}$$

Here, we substituted various known values: $\Pr(HH|F) = ¼$, as calculated above; $\Pr(F)$ and $\Pr(-F)$ are both ½; and since the unfair coin is two-headed, it always gives two heads from two flips, so $\Pr(HH|-F)$ is 1.

Now that we have a result for $\Pr(HH)$, we can substitute it into the definition of $\Pr(F|HH)$:

$$\begin{aligned}\Pr(F|HH) &= \Pr(HH|F)\frac{\Pr(F)}{\Pr(HH)} = \frac{1}{4} \times \frac{\frac{1}{2}}{\frac{5}{8}}\\ &= \frac{1}{4} \times \frac{1}{2} \times \frac{8}{5} = \frac{1}{5} = 20\%.\end{aligned}$$

This is the power of Bayes's Law: from a trivial result, $\Pr(HH|F) = ¼$, and with original beliefs ("prior probabilities") that $\Pr(F) = ½$ and $\Pr(-F) = ½$, we were able to derive new probabilities based on the observed evidence ("posterior probabilities"). We started out believing that a fair coin was 50% likely, and a two-headed coin was 50% likely. Then we observed two heads, which made us revise our beliefs. Now, we believe that a fair coin is only 20% likely, and thus a two-headed coin is 80% likely.

The intuition here is clear: The event *HH* was less likely if the coin was fair. It was more consistent with a two-headed coin. This is why our belief about the probability of a fair coin dropped. Conversely, if the observed evidence had been more consistent with a fair coin, then the belief about the probability of a fair coin would have increased. This is easy to check from the definition. Recall from the coin example that:

$$\Pr(F|HH) = \Pr(HH|F)\frac{\Pr(F)}{\Pr(HH)} = \Pr(F)\frac{\Pr(HH|F)}{\Pr(HH)},$$

So the relationship between the posterior probability $\Pr(F|HH)$ and the prior probability $\Pr(F)$ depends on the value of the fraction $\Pr(HH|F)/\Pr(HH)$:

$$\Pr(F|HH) < \Pr(F) \Leftrightarrow \frac{\Pr(HH|F)}{\Pr(HH)} < 1 \Leftrightarrow \Pr(HH|F) < \Pr(HH).$$

The posterior probability of a fair coin is less than the prior probability of a fair coin if and only if $\Pr(HH|F)$ is less than the unconditional probability $\Pr(HH)$: that is, the evidence (HH) is more likely if we know the coin is fair than if we don't know. We can usefully rephrase:

$$\Pr(HH|F) < \Pr(HH) \Leftrightarrow \Pr(HH|F) < \Pr(HH|-F),$$

so this is equivalent to saying that the evidence (HH) is more likely if we know the coin is fair than if we know it's unfair.[44]

In the extreme case, suppose our only possibilities were a fair coin and a two-headed coin, and we observed HT, heads and then tails. Since tails is totally inconsistent with a two-headed coin, we would now be absolutely sure that the coin was fair; our belief would become $\Pr(F|HT) = 1$.

D. How This Relates to Proving Bias

The quite intuitive central insight of the probabilistic model is this: *A state of affairs becomes more likely if we observe evidence that is more consistent with that state of affairs than with the alternative state of affairs.* Or, rephrasing: *A state of affairs becomes more likely if we observe evidence that would be more likely if that state of affairs is true.*

This discussion relates directly to proving bias: *Bias is more likely if we observe evidence that would be more likely in case of bias.*

In cases such as this one, we cannot directly observe bias. Moreover, our ability to observe conditions like financial interest, which are commonly held to be highly associated with disqualifying bias, is highly limited: discovery to obtain documentary evidence of the full extent of the financial ties and involvement of the parties with interests adverse to respondent ECM has been barred in a couple of decisions.[45]

But we do know what we would expect to find if there were bias—things that are more likely in the presence of bias than in its absence.

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[44] $\Pr(HH|F) > \Pr(HH) \Leftrightarrow \Pr(HH|F) > \Pr(HH|F)\Pr(F) + \Pr(HH|-F)\Pr(-F) \Leftrightarrow (1-\Pr(F))\Pr(HH|F) > \Pr(HH|-F)\Pr(-F) \Leftrightarrow \Pr(HH|F) > \Pr(HH|-F)[\Pr(-F)/(1-\Pr(F))] = \Pr(HH|-F)$.

[45] *See* Order Denying Motion to Compel, Dkt. No. 9358 (June 2, 2014); Order Denying Without Prejudice Respondent's Motion for Leave to Serve Subpoenas Duces Tecum, Dkt. No. 9358 (June 10, 2014).

- If decisionmakers are biased in favor of some party, we expect to find that their decisions track that party's interests especially closely.
- If decisionmakers are biased in favor of some party, we expect that their justifications of why they accepted the party's position rather than another one is not very persuasive.
- Relatedly, if decisionmakers are biased in favor of some party, we expect that they would adopt the party's position in a document that is not subject to especially demanding judicial review.

Because all these features are more likely to occur in the presence of bias than in the absence of bias, observing them should make us more confident that the observed events were the result of bias.

The probabilistic approach breaks down when one can observe directly whether someone's decisions or views are substantively correct. If it could be shown that an agency or an expert witness made the unique right choice—but that right choice was also in line with a party's interests—that would be equally consistent with bias and with a high level of substantive expertise. Therefore, it would be incorrect to infer bias from the mere fact that the agency's or expert witness's views lined up with a party's interests. But such independent verification is rarely available. The point of using expert witnesses is that they have subject-matter knowledge that the court lacks, so inevitably there will be some amount of reliance on the expert witness's judgment. Similarly, in a large set of cases, reviewing courts defer to agency expertise—it is nearly axiomatic that reviewing courts are not to substitute their judgment for that of the agency.[46] So the probabilistic approach remains valid in many cases where the agency (in the case of giving weight to expert witness testimony or the probative value of a piece of evidence) or a reviewing court (in the case of reviewing an agency's decisions, including an agency's decision to give particular weight to expert witness testimony or other evidence) is unable to directly verify correctness.

[46] *See, e.g.*, Citizens to Preserve Overton Park v. Volpe, 401 U.S. 402 (1971); Motor Vehicle Mfrs. Ass'n v. State Farm Mut. Auto. Ins. Co., 463 U.S. 29, 43 (1983).

The probabilistic approach can also be used together with other ways of inferring bias. For instance, everyone would agree that financial incentives increase the probability of bias, often to unacceptable levels[47] (though, as noted above, the Commission has limited ECM's ability to discover the extent of such financial incentives[48]). Expert witnesses are generally paid by the parties, and their testimony generally lines up with the interest of the party that paid them. Even a disinterested expert can be suspected of bias—because, per the probabilistic model, bias would make him more likely to adopt a position coinciding with that of the party. But an expert paid by the party should be suspected of bias even more—despite the general rule that experts must remain disinterested.[49] Of course, since expert testimony and reports produced for money are quite usual, the probabilistic model merely counsels in favor of an attitude of skepticism toward all paid expert testimony;[50] it does not provide any specific reason to be more skeptical of any particular paid testimony or report. An additional measure of skepticism (whether produced by expert witnesses or otherwise) is warranted when, for instance, the producers of certain evidence have other financial interests that would encourage them to take the position they do, apart from the mere fact of being paid by a party—such as outside consulting or other ongoing commercial relationships that would be benefited by the position they take.

Similarly, agencies constantly take positions on one issue or another. The probabilistic model suggests that one should suspect bias in favor of whoever's interests are served by those positions. But because any position an agency takes will probably be in *someone's* interest, the mere fact that this occurs in a particular case counsels in favor of no more than a general attitude of skepticism. But other indicia of bias should increase the amount of skepticism. For instance, John Shepard Wiley has suggested testing for capture by looking for evidence of lobbying: "The most direct way . . . would be to examine the facts surrounding a regulation's origin. Judges could demand that plaintiffs, on pain of dismissal, identify producers who profit from the regulation's competitive

[47] *See, e.g.*, Tumey v. Ohio, 273 U.S. 510 (1927); Ward v. Village of Monroeville, 409 U.S. 57 (1972).

[48] *See supra* note 45.

[49] *See* text accompanying *infra* notes 112–114.

[50] Obviously, this critique of expert reports also applies to this report.

restraint and who played a *decisive* political role in its adoption."[51] Even the substantively correct approach has its lobbyists, so being skeptical of an agency's bias or capture does not *necessarily* imply that the agency's position is invalid. Rather, skepticism implies a higher degree of suspicion and a lower degree of deference.

Other indicia of bias can increase one's skepticism still further. If the agency's position is also substantively shaky on other grounds, this makes bias still more likely, according to the probabilistic model. Thus, Wiley's approach—which he suggests for purposes of applying state-action immunity in antitrust law—also requires that the policy or conduct at issue not solve a "substantial market inefficiency" and not be covered by an existing antitrust exemption.[52] Thus, Wiley's test assigns meaning to evidence of lobbying only when combined with some other reason to doubt the merits.

The following Parts of this report point out how some of these indicia of bias are present in evidence, expert testimony, and agency decisions.

IV. Bias in the Promulgation of the Green Guides and the Decision to Bring This Enforcement Action

This Part discusses the Commission's decision to rely on financially interested parties in its promulgation of the Green Guides and in its litigation against ECM.

As mentioned above, to the extent that there is a correct definition of "degradable," that definition will probably be in someone's financial interest, and of course one expects that this party will have participated in the process. Indeed, administrative law relies to a great extent on interested parties' participation in the process, in the hope that the optimal solution will emerge from the combined information submitted by parties with diverse interests.

But the theory of collective action also counsels caution, since small groups with concentrated interests find it much easier to overcome the costs of organizing than diffuse groups; and so even well-meaning agencies may be overwhelmingly exposed to infor-

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[51] John Shepard Wiley Jr., *A Capture Theory of Antitrust Federalism*, 99 Harv. L. Rev. 713, 769 (1986).

[52] *Id.* at 743.

mation favoring the better-organized side and thus succumb—even if unknowingly—to bias and regulatory capture.

The presence of determined and organized "lobbying," both official and unofficial, by one particular group of businesses against their competitors' position is thus consistent with bias and capture. One expects to see lobbying far more often in cases where bias and regulatory capture are present than in cases where they are absent. The fact that one sees it in this case is therefore evidence of bias and capture; knowing about such lobbying should make one believe that its probability is higher than one previously thought.

A. The Influence of the Biodegradable Products Institute

The Biodegradable Products Institute (BPI) is a trade association representing various people and corporations making compostable products—which are thus in direct competition with ECM. BPI's member organizations "include BASF, NatureWorks LLC, Metabolix, Novamont, Cereplast, BiobagUSA, Heritage Bag and Poly-America."[53] BPI has a long history of contacts and correspondence with Commission staff, stretching back over a decade.

BPI has commented on the Green Guides on degradability and compostability,[54] supporting the one-year-or-less standard for biodegradation.[55] (These comments were shared with other industry members, one of whom noted that the comments had to be kept simple for FTC members, who were "not experts in any of this" and "lack[ed] technical understanding."[56])

In its comments, BPI suggested including, as an example of a deceptive claim, the marketing of trash bags as "biodegradable" when the claim is based on soil burial tests but the bags are in fact customarily disposed of in ways that inhibit degradation—in incineration facilities or landfills:

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[53] Letter from Steven A. Mojo, BPI Executive Director, to FTC, Re: Green Guides Regulatory Review, 16 CFR Part 260, Comment, Project No. P954501, Jan. 30, 2008. Other members include Cargill Dow LLC, Eastman Chemical, Dow Chemical, DuPont, Biocorp NA, the Massachusetts Department of Environmental Protection, and Michigan State University. *See* Who Is the BPI.

[54] Letter from Steven A. Mojo, BPI Executive Director, to FTC, Re: Proposed, Revised Green Guides, 16 CFR Part 260, Project No. P954501, Dec. 7, 2010.

[55] Mojo 1/30/08 letter, *supra* note 53.

[56] E-mail from buzz to Steven Mojo, Re: Reply, Draft of Comments to FTC Green Guides (Nov. 10, 2010, 5:20 PM). buzz apparently refers to Buzz Chandler of StalkMarket Products, a compostable products manufacturer.

> **Example 1**
> A trash bag is marketed as "biodegradable". The marketer relies on soil burial tests to show that the product will decompose in the presence of water and oxygen. The trash bags are customarily disposed of in incineration facilities or at sanitary landfills that are managed in a way that inhibits biodegradation by minimizing moisture and oxygen. Biodegradation is irrelevant for those trash bags that are incinerated and, for those disposed of in landfills. Also, the marketer does not possess adequate substantiation that the bags will completely biodegrade in 12 to 18 months, using ASTM Test Methods, which replicate landfill conditions. The claim is therefore deceptive.[57]

Compare this to the FTC's language in the actual Green Guides:

> **Example 1:** A marketer advertises its trash bags using an unqualified "degradable" claim. The marketer relies on soil burial tests to show that the product will decompose in the presence of water and oxygen. Consumers, however, place trash bags into the solid waste stream, which customarily terminates in incineration facilities or landfills where they will not degrade within one year. The claim is, therefore, deceptive.[58]

There is thus direct evidence that BPI influence has affected the precise content of the Green Guides.

Since at least 2002, BPI has frequently communicated with, met with, and made presentations to the FTC.[59] The e-mails be-

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[57] *Id.* at 4.

[58] Green Guides, 16 CFR Pt. 260, § 260.8(d) ex.1, *available at FTC: The Green Guides, Statement of Basis and Purpose*, at 284.

[59] *See* Letter from Steven A. Mojo, BPI Executive Director, to Janice Frankle, FTC, Feb. 27, 2002; E-mail from Janie Podoll Frankle to smojo@galatech.org, Re: RE: FTC Offsets Meeting (Jan. 9, 2008, 4:11:49 PM); E-mail from Janice Podoll Frankle to Steve Mojo, Re: Call on Tuesday, Feb. 5 (Jan. 31, 2008, 11:33:39 AM); E-mail from Steve Mojo to Janice Podoll Frankle, Re: RE: Call on Tuesday, Feb. 5 (Jan. 31, 2008, 12:32:00 PM); E-mail from Janice Podoll Frankle to smojo@galatech.org, Re: RE: Discussion (Feb. 4, 2008, 8:48:21 AM); E-mail from Janice Podoll Frankle to smojo@galatech.org, Re: RE: Follow UP (Feb. 5, 2008, 1:00:11 PM); E-mail from Anne McCormick to four recipients including smojo@galatech.org, Re: Conference Call on April 9, 2008 @ 3:00 p.m. (Apr. 8, 2008, 6:26:06 PM); E-mail from Anne McCormick to three recipients including smojo@galatech.org, Re: Powerpoints - Panel 2 (Apr. 15, 2008, 6:17:24 PM); E-mail from Janice Podoll Frankle to steve.mojo@galatech.org, Re: RE: A question (Apr. 22, 2008, 12:59:45 PM); E-mail from Janice Podoll Frankle to three recipients including steve.mojo@galatech.org, Re: FTC Workshop, Panel 2 proposed questions (Apr. 28, 2008, 12:23:57 PM); E-mail from Steve Mojo to Laura Koss and smojo@galatech.org, Re: RE: The story of the spoon (July 24, 2008, 3:14:00

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tween FTC staff and BPI generally have a friendly tone, and FTC staff have made it clear on several occasions that they welcomed BPI's input.[60] For instance, FTC attorney Janice Podoll Frankle wrote to Steve Mojo, BPI's Executive Director, while organizing a workshop on green packaging claims:[61] "Please know that you and your presentation are very important to the discussion at the workshop!"[62] And FTC attorney Michael Davis wrote to Steve Mojo: "Steve, it's always good to hear from you and I appreciate your latest message. I minimize my written traffic, but I wanted to thank you again. Mike".[63]

BPI has often pointed out degradability claims that it believed were unsupported[64]—including claims by ECM,[65] which BPI staff

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PM); E-mail from Steve Mojo to Laura Koss, Re: RE: Follow Up (July 30, 2008, 9:37:00 AM); E-mail from Michael Davis to Steven Mojo, Re: (Nov. 5, 2009, 2:43:50 PM); E-mail from Michael Davis to Steven Mojo, Re: March 17 powerpoint (Mar. 24, 2011, 11:31:32 AM); E-mail from Michael Davis to Steven Mojo, Re: RE: Your Email of March 23, 2011 (Mar. 24, 2011, 3:59:06 PM); STEVE MOJO, SCIENCE OF BIODEGRADABLE ADDITIVES (presentation to FTC, Apr. 2011); E-mail from Steven Mojo to mdavis@ftc.gov, Re: Biobased/Renewable Labeling (Sept. 6, 2011, 10:57:40 AM); E-mail from Steven Mojo to lkoss@ftc.gov, Re: FW: A question from the BPI (Mar. 12, 2013, 2:42:00 PM); E-mail from Steven Mojo to lkoss@ftc.gov, Re: Labeling Question (May 28, 2013, 2:18:00 PM). Janice Podoll Frankle, Anne McCormick, Michael Davis, and Laura Koss are FTC employees; and smojo@galatech.org and steve.mojo@galatech.org are Steven Mojo, BPI's Executive Director.

[60] *See* E-mail from Steve Mojo to Janice Podoll Frankle, Re: Re: Latest Development in "Degradables" (Aug. 9, 2007, 12:53:22 PM) (discussing claims by Hilex) (Janice Podoll Frankle wrote to Steve Mojo: "The staff . . . sincerely appreciates all of your communications regarding these issues and welcomes the information."); E-mail from Janice Podoll Frankle to Steve Mojo, Re: RE: Latest Development in "Degradables" (Aug. 9, 2007, 1:01:23 PM) ("Seriously, we appreciate your information."); E-mail from Janice Podoll Frankle to smojo@galatech.org, Re: RE: Follow UP (Feb. 5, 2008, 1:00:11 PM) ("Thank you so much for taking the time to speak with us this morning. Thank you also for all of the useful information in your email! Janice, Anne and Laura"). Anne and Laura are presumably Anne McCormick and Laura Koss.

[61] *See* FTC, *Green Packaging Claims*, http://www.ftc.gov/news-events/events-calendar/2008/04/green-packaging-claims.

[62] E-mail from Janice Podoll Frankle to smojo@galatech.org, Re: RE: April 30th Meeting (Feb. 27, 2008, 3:31:44 PM).

[63] E-mail from Michael Davis to steve.mojo@galatech.org, Re: Thank you (May 1, 2008, 11:14:34 AM).

[64] Letter from Steven A. Mojo, BPI Executive Director, to Janice Frankle, FTC, Feb. 7, 2002 (discussing claims by Environmental Products Inc.); Letter from Steven A. Mojo, BPI Executive Director, to Janice Frankle, FTC, Feb. 11, 2002 (apparently identical to the Feb. 7 letter, *supra*); Letter from Steven A. Mojo, BPI Executive Director, to Janice Frankle, FTC, July 10, 2002 (discussing claims by EPI and Plastic Solutions); Aug. 9, 2007 e-mail, *supra* note 60 (discussing claims by Hilex); E-mail from Janice Podoll Frankle to Steve Mojo, Re: RE: Favorite Claims (Aug. 15, 2007, 1:15:46 PM) (discussing claims in a sales flyer); E-mail from Steve Mojo to Janice Frankle, Re: The latest biodegradable landfill product (Jan. 29, 2008, 2:38:00 PM) (discussing claims reported in a news story from Sacramento); E-mail from Janice Podoll Frankle to smojo@galatech.org, Re: RE: The latest biodegradable landfill product (Jan. 30, 2008, 10:02:52 AM) (same); E-mail from Janice Podoll Frankle to smojo@galatech.org, Re: RE: An example of poor science (Feb. 19, 2008, 9:02:50 AM) (discussing claims by Bio-Tec); E-mail from Janice Podoll Frankle to smojo@galatech.org, Re: FW: Article-Hilex introduces biodegradable HDPE bag (Feb. 19, 2008, 11:47:41 AM) (discussing

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often discussed internally.[66] (BPI has also encouraged others to report claims it considered unsupported.[67] It has also reported claims it considered unsupported to other government organizations.[68])

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claims reported in a *Plastics News* article); E-mail from Laura Koss to smojo@galatech.org, Re: RE: The story of the spoon (July 24, 2008, 10:44:19 AM) (discussing claims on a USDA website); E-mail from Janice Podoll Frankle to smojo@galatech.org and Laura Koss, Re: RE: Biodegradable Shoes (Aug. 4, 2008, 10:39:35 AM) (discussing BrooksR Sports claims about biodegradable sneakers); E-mail from Janice Podoll Frankle to smojo@galatech.org, Re: RE: Info on Paradigm Biodegradable Garbage Bags (Sept. 25, 2008, 1:40:21 PM) (discussing claims in a Paradigm Group press release); E-mail from Janice Podoll Frankle to smojo@galatech.org, Re: RE: More landfill claims (Oct. 15, 2008, 2:28:36 PM) (discussing claims reported in a *Plastics News* article); Letter from Steve Mojo, BPI Executive Director, to Michael Davis, FTC, Mar. 30, 2010 (discussing claims by Bio-Tec); E-mail from Steven Mojo to mdavis@ftc.gov, Re: Continuing "Biodegradable" Claims (Feb. 17, 2011, 9:44 AM) (discussing NomaGreen from Nomaco Engineered Foam Solutions); E-mail from Steven Mojo to mdavis@ftc.gov, Re: The claims keep coming (Aug. 29, 2011, 1:52:55 PM) (discussing claims regarding the product EVRgreen EPS from StyroChem, as well as the product EcoPure); E-mail from Steven Mojo to lkoss@ftc.gov, Re: Some still have not gotten the message (Dec. 19, 2013, 2:51:00 PM) (discussing claims regarding Multiplast additives). lkoss@ftc.gov, referred to as "Laura," is presumably the same as FTC employee Laura Koss.

[65] Jan. 29, 2008 e-mail, *supra* note 64 (noting that the claims at issue there were "[o]n the order of the ECM documents that [Steve Mojo] forwarded to [Janice Podoll Frankle] previously"); E-mail from Steve Mojo to Janice Podoll Frankle, Re: Dispozo-o Enviroware Certificate.pdf (Mar. 17, 2008, 2:24:00 PM) (discussing a company's product claims where "the language reads, as if it is ECM's additive"); E-mail from Steven Mojo to Janice Podoll Frankle, Re: RE: A question (Apr. 22, 2008, 2:55:00 PM) (discussing "the litany of claims" made by ECM in the context of ECM comments to FTC); E-mail from Steve Mojo to Laura Koss, Re: Follow Up (July 29, 2008, 3:05 PM) (discussing comments from "Mr. Sinclair," presumably Robert Sinclair of ECM); E-mail from Laura Koss to smojo@galatech.org, Re: RE: Follow Up (July 30, 2008, 8:33:44 AM) (same); Aug. 4, 2008 e-mail, *supra* note 64 (containing forwarded e-mail chain about ECM claims); E-mail from Steve Mojo to Janice Podoll Frankle and Laura Koss, Re: ECM Follow Up (Aug, 19, 2008, 10:08 AM) (discussing claims of a Canadian retailer using ECM additives).

[66] E-mail from Ramani Narayan to three recipients, including Steve Mojo, Re: RE: MoU Thailand (Oct. 11, 2007, 4:52:01 PM); E-mail from Steve Mojo to Ramani Narayan, Re: Bio-Degradable Power-Point (Mar. 28, 2008, 6:15:00 PM); E-mail from Steve Mojo to Ramani Narayan, Re: ecm (July 18, 2008, 11:56:00 AM); E-mail from Steve Mojo to Ramani Narayan, Re: FW: Sandia stuff -- Biobatch (July 18, 2008, 1:37:00 PM); E-mail from Steve Mojo to Ramani Narayan, Re: Bob Sinclair Comments (July 29, 2008, 2:09:00 PM). BPI has also discussed its views against biodegradability claims of plastic additives to outsiders. *See* E-mail from Ramani Narayan to R.S.Mantri, Re: RE: bIODEGRADABLE ADDITIVES (Oct. 14, 2011, 7:28:19 AM); E-mail from Ramani Narayan to Daniella Russo and Laurie Hansen Sheets, Re: RE: Education and Scientific data on Oxo (Apr. 30, 2012, 10:37:45 AM). Ramani Narayan is the head of the Biodegradable Products Institute's (BPI) Scientific Review Committee. *See* BPI, *Frequently Asked Questions*, http://www.bpiworld.org/BPI-Public. R.S. Mantri works at Poddar Pigments Ltd. in India, Daniella Russo is with the Plastic Pollution Coalition, and Laurie Hansen Sheets is with the Western Plastics Association.

[67] E-mail from Steve Mojo to Darryl Stromberg, Re: RE: (Oct. 21, 2008, 10:14:08 AM) (encouraging Darryl Stromberg, of the food container and packaging corporation Genpak, to report ECM claims to Janice Frankle Podoll at FTC); E-mail from Ramani Narayan to Richard Fine, Re: RE: Organic Additive Claim (Aug. 29, 2011, 9:02:13 AM) (encouraging Richard Fine of BioPak in Australia to report claims to Australian authorities); *see also* E-mail from Luke Vernon to smojo@galatech.org, Re: RE: FTC (July 28, 2008, 6:08:42) (Luke Vernon of Eco-Products told Steve Mojo he was "considering reporting Dispozo/Enviroware" for misleading claims, and Steve Mojo said he believed "that Dispozo uses the ECM additive").

[68] *See* E-mail from Steve Mojo to hbranch@ciwmb.ca.gov, Re: Fw: Please review "Wal-Mart letter" (July 17, 2007, 9:54:05 AM) (reporting ECM claims to California Integrated Waste Manage-

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BPI has written to the FTC supporting a consent order for misleading advertising in the case of Dyna-E International and suggesting modifications in the consent order.[69] In the case of a few corporations, BPI has asked that the FTC investigate and take action against claims that BPI argued were misleading.[70] BPI has also asked the FTC to commit to investigating similar claims by other corporations.[71]

This enforcement action against ECM is the culmination of a long process of lobbying by BPI, from BPI's influence in the adoption of the current wording of the Green Guides and support for the one-year-or-less standard, to its constant urging that the FTC take action against claims that BPI considered unfounded, including by ECM.

B. Unpersuasiveness of the Commission's Treatment of Consumer Surveys

A case for agency bias becomes more persuasive when combined with evidence that the agency's position is unpersuasive on the merits.

"The 1998 Guides stated that an unqualified degradable claim should be substantiated with competent and reliable scientific evidence that the entire product or package will completely break down and return to nature within a reasonably short period of time after customary disposal."[72] The new proposed Guides replaced this "reasonably short period of time" standard with the more specific standard of one year,[73] based in part on "a consumer perception survey" by APCO that purported to show that "60 percent of

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ment Board); Jan. 29, 2008 e-mail, *supra* note 64 (noting that the claims at issue there "will be brought to the attention of [the California Integrated Waste Management Board]"); Oct. 21, 2008 e-mail, *supra* note 67 (reporting that BPI members have brought claims to the attention of Canadian authorities). hbranch@ciwmb.ca.gov is Harllee Branch, a CIWMB attorney.

[69] Letter from Steven A. Mojo, BPI Executive Director, to FTC, Sept. 21, 2009, Ref: Dyna-E International, Docket No. 9336. BPI's suggested modifications were not accepted. Letter from Donald S. Clark, Secretary, FTC, to Steven A. Mojo, BPI Executive Director, Dec. 15, 2009, Re: In the Matter of Dyna-E International, Inc. and George Wheeler, FTC Docket No. 9336.

[70] Letter from Steven A. Mojo, BPI Executive Director, to Janice Frankle, FTC, Sept. 12, 2003; Letter from Steven A. Mojo, BPI Executive Director, to Janice Frankle, FTC, Apr. 25, 2005.

[71] *See* FTC Goals and Proposed Agenda Items.

[72] *FTC: The Green Guides, Statement of Basis and Purpose*, at 116.

[73] *Id.*

respondents stated they would expect an item labeled biodegradable without qualification to decompose in one year or less."[74]

One of the commenters that disagreed with the Commission's guidance was EcoLogic, which submitted its competing consumer perception study by Synovate, in which only 25% of respondents expected a product labeled biodegradable to degrade after one year, and another 45% expected it to degrade within five years.[75]

The Commission granted that "[b]oth studies may be faulted for lacking control groups and presenting the timeframe questions with closed-ended, rather than open-ended, answers," but noted that these two studies "nevertheless are the only studies in the record."[76] One approach to bad data would be to hold off on regulation—since, after all, regulation imposes real burdens, and the Administrative Procedure Act dictates that, in formal proceedings, sanctions not be imposed except when "supported by and in accordance with . . . *reliable* . . . evidence."[77]

David Stewart's expert report adequately explains the significant flaws in both studies. Perhaps the most significant flaw is the reliance on closed-ended questions when potential responses are highly heterogeneous and potentially nuanced: a limited set of closed-ended questions may manufacture a false sense of homogeneity even when respondents disagree significantly.[78] Another problem with a limited set of closed-ended responses, that I discuss at greater length below, is that they will inevitably produce framing effects—in this case, by suggesting to survey respondents what timeframes for biodegradability seem extreme and what timeframes seem reasonable.

But the Commission decided to choose the APCO study over the Synovate study because:

> Unlike the APCO survey, the Synovate study results suggest that respondents' answers may have been not only biased, but also influenced by a tendency to avoid extreme answers. As a result, reliable real-world conclusions cannot be drawn from the Synovate study. First, some respondents' answers to the question about decomposition timing

[74] *Id.*
[75] *Id.* at 118–19.
[76] *Id.* at 121 n.409.
[77] 5 U.S.C. § 556(d) (emphasis added); *see also* Steadman v. SEC, 450 U.S. 91 (1981).
[78] *See* generally David Stewart expert report.

> likely were biased by framing from several previous statements and questions. For example, respondents were told that the study was paid for by a company that creates products designed to "be helpful to the environment and [] improve the ways that plastic products are disposed." Additionally, respondents were informed that "non-biodegradable plastic products take hundreds of years to decompose." Such statements are absent from most marketing contexts, and did not appear in the APCO questionnaire.
>
> Second, the Synovate study indicates that some respondents were influenced by an aversion to extreme responses. When asking about decomposition timing, Synovate provided respondents with choices including "less than 1 year," and five much longer time periods. Unlike the APCO questionnaire, the Synovate questionnaire did not provide respondents with multiple options of time periods less than one year. While 25 percent of Synovate's respondents selected the initial option, a much larger subset chose the next available option. This pattern of responses, together with the absence of choices in the range of less than one year, suggests that some respondents were avoiding an extreme response. By contrast, the APCO survey offered respondents multiple options of less than one year and more than one year, and the pattern of answers was not clustered next to an extreme. Thus, the Commission concludes that the proportion of consumers expecting full decomposition in under one year would be closer to 60 percent rather than 25 percent.[79]

In the first place, it is unclear how being told that a study is paid for by a pro-environmental company should bias respondents' views on how long it takes for an item to decompose.

In the second place, framing effects are ubiquitous, whether or not one is given true information about rates of decomposition of non-biodegradable plastics. Economists, psychologists, and others have produced a massive literature showing how minor differences

[79] *Id.* at 121–22.

in the phrasing of a question can have an immense effect on respondents' answers to survey questions. Here are some examples:

- People respond differently to ground beef that is described as "80% lean" vs. "20% fat"—the 80% lean beef is considered better.[80]
- 54% of respondents believe that the United States should *forbid* public speeches against democracy, but 75% believe that the United States should *allow* public speeches against democracy.[81]
- Tversky and Kahneman's "Asian disease" problem is classic: consider two public health interventions against a hypothetical disease, (A) one which will save 200 people for sure and (B) another which have a 1/3 probability of saving 600 people and a 2/3 probability of saving no one. When the interventions as described in this way, survey respondents tend to prefer (A), the more certain intervention. But describe the interventions in a "dying" way instead of a "saving" way—(A) 400 people die for sure, and (B) no one dies with a 1/3 probability and 600 die with a 2/3 probability—and people tend to prefer (B), the one with some non-trivial chance of saving everyone.[82]
- In "contingent valuation" surveys that seek to elicit how much people would pay to preserve an environmental amenity or prevent environmental damage (like an oil spill), survey respondents report an average of about $84 to prevent oil spills off the coast of Alaska—but when asked about their total willingness to pay for a range of social programs, and then asked to identify how much of that amount they'd pay for environmental protection . . . and how much of that they'd pay to protect wilderness areas . . . and how much of *that* they'd pay to prevent human-caused problems . . . and how much of *that* they'd pay to prevent marine oil spills . . . and how much of *that* they'd pay to

[80] *See, e.g.*, I.P. Levin & G.J. Gaeth, *Framing of Attribute Information Before and After Consuming the Product*, 15 J. CONSUMER RES. 374 (1988).
[81] D. Rugg, *Experiments in Wording Questions: II*, 5 PUB. OPINION Q. 91 (1941).
[82] A. Tversky & D. Kahneman, *The Framing of Decisions and the Psychology of Choice*, 211 SCIENCE 453 (1981).

> prevent marine oil spills in Alaska, the average response is $0.29.[83]

Sometimes the opposite happens: *major* changes in the question lead to *minor* changes in answers. For instance—again in the context of contingent valuation surveys—people report essentially the same willingness to pay to preserve bird populations when 2000, 20,000, or 200,000 birds are on the line.[84] Essentially, people are reporting a number that gives them a "warm glow," not their actual valuation of that number of birds.

The problem is not necessarily that some framings give the correct answer while others give a biased answer. It could be that *everything* is framing.[85] As political scientists John Zaller and Stanley Feldman write:

> The literature on response effects . . . makes it clear that survey questions do not *simply* measure public opinion. They also shape and channel it by the manner in which they frame issues, order the alternatives, and otherwise set the context of the question. . . . [P]eople do not merely *reveal* preexisting attitudes on surveys; to some considerable extent, people are using the questionnaire to decide what their "attitudes" are. . . .
>
> Despite the evidence from psychologists and survey methodologists, public opinion researchers largely ignore [this problem].[86]

These insights come from diverse sources: political surveys, surveys of willingness to pay for environmental amenities, surveys of preferences over public health interventions, surveys of reactions to nutritional labeling. These are all cases where many people do not have fixed preexisting views, so it is unsurprising to find that the way questions are framed affects their answers: their answers are somewhat affected by their real beliefs on the matter, but

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[83] Michael A. Kemp & Christopher Maxwell, *Exploring a Budget Context for Contingent Valuation Estimates*, *in* CONTINGENT VALUATION: A CRITICAL ASSESSMENT 217, 231 exh. 3, 235 (Jerry A. Hausman ed., 1993).

[84] *See* William H. Desvouges et al., *Measuring Natural Resource Damages with Contingent Valuation: Tests of Validity and Reliability*, *in* CONTINGENT VALUATION, *supra* note 83, at 91, 102 fig.4.

[85] *See also* MARIT E. KRAGT & JEFF BENNETT, DESIGNING CHOICE EXPERIMENTS TO TEST FOR ANCHORING AND FRAMING EFFECTS (Envt'l Econ. Res. Hub, Res. Rept. No. 10, Dec. 2008).

[86] John Zaller & Stanley Feldman, *A Simple Theory of the Survey Response: Answering Questions Versus Revealing Preferences*, 36 AM. J. POLIT. SCI. 579, 582–83 (1992) (citations omitted).

are also affected by their broader attitudes, the context of the interview process, and the like.

Coming back to the case of biodegradability, it is likely that here, too, most people have no fixed idea of what the concept means because they rarely (if ever) have to deal with differences between products that both call themselves biodegradable but that degrade at different rates. Their views of what "biodegradable" means are partly formed at the moment the question is asked, which means they may have little basis in reality and are also probably heavily influenced by the wording of the question.

In terms of the merits, this probably counsels in favor of a rule that would not penalize people for using a word unless their usage is *extremely* far from consumer expectations. But, for purposes of this report, the more interesting question is what the Commission's treatment of the issue, and why it chose the APCO study over the Synovate study, tells us about its possible bias. The Commission's treatment of framing effects suggested uncritically that the wording of one study led to bias and extreme-response aversion, while apparently ignoring even the possibility of framing effects in the other study. It is not clear why it is a virtue of the APCO study that it provided multiple options of less than a year and more than a year: this choice, too, can bias responses in that "one year" looks like a reasonable, moderate result when placed in this context.

To be sure, in the presence of framing effects, there are better and worse ways of proceeding, but the Commission's approach, and radically asymmetrical treatment of the two studies, shows a surprising naiveness about the issue—especially since complaint counsel's own expert, Shane Frederick, concludes that both studies are "reasonably reliable and valid."[87] (Shane Frederick's own surveys show the pervasiveness of framing effects and—to the extent they are valid—at least suggest the absence of a consensus on the definition of biodegradability.[88]) This would be more likely if the

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[87] *See* Shane Frederick expert report, ¶¶ 14–25. I do not mean to endorse Dr. Frederick's view that both studies are "reasonably reliable and valid": David Stewart's expert report in this case explains the serious problems with the studies, which I have also discussed earlier in this section. I merely mean to contrast both Dr. Frederick's rosy view of both studies and Dr. Stewart's critical view of both studies with the Commission's oddly asymmetric attitude that the APCO study is significantly better than the Synovate study.

[88] Later in this report, *see infra* Part V.C, I discuss problems with Dr. Frederick's Google surveys. But—taking these Google surveys at face value for now—many of his surveys show that the percentage of respondents who believe that biodegradability must occur in no more than a year is

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Commission—whether consciously or not—was biased in favor of the position of the compostable producers; and so, according to the probabilistic model, bias should be deemed more likely, especially when combined with the evidence of lobbying in the previous section.

C. Bias and the Force of Law

That the Commission believes that the Green Guides do not have the force of law[89] is an extra reason to suspect bias.

The Green Guides themselves can be seen as interpretations of the "unfair or deceptive" language in the FTC Act,[90] so they can be argued to fall within the exception to notice-and-comment rulemaking for "interpretative rules."[91] While this is evidently the Commission's theory, the "interpretative rule" exception might not apply here, which would make the Green Guides a legislative rule and thus subject to full notice-and-comment proceedings. As the D.C. Circuit has recently written:

> [I]if the relevant statute or regulation "consists of vague or vacuous terms—such as 'fair and equitable,' 'just and reasonable,' 'in the public interest,' and the like—the process of announcing propositions that specify applications of those terms is not ordinarily one of interpretation, because those terms in themselves do not supply substance from which the propositions can be derived."[92]

Though the Commission has specific statutory authority to prescribe "interpretive rules and general statements of policy *with respect to* unfair or deceptive acts or practices,"[93] this authority coex-

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highly variable, depending on the phrasing, and often less than 50%. *See, e.g.*, Shane Frederick expert report ¶¶ 31–32, 35. This is evidently why Dr. Frederick phrases his results in terms of "at least a substantial minority" or "at least a significant minority," *see id.* ¶¶ 26–37.

[89] *FTC: The Green Guides, Statement of Basis and Purpose*, at 1; FTC, *Guides for the Use of Environmental Marketing Claims*, 77 Fed. Reg. 62122, 62122 (2012).

[90] 15 U.S.C. § 45.

[91] 5 U.S.C. § 553(b)(A). The Commission takes the position that they are "administrative interpretations of the law" and "do not have the force of law," 77 Fed. Reg. at 62122, and agency intent is an important determinant of whether an agency statement is an interpretive rule not subject to notice and comment, *see* Am. Mining Cong. v. Mine Safety & Health Admin., 995 F.2d 1106 (D.C. Cir. 1993).

[92] Catholic Health Initiatives v. Sebelius, 617 F.3d 490, 495 (D.C. Cir. 2010) (quoting Robert A. Anthony, *"Interpretive" Rules, "Legislative" Rules, and "Spurious" Rules: Lifting the Smog*, 8 ADMIN. L.J. AM. U. 1, 6 n.21 (1994)).

[93] 15 U.S.C. § 57a(a)(1)(A) (emphasis added).

ists with an authority to prescribe "*rules which define with specificity* acts or practices which are unfair or deceptive."[94] This statutory structure seems to require that "rules," i.e. legislative rules, be issued for highly specific definitions like those in the Green Guides, leaving the interpretive rules and policy statements for ancillary matters—"with respect to" unfair or deceptive acts already defined by legislative rule. The Commission's view that the Green Guides are not legislative rules (and thus do not have the force of law) therefore seems somewhat dubious.

Nonetheless, the Commission's view on whether the Green Guides have the force of law—whether correct or not—is certainly probative of its own view. And since, *in the Commission's view*, notice, comment, and a "concise general statement of . . . basis and purpose"[95] were not required, *the Commission must have believed* that the statement accompanying the Green Guides would not be subject to stringent judicial review. Generally, agencies are held to strict standards of responding to cogent positions argued in comments,[96] but the caselaw establishing those requirements was developed in the context of the requirements of notice-and-comment rulemaking.

The agency's voluntary decision to solicit and respond to comments is thus not equivalent to actual, legally required notice-and-comment rulemaking: the agency would have believed that its own responses to comments would have been subjected to looser review—indeed, perhaps treated as laudable because they were not required. The Commission would have felt that it had more freedom to not respond to cogent positions argued in comments as would otherwise be required, or to respond without as much reasoning. The effect of the give-and-take of the notice-and-comment process, where the need to respond to counterarguments alleviates the possible effects of bias, is thus significantly muted.[97]

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[94] *Id.* § 57a(a)(1)(B) (emphasis added).
[95] 5 U.S.C. § 553(c).
[96] *See* United States v. Nova Scotia Food Products Corp., 568 F.2d 240 (2d Cir. 1977).
[97] *See* text accompanying *supra* notes 21–24.

V. BIAS IN SOME OF THE EVIDENCE IN THIS CASE

This Part discusses indicia of potential bias related to some of the evidence in this case. Section A discusses the self-interest of Stephen McCarthy, who is one of complaint counsel's experts. Section B discusses issues of self-interest in a recent paper by Frederick Michel and Eddie Gómez, which complaint counsel is relying on in this case (and which McCarthy cites in his expert report[98]). Section C discusses the substantive validity of the research of Shane Frederick, who is one of complaint counsel's experts.

The discussion of bias serves two purposes: First, recognizing the sources of self-interest in this evidence is an argument for giving the evidence reduced weight. Second, to the extent the agency nevertheless relies on this evidence in spite of its possible bias, that fact can be used to support an argument that the agency is itself biased against ECM.

A. The Self-Interest of Expert Stephen McCarthy

One of complaint counsel's experts is Stephen McCarthy. McCarthy is connected to the biodegradable products industry in various ways. He is a founding member of the BioEnvironmental Polymer Society,[99] has won its lifetime achievement award,[100] and (at least as of 2010) is on its international advisory board.[101] McCarthy regularly attends[102] and speaks at[103] plastics conferences.

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[98] *See* McCarthy expert report at 7 n.3.

[99] *See* BioEnvironmental Polymer Society, *History*, http://www.beps.org/history.html.

[100] *See* BioEnvironmental Polymer Society, *Award Descriptions*, http://beps.org/awards.html.

[101] *See* BioEnvironmental Polymer Society, *Polymers and the Environment: Emerging Green Technologies & Science*, 2nd Circular & Call for Papers (conference held Oct. 13–16, 2010 in Toronto).

[102] *See* Final Report to the Office of Naval Research on Grant No. N00014-95-1-1194 for the partial support of the 4th International Workshop on Biodegradable Plastics and Polymers, Durham, N.H.

[103] *See 7th Annual Meeting of the Bio/Environmentally Degradable Polymer Society* (Aug. 19–22, 1998, Cambridge, Mass.); Soc'y of Plastics Engrs., Auto. & Composites Divs., *First Annual Global Automotive Composites Conference (Sept. 19–20, 2001)*, http://www.speautomotive.com/pdfs/01%20Files/01%20SPE%20ACCE%20Program%20Guide.pdf; Univ. of N. Tex., Off. of Res. & Econ. Dev't, *UNT to Host 20th Anniversary BioEnvironmental Polymer Society Conference*, http://research.unt.edu/announcements/unt-host-20th-anniversary-bioenvironmental-polymer-society-conference (2012). *See also* CIPET, *APM 2010: Moments*, http://www.cipet.gov.in/apm_2010.html (2010); Edwin L. Aguirre, *Prof. McCarthy Delivers Plastics Lecture in India*, Mar. 31, 2010, http://www.uml.edu/News/stories/2009-10/mccarthy_india_trip.aspx. Both McCarthy's institution, the University of Massachusetts at Lowell, and Narayan's institution, Michigan State University at

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McCarthy also performs BPI certification.[104] (Companies with BPI certification are allowed to use BPI's compostable logo.[105])

McCarthy's connections go further than merely being an active participant in this industry and having some connections with BPI. McCarthy holds many patents for biodegradable and bioresorbable polymers and polymer blends.[106] He has received a considerable amount of contract and grant support related to biodegradable products. More than $1.5 million of this support comes from Metabolix.[107] Metabolix is not only a member of BPI—various of its products are BPI-certified[108]—but also the exclusive licensee for one of McCarthy's patents.[109] The patent is for a biodegradable blend that is:

> environmentally friendly and commercially attractive for making biodegradable plastic films, sheets, and other plastic products made by conventional processing methods such as blown film, extrusion, and injection molding. These plastic products can be used for food packaging, compost bags, and other disposable items. The new blends provide an entry for polylactic acid in the potentially large market of biodegradable polymers.
>
> . . .
>
> Like wood and paper, these blends are stable in the atmosphere but biodegradable in compost, in moist soil, in

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East Lansing, collaborate with the Central Institute of Plastics Engineering (CIPET) in India. *See* CIPET, *International Relations*, http://cipet.gov.in/cipetmou.html; Edwin L. Aguirre, *University and CIPET to Forge Collaboration*, Sept. 23, 2009, http://www.uml.edu/News/stories/2009-10/indian_secretary_visit.aspx.

[104] *See* Stephen McCarthy's LinkedIn page.

[105] *See* BPI, *The BPI Certification Process*, http://www.bpiworld.org/BPI-certification-process; BPI, *The BPI Approval Process & Test Requirements*, http://www.bpiworld.org/BPI-certification-requirements.

[106] *See* Patent No. 5,439,985 (1995); Patent No. 5,440,007 (1995); Patent No. 5,883,199 (1999); 6,093,792 (2000); *see also* WONDU HOLDINGS, BIOPLASTICS SUPPLY CHAINS—IMPLICATIONS AND OPPORTUNITIES FOR AGRICULTURE 206–07 (Australian Gov't, Rural Inds. Res. & Dev't Corp., Nov. 2004).

[107] *See* Stephen P. McCarthy CV, "Contract and Grant Support" section.

[108] *See* Metabolix, BPI Certified Products Catalog, http://products.bpiworld.org/companies/metabolix.

[109] The patent is Polylactic Acid-based Blends, No. 5,883,199, *see* note 106 *supra*. Press release, *Metabolix Grants a Patent License to NatureWorks LLC for New Biopolymer Blends*, Mar. 14, 2012, http://www.uml.edu/News/press-releases/2012/Metabolix.aspx; *see also* Edwin L. Aguirre, *UMass Lowell, Metabolix/Telles Celebrate Partnership*, https://www.uml.edu/News/stories/2009-10/metabolix_celebration.aspx ("Metabolix has funded more than $2.5 million in sponsored research with UMass Lowell . . . . It has also donated more than a half million dollars' worth of bioplastic processing equipment. 'Metabolix has licensed UMass Lowell patents for bioplastic blends, with potential royalties of $100,000 a year,' said McCarthy.").

> water with activated sludges, and in the sea, where a large number of microorganisms are present. These blends can be incinerated with only slight damage to the furnace since the heat of combustion is relatively low, and no toxic gases are generated.[110]

This patent competes directly with products like those of ECM. To the extent that claims of biodegradability are limited to substances that can degrade in a short amount of time, like compostables, McCarthy's patent(s) would become more valuable if the FTC rules against ECM in this case.

And, in fact, Metabolix has complained to the FTC about ECM's claims and urged the FTC to take action against ECM.[111]

McCarthy's self-interest is relevant because of the general rule, in both federal and state evidence systems, that expert witnesses' testimony should be discounted when there is evidence of bias, from whatever source.[112] Evidence scholar David Bernstein collects several cases stating the general principle that experts should be impartial:

> As one court remarked, "despite the fact that one party retained and paid for the services of an expert witness, expert witnesses are supposed to testify impartially in the sphere of their expertise." Kirk [v. Raymark Indus., 61 F.3d 147, 164 (3d Cir. 1995)]; *see also* Selvidge v. United States, 160 F.R.D. 153, 156 (D. Kan. 1995) ("An expert witness should never become one party's expert advocate. An expert witness should be an advocate of the truth with testimony to help the court and the jury reach the ultimate truth . . . which should be the basis of any verdict."); English Feedlot, Inc. v. Norden Labs., Inc., 833 F. Supp. 1498,

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[110] *Polylactic acid polymer and copolymer with polyesters*, US 5883199 A, http://www.google.com/patents/US5883199.

[111] E-mail from Brian Igoe to jfrankle@ftc.gov, Re: FW: Good Earth and ECM (June 26, 2008, 4:55:47 PM). Brian Igoe is VP and Chief Brand Officer of Metabolix; jfrankle@ftc.gov is Janice Frankle, an FTC attorney.

[112] *See, e.g.*, 3 STEPHEN SALTZBURG ET AL., FEDERAL RULES OF EVIDENCE MANUAL 702.03[12] (10th ed. 2011); DAVID H. KAYE ET AL., THE NEW WIGMORE: EXPERT EVIDENCE §§ 1.3.1, 1.4.1 (2d ed. 2011); COMM. ON PATTERN JURY INSTRUCTIONS, FIFTH CIR. DIST. JUDGES' ASS'N, PATTERN JURY INSTRUCTIONS: FIFTH CIRCUIT, CIVIL CASES § 2.19 (2009) (listing bias as a reason for juries to discount expert evidence); Pack v. Geico Gen. Ins. Co., 119 So. 3d 1284, 1287–88 (Fla. App. 2013); FLA. STAT. ANN. § 90.608(2) (listing bias as a factor against the credibility of a witness); 286 P.3d 1256, 1260–62 (Utah App. 2012); TEX. R. CIV. P. 192.3(e)(5) (allowing discoverability of evidence relevant to expert's bias); Michael Graham, *Impeaching the Professional Expert Witness by a Showing of Financial Interest*, 53 IND. L.J. 35 (1977).

1501 (D. Colo. 1993) ("Experts are not advocates in the litigation but [] sources of information and opinions.").

David E. Bernstein, *Expert Witnesses, Adversarial Bias, and the (Partial) Failure of the* Daubert *Revolution*, 93 IOWA L. REV. 451, 453 n.13 (2008).

Generally, the anti-financial bias principle shows up in the rule that federal agencies cannot compensate their witnesses on a contingency fee basis,[113] "[t]o help ensure the integrity and effective supervision of the legal and expert witness services provided to or on behalf of the United States."[114] But similar concerns are at play when the expert witness is a competitor of the opposing party: from an economic perspective, it is difficult to distinguish the incentives of an expert expecting part of the recovery if his competitor loses the case and those of an expert "merely" expecting to do better in his business if his competitor loses the case.

As mentioned above, the probabilistic model dictates that evidence presented by an expert should be considered more likely to be biased if it is substantively flawed, for instance if it contradicts other statements by the same expert.[115] In this case, McCarthy writes that evidence that a substance is biodegradable is not "competent and reliable"[116] unless the tested sample reaches "at least 60% biodegradation,"[117] and there is both a "negative control" and a "positive control."[118] However, McCarthy's patent discussed above[119] made claims that certain substances biodegraded even though the rate of biodegradation was lower than 60%.[120] Moreover—though I lack the scientific knowledge to fully appreciate the details of the patent—I did not find any discusion of negative or positive controls in the patent to support the patent's claim of biodegradability.

McCarthy also writes in his expert report that a conventional (non-biodegradable) plastic (such as polypropylene or polyeth-

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[113] Exec. Order No. 13,433, §§ 2(b), 3(b), 3 C.F.R. 638 (2007).
[114] *Id.* § 1.
[115] *See supra* Part III.D.
[116] McCarthy expert report ¶ 37, at 13.
[117] *Id.* ¶ 38, at 15.
[118] *Id.* ¶ 38, at 16.
[119] *See supra* note 110.
[120] *See, e.g.*, '199 patent, *supra* note 110 (stating that "Fig. 11 shows that polylactic acid degrades in soil," but reporting that "polylactic acid degraded only about 14% by loss in weight" in 45 days); *id.* (stating that the A70B30 blend degraded 25% after 45 days).

ylene[121]) "remains non-biodegradable" after being "melt-batch blended"[122] with the ECM additive, because "a **physical** blend of a biodegradable polymer with a conventional plastic does not alter the **chemical** structure of the conventional plastic," and so "the non-biodegradable plastic component is no more susceptible to biodegradation after blending than it was before."[123] However, McCarthy was the co-author of a 1990 paper that proposed to test "binary blends of bacterial polyesters with polyethylene (PE) and polystyrene (PS)"; the blends were prepared using "melt blending."[124]

I lack the scientific knowledge to fully understand the details of this paper, but it seems at a minimum that there is some tension between McCarthy's view in his expert report that a physical blend of a biodegradable polymer with a conventional plastic cannot biodegrade because blending does not change the conventional plastic's chemical properties, and his willingness in his paper to test such a blend. Perhaps there is an explanation, but if McCarthy cannot produce such an explanation, this would provide additional reason to suspect his expert report of bias.[125]

B. The Self-Interest of Frederick Michel and OARDC

It has been represented to me that complaint counsel is relying on a paper by Eddie Gómez and Frederick C. Michel Jr. called *Biodegradation of Conventional and Bio-Based Plastics and Natural Fiber Composites During Composting, Anaerobic Digestion and Long-Term Soil Incubation*,[126] in which ECM products were tested.[127] Michel is a professor in the Department of Food, Agricultur-

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[121] *See* McCarthy expert report ¶¶ 29–30, 34, at 10–12.

[122] *Id.* ¶ 61, at 24.

[123] *Id.* ¶ 64, at 25–26; *see also id.* ¶ 17, at 7.

[124] S.N. Bhalakla, T. Patel, R.A. Gross & S.P. McCarthy, *Biodegradable Blends of Bacterial Polyesters with Polyethylene and Polystyrene*, 31 POLYMER PREPRINTS 441 (1990).

[125] The same is true of McCarthy's '199 patent, which covers (in claim 9) a blend involving PET. As I have mentioned in the text, I lack the scientific expertise to fully understand the claims in this patent, but the consistency of McCarthy's view in his expert report and the claim in the patent should be explained.

[126] Eddie F. Gómez & Frederick C. Michel Jr., *Biodegradation of Conventional and Bio-Based Plastics and Natural Fiber Composites During Composting, Anaerobic Digestion and Long-Term Soil Incubation*, 98 POLYMER DEGRADATION & STABILITY 2583 (2013).

[127] *Id.* at 2585 tbl.2 (testing "PP + 2% additive" and "PS + 2% additive," where the additive is ECM Masterbatch Pellets).

al and Biological Engineering at Ohio State University, and Gómez is his graduate student.

One may quarrel with the applicability of the paper to ECM products—for instance, it has been represented to me that polypropylene pellets represent under 2% of the applications of ECM's products. But the purpose of this report is not to question the merits of the paper, just as it did not question the merits of the testimony of Stephen McCarthy in the previous section; this section merely points out that Michel's self-interest aligns with the results of his research, so that the probative value of the results may be appropriately discounted. (In terms of the probabilistic model developed earlier, a researcher driven by his financial self-interest would produce a paper supporting that self-interest. Therefore, observing a paper whose results align with the researcher's self-interest should increase one's belief that the researcher is biased.)

Michel studies the composting process professionally (as is clear from his CV), and he has also done private consulting for various composting-related entities, such as the U.S. Composting Council and Indian Summer Compost.[128] He has also had some dealings with BPI. At one point, he submitted a proposal to BPI to test various compostable bioplastics (the cost of this proposal would have been $3750),[129] though the proposal was ultimately not accepted.[130] Later, on a few occasions, Michel was in correspondence with BPI, with a view toward getting his lab approved for doing testing that would allow him to use the BPI/USCC compostable logo.[131]

It is reasonable to suppose that a market boost to compostables—for instance, if non-compostables have greater trouble using

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[128] E-mail from Frederick Michel to Matthew Wiltshire, Re: RE: available for phone call today? (Nov. 15, 2012).

[129] E-mail from Steve Mojo to Frederick Michel, Re: RE: proposal (Nov. 20, 2008, 9:31 AM). The proposal is probably Frederick Michel, Human Health and Ecosystem Risk Assessment of Compostable Bioplastics and Their Degradation Products, a proposal to the Biodegradable Products Institute, Nov. 21, 2008. Though this proposal is dated November 21, 2008, the properties of the MS Word file, CON-bpiproposal.doc, show that the document was created and last modified on November 20, 2008 (at 12:02 AM and 12:14 AM, respectively), which is the same date as the e-mail cited above.

[130] E-mail from Steve Mojo to Frederick Michel, Re: Update on your proposal (Nov. 25, 2008, 2:12 PM).

[131] E-mail from Steve Mojo to michel.36@osu.edu, Re: RE: Compostable logo (Dec. 9, 2008, 11:52 AM); E-mail from Steven Mojo to michel.36@osu.edu, Re: RE: Samples on the Way (Apr. 18, 2011, 11:51 AM).

the term "biodegradable" in their advertising, as will be the case if ECM loses this litigation—would redound to Michel's benefit.

Moreover, the research leading up to the Gómez & Michel article was apparently funded by a competitor of ECM. Michel received funding on various occasions from Myers Industries, Inc.[132] Myers Industries' Lawn & Garden Group produces "nursery containers made of bioplastics and natural fibers."[133] Michel requested $29,175 from Myers Industries for research to last 12 months beginning March 1, 2010,[134] but it is unclear whether that funding was received.[135] Myers Industries gave Michel $28,000 for the period between June 2011 and January 2012.[136] In February 2012, Myers Industries offered Michel a matching grant of up to

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[132] *See, e.g.*, E-mail from Eddie Gomez to michel.36@osu.edu, Re: RE: Tomorrow (Oct. 5, 2011, 11:46 AM) (quoting E-mail from Tarang Shah to michel.36@osu.edu, Re: Re: Tomorrow (Oct. 5, 2011, 10:03 AM) ("Fred, would you be available tomorrow? I wanted to stop by and drop the check.")).

[133] Letter from Tarang Shah, Manager, Corporate Materials Application, Myers Industries, Inc., to Dr. Michel, Feb. 2, 2012, attached to E-mail from Frederick Michel to Eddie Gomez, Re: FW: (Feb. 6, 2012, 10:48 AM).

[134] E-mail from Frederick Michel to tshah@myersind.com and DThomas@myerslawnandgarden.com, Re: Proposal for pot degradability testing (Feb. 22, 2010, 10:29 AM).

[135] E-mail from tshah@myersind.com to michel.36@osu.edu, Re: Re: Proposal for pot degradability testing (Feb. 26, 2010, 4:13 PM) ("Professor, We are working on the proposal, and remain very interested in moving this forward. The delay has been due to our company's process.").

[136] Grant application, *supra* note 132, at 17 (noting support "Evaluation of the Compostability, soil degradation and anaerobic digestion of Bioplastics used for nursery pots"). Perhaps this is related to a $31,400 proposal that Michel apparently made to Myers for research to last 12 months beginning August 1, 2011. *See* Frederick C. Michel, Biodegradability and Life Cycle Analysis of Nursery Pots Made of Ecotainer Formulations, a proposal to Myers Industries, Inc. The document is undated, but the properties of the MS Word file, MyersAkroMilproposal2011.doc, shows that it was created on July 14, 2011, and last modified on July 15, 2011. Michel also made a $31,400 proposal with the same name, starting August 15, 2011, only lasting six months. *See* E-mail from Frederick Michel to Tarang Shah (cc:ing Eddie Gomez), Re: RE: proposal (Aug. 10, 2011, 10:42 AM). I am not sure how the $28,000 reported as received for a period starting in June 2011 relate to these proposals, which were written in July and August 2011.

$20,000.[137] This money may have gone directly to support Eddie Gómez's graduate education.[138]

The purpose of Myers Industries' funding was to evaluate the compostability and degradability of its products.[139] Myers Industries had an interest in the issue on several fronts: Any product with good results could be a good candidate for Myers to buy and offer in the future as part of its catalog.[140] But the results would also be useful to the extent they established that Myers Industries' products were better than those offered by its competitors. In providing the funding, Myers Industries committed to "provide the bioplastics and natural fibers that will be required to conduct the experiments,"[141] though Myers had been providing products for testing by Gómez and Michel since at least 2010.[142]

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[137] *See, e.g.*, Feb. 2, 2012 letter, *supra* note 133 ("Myers Industries Lawn & Garden Group is pleased to offer matching funds up to $20,000, equal to 100% awarded to you for studying the biodegradability and life cycle analysis of nursery containers made of bioplastics and natural fibers."); Grant application to OARDC attached to E-mail from Eddie Gomez to Frederick Michel, Re: OARDC-Matching_Myers_2012.docx (Feb. 6, 2012, 2:24 PM), at 13 ("Matching Funds will be obtained from Myers Industries Inc. as a dollar for dollar match for the project. A support letter from Myers Industries is attached to the end of the proposal." (attaching Feb. 2, 2012 letter, *supra* note 133)). Michel billed Shah for at least $8600 as "half of the payment for the life cycle analysis proposal." E-mail from Frederick Michel to Tarang Shah (cc:ing Eddie Gomez), Re: RE: Invoice (July 27, 2012, 3:24 PM) (quoting E-mail from Tarang Shah to Frederick Michel, Re: Re: Invoice (July 27, 2012, 12:50 PM) ("Fred, Can you break it in to 2 half amount invoices? ($8,600 ea.)")).

[138] *See* Grant application, *supra* note 132, at 12 ("The study is an extension of work being conducted in collaboration with Myers Industries, an Ohio manufacturer of plastic pots for the nursery industry. They have provided tuition and stipend support for Eddie Gomez. The funds will allow additional work to be completed that will lead to peer reviewed publications."); Eddie F. Gomez, Biodegradation of Bioplastics and Natural Fibers During Composting, Anaerobic Digestion and in Soil (SEEDS: The OARDC Graduate Research Enhancement Grant Program, Ph.D. application) (applying for funding for June 20, 2012 to November 20, 2012) (noting that "[t]he study is an extension of work being conducted in collaboration with Myers Industries, an Ohio manufacturer of plastic pots for the nursery industry. They have provided tuition and stipend support for Eddie Gomez."); E-mail from Eddie Gomez to tshah@myerslawnandgarden.com (cc:ing michel.36@osu.edu and Jay Martin), Re: Myers Final Report (Oct. 21, 2011, 3:17 PM) ("Tarang - It was good to talk to you and thanks for supporting me with my studies. It's a great learning experience to work together with industry.").

[139] *See supra* note 136.

[140] *See* Eddie F. Gomez, Life Cycle Assessment and Study of the Biodegradability of Novel Plastics and Natural Fiber Composites Under Aerobic and Anaerobic Conditions (Ph.D. proposal), attached to E-mail from Eddie Gomez to Frederick Michel, Re: File for Gomez proposal (June 29, 2012, 4:33 PM). Gomez writes: "Myers Industries Inc., an Ohio manufacturer of plastic pots for the nursery industry will be used as the model for this study. The company buys plastics in the form of pellets and fibers from different providers around the world. These materials are then transformed into nursery pots in several plants around the state and then shipped to retailers. Recently, Myers is interested in purchasing materials that are claiming to be biodegradable in order to reduce the impact of their activities in the environment." *Id.* at 13.

[141] Feb. 2, 2012 Letter, *supra* note 133.

[142] E-mail from Eddie Gomez to Tarang Shah (cc:ing michel.36@osu.edu), Re: Follow-up (July 9, 2010, 1:02 PM) (quoting E-mail from Tarang Shah to Eddie Gomez (cc:ing

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This funding was important to Michel as well as to Gómez: when Gómez expressed concern that he might not be able to complete "Tarang[']s final report"[143] because of his graduate coursework, Michel wrote back: "Eddie, I think we need to complete the report. It is really the first priority if we want funding to continue. If you have to, you may need to drop the class."[144]

Michel and Gómez have been corresponding with Tarang Shah of Myers Industries since at least 2010,[145] and Shah has taken an active interest in the progress of the research.[146] Shah has been so

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michel.36@osu.edu), Re: RE: Follow-up (July 6, 2010, 1:16 PM) ("Eddie, Would you be available Thursday morning? I have additional control flower pots and can drop them off.")).

[143] This report is apparently the one referred to below as Gómez & Michel internal report for Myers Industries, *infra* note 154.

[144] E-mail from Eddie Gomez to michel.36@osu.edu, Re: RE: Myers (Oct. 19, 2011, 11:53 AM).

[145] *See, e.g.*, E-mail from Frederick Michel to tshah@myersind.com, Re: RE: Proposal for pot degradability testing (Feb. 26, 2010, 4:29 PM); E-mail from Eddie F. Gómez to tshah@myersind.com and michel.36@osu.edu, Re: RE: materials needed (May 19, 2010, 11:55 AM); E-mail from Eddie Gomez to Tarang Shah and michel.36@osu.edu, Re: Follow-up (June 8, 2010, 9:21 AM) ("Hi Tarang, The pleasure was mine, thank you for giving OARDC the opportunity to work together with Myers. . . . I will write you again to keep you updated"); E-mail from Eddie Gomez to Tarang Shah (cc:ing michel.36@osu.edu), Re: Titrations (June 9, 2010, 3:12 PM) ("Tarang- Please take a look to the calendar of titrations, you are more than welcome to join me during the process."); E-mail from Eddie Gomez to michel.36@osu.edu, Re: Lab meeting (June 14, 2010, 5:26 PM) ("Fred, I will be working with Tarang tomorrow in the morning."); E-mail from Eddie Gomez to Tarang Shah and michel.36@osu.edu, Re: Anaerobic Digestion update (July 28, 2010, 8:18 PM) ("I look forward to meet with you next week. Please let me know if any questions or suggestions."); E-mail from Eddie Gomez to TShah@myersind.com (cc:ing michel.36@osu.edu), Re: Results for MYERS (Aug. 6, 2010, 1:57 PM) ("Tarang – Please take a look to the updated file for Myers experiments."); E-mail from Eddie Gomez to michel.36@osu.edu, Re: Lab Meeting (Aug. 16, 2010, 12:13 PM) ("Fred - I have to meet with Tarang tomorrow at 10am."); E-mail from Eddie Gomez to Tarang Shah (cc:ing Frederick Michel), Re: Experiments (Oct. 27, 2010, 3:42 PM) ("Tarang - Thanks for meeting with me this Monday. Just wanted to let you know that the AD experiment that I started last Friday is stable. . . . I will update the database next week and I'll send you a copy.").

[146] *See, e.g.*, E-mail from Eddie Gomez to Tarang Shah (cc:ing michel.36@osu.edu), Re: MYERSEXP - Design Results (1-8-2011).xlsx (Jan. 8, 2011, 5:13 PM) ("Tarang - data up to 1-8-2011"); E-mail from Eddie Gomez to Tarang Shah (cc:ing michel.36@osu.edu), Re: Experiments (Jan. 31, 2011, 10:42 AM) ("Tarang - I went to Wooster this weekend to check the experiments."); E-mail from Eddie Gomez to Tarang Shah (cc:ing michel.36@osu.edu), Re: MYERSEXP - Design Results (2-1-2011).xlsx (Feb. 1, 2011, 8:16 PM) ("Updated soil experiment data."); E-mail from Eddie Gomez to Tarang Shah (cc:ing michel.36@osu.edu), Re: AD update (Apr. 1, 2011, 7:28 PM) ("Tarang - update for AD 5511 experiment on ECM 2%, Ecopure, Ecobras and Ecotainer. I will continue working on this data. Please not that this is not a final report."); E-mail from Eddie Gomez to Tarang Shah (cc:ing Fred Michel), Re: Experiments (May 9, 2011, 10:04 PM) ("Tarang - I was this weekend in Wooster checking the experiments."); E-mail from Frederick Michel to Eddie Gomez, Re: paper (May 24, 2011, 12:44 PM) ("Tarang will be visiting Thursday morning to discuss the summer plans and review the tests."); E-mail from Eddie Gomez to Frederick Michel, Re: RE: Myers Report 2011draftIEG.docx (Dec. 20, 2011, 9:52 AM) ("I met with Tarang and we went over the report, I answered his questions and he was happy with it.") (responding to an e-mail from Frederick Michel to Eddie Gomez, Re: RE: Myers Report 2011draftIEG.docx (Dec. 19, 2011, 5:14 PM), asking: "Did you get any response from Myers on the Annual Report? Were they happy with it?"); E-mail from Eddie Gomez to Frederick Michel, Re: Meeting with Tarang (June 29, 2012, 10:56 AM) ("Hi Fred -

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involved in the research that Michel and Gómez listed him as a collaborator on a draft grant request;[147] and when Michel and Gomez proposed to present a previous version of their paper at a 2012 meeting in France,[148] Michel suggested that he could add Shah as an author "since [he had] been involved in the research from the beginning."[149]

When Michel and Gomez have presented their work comparing the biodegradability of Myers's products with ECM's (among others), their presentation materials have not always indicated the precise provenance of the items tested. Thus, the PowerPoint file presented at an April 2011 conference generally showed the items tested without noting what companies produced them; Michel wrote to Tarang Shah asking if Shah "would have any problems with [Michel's] presenting the . . . Powerpoint," adding: "There are no references to Myer[s]."[150] It thus seems likely that some product noted in that PowerPoint is from Myers. A substantially similar presentation from May 2011 lists many producers, including ECM, Ecobras, and Ecopure, but does not mention Myers Industries. The filename, though, is "meyerspreliminaryresults.pdf" [sic], which strongly suggests that a Myers product was involved.[151] (In other e-mails as well, Michel has checked his presentation of the results with Shah.[152]) Gómez's dissertation, which contains substantially

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I would like to meet with Tarang and you to discuss use of data and publications for the LCA study."). The "Annual Report" referenced here is the same as Gómez & Michel internal report for Myers Industries, *infra* note 154.

[147] Grant application, *supra* note 138, at 1 (listing "Tarang Sha" [sic] as "Collaborator 1"); Grant application at 11 ("Dr. Frederick Michel and Tarang Shah of Myers Industries Inc. will coordinate the research aspects of the project and design experiments, analyse data and prepare reports and publications about the project. Dr. Michel will supervise a graduate student who will conduct the experiments . . . .").

[148] The meeting was the ORBIT2012 conference in Rennes, France, "Global Assessment for Organic Resources and Waste Management," http://www.orbit2012.fr/.

[149] E-mail from Frederick Michel to Tarang Shah, Re: RE: Tomorrow (Oct. 24, 2011, 2:12 PM).

[150] E-mail from Frederick Michel to Tarang Shah, Re: RE: this week (Apr. 25, 2011, 1:07 PM).

[151] Presentation attached to E-mail from Frederick Michel to Tarang Shah (cc:ing Eddie Gomez), Re: preliminary data (May 2, 2011).

[152] *See, e.g.*, Oct. 5, 2011 E-mail, *supra* note 132 (quoting E-mail from Frederick Michel to Tarang Shah (cc:ing Eddie Gomez), Re: RE: Tomorrow (Oct. 5, 2011, 11:08 AM) ("I would like to ask you about presenting the data at a meeting I would like to attend.")); E-mail from Eddie F. Gómez to Frederick Michel, Re: Fwd: Fwd: Document for publication [Myers revision needed] (Jan. 31, 2013, 8:06 AM) ("Fred - Myers approved publication of this document. I[']m just waiting for your final revision."), quoting E-mail from Eddie F. Gómez to shahtr@hotmail.com, Re: Document for publication [Myers revision needed], Jan. 15, 2013 (10:17:29AM EST) ("Please forward this to your boss and let me know if Myers name is compromised by any means in the document and I will make changes accordingly.").

the same material, likewise lists the ECM products as coming from ECM but does not list Myers as the source for any products.[153]

However, in a draft report apparently circulated only to Myers Industries,[154] a paper product and a paper-with-asphalt product were clearly listed as coming from Myers;[155] the only other paper-with-asphalt product discussed in that paper was from Western Pulps.[156] And in another draft of Michel and Gómez's work, a paper-with-asphalt product was listed as being from Western Pulps and a coconut coir pot was listed as being from Myers.[157]

In the final paper published in the *Polymer Degradation and Stability* journal, the ECM additives tested are clearly listed as coming from ECM BioFilms Inc.,[158] but the "Paper pulp + asphalt" and "Coconut coir" are not listed as coming from any particular manufacturer.[159] But as noted above, it is clear from various drafts and presentations of Gómez and Michel's research that they did test some paper-with-asphalt products, one from Myers Industries and another from Western Pulps, and a coconut coir product from Myers Industries. Indeed, testing Myers products was the goal of the funding that Myers provided to Michel and his lab.

In light of the foregoing evidence, it seems highly likely that at least one of the products in the finished paper is from Myers; and in any event, it's clear that Myers Industries provided substantial funding and was heavily involved in Michel and Gómez's overall research and that Tarang Shah of Myers was heavily involved in the day-to-day conduct of the research. These factors, as well as Michel's need to clear his presentation of the results with Myers

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[153] Eddie Francisco Gómez, Studies Conducted on: Biodegradability of Bio-Based Plastics and Polyurethane Foams Under Aerobic and Anaerobic Conditions; and Effects on Particle Size and Reactor Performance in Mesophilic Anaerobic Digesters Treating Cavitated Sewage Sludge (Ph.D. dissertation, 2013), draft included in E-mail from Frederick Michel to Frederick Michel, Re: eddie revise thesis (Oct. 9, 2013, 4:36 PM).

[154] Eddie Gómez & Frederick C. Michel, *Biodegradation of Bioplastics and Natural Fibers During Composting, Anaerobic Digestion and in Soil – Report I, A Report – Only for Myers Industries Inc. use, Attention Tarang Sha* [sic] [hereinafter Gómez & Michel internal report for Myers Industries], attached to E-mail from Eddie Gomez to michel.36@osu.edu, Re: FW: Myers Report 2011draftIEG.docx (Dec. 5, 2011, 11:25 AM).

[155] *See id.* at 7 tbl.2, 19–21, 25 tbl.3, 26 tbl.4, 28 tbl.9, 29 tbl.10, 36 tbl.27, 37 tbl.28.

[156] *See id.* at 7 tbl.2, 21, 25 tbl.3, 26 tbl.4, 32 tbl.15, 33 tbl.16.

[157] Eddie F. Gómez & Frederick C. Michel, Relative Biodegradation of Novel Plastics and Natural Fiber Composites During Composting, Anaerobic Digestion and Long-Term Soil Incubation, at 27 tbl.2, attached to E-mail from Eddie F. Gómez to Frederick Michel, Re: Paper Eddie to revise (Mar. 12, 2013, 1:36 PM).

[158] *See* Gómez & Michel, *supra* note 126, at 2585 tbl.2.

[159] *Id.*

and Shah, thus point to possible bias of the Gómez & Michel paper.

C. The Substantive Validity of Shane Frederick's Research

As discussed above, the probabilistic model suggests that substantively implausible positions should lead one to revise upwards one's estimate of the probability of bias. This result may be applied to the report of Shane Frederick, one of complaint counsel's experts.

Expert witness David Stewart explains the problems behind this research, so I merely summarize the problems here. We do not know the composition of the surveyed sample. Google Surveys provides limited demographic information about respondents, and there is limited protection against fraudulent demographic responses. Survey respondents are forced to answer the survey to be able to access other content, which leads to "disinterest bias." As a result, Shane Frederick's survey picked up many nonsensical answers, like one second, one nanosecond, two minutes, etc. Rather than remove nonsensical results from the sample, Shane Frederick coded them as half a year.

These methods are not only inconsistent with sound statistical practice but are also inconsistent with the requirements for statistical research in the *Manual for Complex Litigation*[160] or the Federal Rules of Evidence.[161] David Stewart's own survey, which has greater statistical validity, shows great heterogeneity among respondents, with less than a fifth of respondents responding that biodegradable products must degrade in a year or less.[162] But regardless of the validity of David Stewart's survey, what is clear is that a Google survey is inadequate to validate the APCO study and does not conform to sound statistical techniques. Such a survey cannot

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[160] MANUAL FOR COMPLEX LITIGATION § 11.493 (4th ed.).

[161] *See* Shari Seidman Diamond, *Reference Guide on Survey Research*, *in* REFERENCE MANUAL ON SCIENTIFIC EVIDENCE 359, 363–64 (Fed. Jud. Ctr., 3d ed. 2011), http://www.fjc.gov/public/pdf.nsf/lookup/SciMan3D01.pdf/$file/SciMan3D01.pdf (noting that, under Federal Rule of Evidence 703, the question with survey data is, "Was the poll or survey conducted in accordance with generally accepted survey principles, and were the results used in a statistically correct way?"); *cf.* Fla. Bar v. Went For It, Inc., 515 U.S. 618, 640–41 (1995) (Kennedy, J., dissenting) (critiquing offered statistical evidence for inconsistency with sound statistical technique).

[162] *See generally* David Stewart expert report.

provide the "*reliable* . . . evidence"[163] that the Administrative Procedure Act requires to impose a sanction in a formal proceeding, nor is it sufficient to validate other evidence as reliable.

Shane Frederick's use of such surveys are thus circumstantial evidence of bias.

VI. CONCLUSION

Taking bias and regulatory capture seriously requires appreciating the difficulty of finding direct evidence. The 17th-century English lawyer noted that it was hard to get satisfactory evidence of witchcraft, so that—because of the presumption of innocence—many undoubtedly guilty persons escaped.[164] Witchcraft isn't real, but agency bias and regulatory capture are. Because direct evidence is so rarely available, circumstantial evidence becomes highly important; this is why the law generally demands not mathematical certainty or indisputable proof, but merely a level of justified belief that exceeds a particular threshold. In this context, proof is inherently probabilistic.

Therefore, to root out bias, one must inevitably be on the lookout for factors that make bias more probable—factors that should make the observer more confident that bias exists. This is the essence of the probabilistic model discussed in this report. Well-known evidence of bias is invaluable; evidence of financial self-interest is one of the most widely recognized types of evidence of bias among law and economics scholars, as is evidence of lobbying.[165] But, as statisticians and economists understand, one can supplement this evidence with other factors that are more common in the presence of bias. Bayesian probabilistic theory dictates that, when a factor is more common in the presence of bias, its presence makes bias more likely. When such factors are present together with familiar evidence of bias like financial self-interest, the inference becomes stronger still.

This report has documented several aspects of the case that are evidence of bias: (1) the Commission's adoption of the Green Guides and initiation of this action against ECM based on intense

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[163] 5 U.S.C. § 556(d) (emphasis added); *see also* Steadman v. SEC, 450 U.S. 91 (1981).
[164] Alexander Volokh, *n Guilty Men*, 146 U. PA. L. REV. 173, 182–83 (1997).
[165] *See* Wiley, *supra* note 51.

lobbying by self-interested industry participants that compete with ECM; (2) the Commission's choice of the APCO over the Synovate study based on patently unconvincing reasoning; (3) the self-interest of complaint counsel's expert witness Stephen McCarthy; (4) the self-interest of Frederick Michel, who authored a paper that complaint counsel is relying on; and (5) the unconvincing statistical studies of complaint counsel's expert witness Shane Frederick.

When evidence of bias is present in any one case, it might easily be coincidental; but the chance of coincidence falls when evidence of bias is present in several instances. Moreover, this may be only scratching the surface, since the Commission has denied respondent ECM the ability to obtain further evidence of bias through discovery.[166]

The already discovered evidence of bias suggests that more might lurk below the surface—which suggests that further discovery is warranted. Moreover, it is incumbent on complaint counsel to rebut the inference of bias discovered thus far.

Alexander Volokh 6/18/04

Signature Date

[166] *See supra* note 45.

Appendix A

Alexander Volokh's CV

Alexander "Sasha" Volokh

avolokh@emory.edu
volokh@post.harvard.edu

Emory Law School
1301 Clifton Rd. NE
Atlanta, GA 30322

office: 404-712-5225
fax: 404-727-6820
cell: 626-354-4581

Academic Employment

Emory University School of Law:	Associate Professor (2012–present) (tenured as of 2014) Assistant Professor (2009–12)
University of Houston Law Center:	Visiting Assistant Professor (2008–09)
Georgetown University Law Center:	Visiting Associate Professor (2006–08)

Courses:

- Administrative Law (F'14, S'14, S'13, S'11, S'10, S'09)
- Constitutional Law (S'15, S'14)
- Torts (F'12, F'11, F'10)
- Law & Economics (S'13, F'08, F'07)
- Law & Economics of Antitrust (F'14, S'11, S'07)
- English Legal History (S'12)
- Current Issues in Privatization (seminar) (F'11, F'09, F'08, F'06)
- Law & Economics of the Environment (seminar) (S'08)

Committees: Clerkship Committee (2009–present; chair 2014–present)
Colloquium Committee (2010–12)

Education

Harvard University
Ph.D., Economics, 2004; J.D., 2003, *magna cum laude*
John M. Olin Fellow in Law & Economics
Executive Editor, *Harvard Law Review*

UCLA, 1993, *summa cum laude*
B.S., Mathematics/Economics
B.A., English/World Literature

Academic Articles (see also http://works.bepress.com/alexander_volokh)

- *Law: Economics of Its Public Enforcement*, *in* INTERNATIONAL ENCYCLOPEDIA OF THE SOCIAL AND BEHAVIORAL SCIENCES (James D. Wright ed., 2d ed. forthcoming 2015)
- *Privatization and Competition Policy*, *in* COMPETITION AND THE ROLE OF THE STATE (D. Daniel Sokol et al. eds., forthcoming Stanford Univ. Press 2014)
- *The New Private-Regulation Skepticism: Due Process, Non-Delegation, and Antitrust Challenges*, 37 HARV. J.L. & PUB. POL'Y 931 (2014)
- *Prison Accountability and Performance Measures*, 63 EMORY L.J. 339 (2014)
- Keynote article, *The Modest Effect of* Minneci v. Pollard *on Inmate Litigants* (Symposium: *Inside America's Criminal Justice System: The Supreme Court and the Rights of the Accused and the Incarcerated*), 46 AKRON L. REV. 287 (2013)
- *Privatization and the Elusive Employee-Contractor Distinction*, 46 UC DAVIS L. REV. 133 (2012)
- The *Prison Vouchers* series
  - *Prison Vouchers*, 160 U. PA. L. REV. 779 (2012)
  - *The Constitutional Possibilities of Prison Vouchers*, 72 OHIO ST. L.J. 983 (2011)
  - *Do Faith-Based Prisons Work?*, 63 ALA. L. REV. 43 (2011)
  - Book review, 25 J.L. & RELIGION 323 (2009–10) (reviewing WINNIFRED FALLERS SULLIVAN, PRISON RELIGION: FAITH-BASED REFORM AND THE CONSTITUTION (Princeton Univ. Press 2009))
- *Rationality or Rationalism? The Positive and Normative Flaws of Cost-Benefit Analysis*, 48 HOUS. L. REV. 79 (2011)
- *Property Rights and Contract Form in Medieval Europe*, 11 AM. L. & ECON. REV. 399 (2009) (peer-reviewed)
- The *Privatization and Lobbying* series
  - *Privatization and the Law and Economics of Political Advocacy*, 60 STAN. L. REV. 1197 (2008)

    abridged at LEGAL WORKSHOP (Mar. 17, 2009), http://legalworkshop.org/2009/03/17/privatization-and-the-law-and-economics-of-political-advocacy

    abridged as *The Effect of Privatization on Public and Private Prison Lobbies*, *in* 3 PRISON PRIVATIZATION: THE MANY FACETS OF A CONTROVERSIAL INDUSTRY 7 (Byron Eugene Price & John Charles Morris eds., Praeger 2012)
  - *Privatization, Free Riding, and Industry-Expanding Lobbying*, 30 INT'L REV. L. & ECON. 62 (2010) (peer-reviewed)

    companion paper: *Privatization, Free-Riding, and Industry-Expanding Lobbying: Additional Materials*, Emory Law & Econ. Research Paper No. 969789 and Georgetown Law & Econ. Research Paper No. 969789 (2007), *available at* http://ssrn.com/abstract=969789

- *Choosing Interpretive Methods: A Positive Theory of Judges and Everyone Else*, 83 NYU L. REV. 769 (2008)

  abridged at LEGAL WORKSHOP (Apr. 20, 2009), http://legalworkshop.org/2009/04/20/choosing-interpretive-methods-a-positive-theory-of-judges-and-everyone-else
- *Externalities, in* THE ENCYCLOPEDIA OF LIBERTARIANISM 162 (Ronald Hamowy ed., 2008)
- *The Appeal*, 103 MICH. L. REV. 1391 (2005) (reviewing FRANZ KAFKA, THE TRIAL (Breon Mitchell trans., Schocken Books 1998) (1925)) (co-authored with Alex Kozinski)
- Essays on Law and Economics (Economics Ph.D. dissertation, Harvard Univ., 2004)
- Case comment, *Reynolds v. Beneficial National Bank*, 288 F.3d 377 (7th Cir. 2002), 116 HARV. L. REV. 2702 (2003)
- *Judicial Reform*, 18 WORLD BANK RESEARCH OBSERVER 61 (2003) (peer-reviewed) (co-authored with Juan Carlos Botero, Rafael La Porta, Florencio López-de-Silanes, and Andrei Shleifer)
- *The Pitfalls of the Environmental Right to Know*, 2002 UTAH L. REV. 805
- Case comment, *Tahoe-Sierra Preservation Council v. Tahoe Regional Planning Agency*, 535 U.S. 302 (2002), 116 HARV. L. REV. 200, 321 (2002)
- Note, *A Tale of Two Systems: Cost, Quality, and Accountability in Private Prisons*, 115 HARV. L. REV. 1838, 1868–91 (2002) (Part III of *Developments in the Law—The Law of Prisons*, 115 HARV. L. REV. 1838 (2002))
- *A Brief Guide to School Violence Prevention*, 2 J.L. & FAM. STUD. 99 (2000)
- n *Guilty Men*, 146 U. PA. L. REV. 173 (1997)

  abridged in ANNALS OF IMPROBABLE RESEARCH, May/June 2000, at 6

  abridged as *Better That Ten Guilty Men...*, *in* BEYOND A REASONABLE DOUBT (Larry King ed., Phoenix Books 2006)

  excerpted in DAVID CRUMP ET AL., CRIMINAL LAW: CASES, STATUTES, AND LAWYERING STRATEGIES 258 (2d ed., LexisNexis 2010)

Works in Progress

- *The Emerging Global Law of Private Delegation*
- *Why Do Judges Read Statutes?*
- *Privatization and the Effectiveness of Monitoring Agencies*

Other Recent Employment

- Law clerk, U.S. Supreme Court, Justice Samuel Alito (2006)

- Law clerk, U.S. Supreme Court, Justice Sandra Day O'Connor (2005–06)
- Law clerk, Ninth Circuit Court of Appeals, Judge Alex Kozinski (2004–05)
- Law clerk, Dep't of the Interior, Office of the Solicitor (Summer 2003)
- Law clerk, Dep't of Justice, Office of Legal Counsel (Summer 2003)
- Law clerk, Inst. for Justice (Summer 2001)
- Policy analyst, Reason Pub. Pol'y Inst. & Reason Foundation (1994–98)
- Policy analyst, Competitive Enterprise Inst. (1993–94)

Other Professional and Academic Activities

- Referee for *American Journal of Political Science*, *Criminology*, *International Review of Law and Economics*, *Journal of Legal Studies*, *Journal of Policy Analysis and Management*, *Law and Social Inquiry*, and *Public Choice*
- Adjunct scholar, Reason Foundation (1998–present)
- Panel co-organizer and presider (*Law as Culture: Compensation, Punishment, and Impunity*), Int'l Congress on Medieval Studies, Kalamazoo, Mich. (May 8, 2014)
- Substitute taught three lectures of undergraduate Law & Economics class at Emory Univ. (Mar. 4, Apr. 8 & 10, 2014)
- Conference co-organizer and host, Georgia Medievalists Group, Emory Law Sch. (Feb. 22, 2014)
- Panel organizer and presider (*Law as Culture: Secular Punishment and Divine Retribution in Medieval Ireland*), Int'l Congress on Medieval Studies, Kalamazoo, Mich. (May 9, 2013)
- Panel organizer and presider (*Law as Culture: Legal Development and Social Change*), Int'l Congress on Medieval Studies, Kalamazoo, Mich. (May 11, 2012)
- Panel organizer and presider (*Law as Culture: Lords, Lands, and Property*), Int'l Congress on Medieval Studies, Kalamazoo, Mich. (May 12, 2011)
- Panel chair (*Law and Economics*), Southern Econ. Ass'n annual meeting, Atlanta, Ga. (Nov. 20, 2010)
- Lecturer, Technische Universität Dresden, Germany (Summer 2010)
- Panel organizer (*Law as Culture: Lordship, Profit, and Rationality*), Int'l Congress on Medieval Studies, Kalamazoo, Mich. (May 13, 2010)
- Co-founder, Emory Medieval Reading Group (2009–present)
- Faculty advisor, Emory Law School Federalist Society (2009–present)
- Faculty advisor, *Emory Law Journal* (2012–14)
- *h*-index: 10; Erdős number: 5; Sunstein number: 3; Bacon number: 2

Other Major Publications
(Non-academic policy studies)

- CHALLENGING GOVERNMENT-SPONSORED PRIVATE REGULATION OF COMPETITORS (Reason Found. Pol'y Brief No. 120, 2014)
- OVERPROTECTING PUBLIC EMPLOYEE PENSIONS: THE CONTRACT CLAUSE AND THE CALIFORNIA RULE (Fed. Soc. White Paper, 2013)
- ENVIRONMENTAL INFORMATION, THE TOXICS RELEASE INVENTORY, AND THE RIGHT TO KNOW (Reason Pub. Pol'y Inst., Pol'y Studies No. 246 and 247, 1998)
- RACE TO THE TOP: THE INNOVATIVE FACE OF STATE ENVIRONMENTAL MANAGEMENT (Reason Pub. Pol'y Inst., Pol'y Study No. 239, Feb. 1998)
- A BRIEF GUIDE TO RECYCLED MARKET DEVELOPMENT (Reason Pub. Pol'y Inst., Pol'y Brief, 1998) (co-written with Lynn Scarlett)
- SCHOOL VIOLENCE PREVENTION: STRATEGIES TO KEEP SCHOOLS SAFE (Reason Pub. Pol'y Inst., Pol'y Study No. 234, Oct. 1997) (co-written with Lisa Snell)
- PACKAGING, RECYCLING, AND SOLID WASTE (Reason Pub. Pol'y Inst., Pol'y Study No. 223, June 1997) (co-written with Lynn Scarlett, Richard McCann, and Robert Anex)
- PUNITIVE DAMAGES AND ENVIRONMENTAL LAW: RETHINKING THE ISSUES (Reason Found. Pol'y Study No. 213, Sept. 1996)
- ENVIRONMENTAL ENFORCEMENT: IN SEARCH OF BOTH EFFECTIVENESS AND FAIRNESS (Reason Found. Pol'y Study No. 210, Aug. 1996) (co-written with Roger Marzulla), *abridged in* AMERICAN VALUES: AN ENVIRONMENTAL VISION (Bonner R. Cohen et al. eds., 1996)
- RECYCLING AND DEREGULATION: OPPORTUNITIES FOR MARKET DEVELOPMENT (a three-study series)
  1. THE FDA VS. RECYCLING: HAS FOOD PACKAGING LAW GONE TOO FAR? (Reason Found. Pol'y Study No. 196, Oct. 1995)
  2. RECYCLING HAZARDOUS WASTE: HOW RCRA HAS RECYCLERS RUNNING AROUND IN CERCLAS (Reason Found. Pol'y Study No. 197, Oct. 1995)
  3. HOW GOVERNMENT BUILDING CODES AND CONSTRUCTION STANDARDS DISCOURAGE RECYCLING (Reason Found. Pol'y Study No. 202, Mar. 1996)

Presentations at Conferences, Workshops, and Elsewhere

- Emory Law Sch. Christian Legal Soc'y, Mar. 31, 2014
  Do Faith-Based Prisons Work?
- Next Generation of Antitrust Scholars Conference, NYU Sch. of Law, Jan. 17, 2014
  The New Private-Regulation Skepticism: Due Process, Nondelegation, and Antitrust Challenges
- Georgetown Univ. Law Ctr. Federalist Soc'y, Washington, D.C., Oct. 28, 2013
  Is Law and Economics a Right-Wing Conspiracy?

- Georgia Senate, Health and Human Services Cmte., Oct. 22, 2013
  Testimony, *The Constitutionality of the Patient Injury Act*
- Montgomery (Ala.) Federalist Soc'y, Oct. 17, 2013
  A Discussion on Private Prisons
- Ga. State Law School Federalist Soc'y, Oct. 9, 2013
  Discussant, John Kunich talk on *Nuclear Fusion & Free Market Environmentalism*
- Atlanta Federalist Soc'y, Sept. 17, 2013
  Panelist, *Supreme Court Update: Noteworthy Cases on the Horizon and Key Decisions from Last Spring*
- Emory Law Sch., Sept. 4, 2013
  Scholarly writing workshop
- Emory/UGa legal scholarship workshop, Athens, Ga., July 17, 2013
  Prison Accountability and Performance Measures
- Atlanta Objectivist Society conference, May 25, 2013
  Privatization and Its Discontents
- Greenville (S.C.) Federalist Soc'y, Feb. 28, 2013
  The Modest Effect of Minneci v. Pollard *on Inmate Litigants*
- Thrower Symposium (*Privatization: Managing Liability and Reassessing Practices in Local and International Contexts*), Emory Law Sch. (Feb. 7, 2013)
  Performance Measures and Private Prisons
- Thomas Goode Jones Law School Federalist Soc'y, Jan. 31, 2013
  Is Law and Economics a Right-Wing Plot?
- Birmingham (Ala.) Federalist Soc'y, Jan. 17, 2013
  The Modest Effect of Minneci v. Pollard *on Inmate Litigants*
- George Mason Univ. Law & Econ. Ctr., Arlington, Va., Dec. 12–13, 2012
  Discussant, *The Law and Economics of Privacy and Data Security*
- Ga. State Univ. Philosophy Dep't, Atlanta, Ga., Nov. 30, 2012
  Privatization and the Elusive Employee-Contractor Distinction
- Ga. State Univ., Ethics Center brownbag, Atlanta, Ga., Nov. 29, 2012
  Fiddling with Contracts; or, How Not to Help People
- Philosophy in Action (internet radio show), Nov. 7, 2012
  Taking Stock of Tort Law
- Emory Law Sch. Federalist Soc'y, Nov. 6, 2012
  Discussant, Rory Gray (Alliance Defending Freedom) talk on *Mt. Soledad Memorial Ass'n v. Trunk*, 629 F.3d 1099 (9th Cir. 2011)
- Mercer Law Sch., Macon, Ga., Oct. 24, 2012
  Is Law and Economics a Right-Wing Plot?
- Emory Law Sch., Sept. 15, 2012
  Scholarly writing workshop
- Federalist Soc'y Faculty Colloquium, Warrenton, Va., Apr. 20–21, 2012
  Discussant, *Government Ownership and the Private Sector*
- Vermont Law Sch. Symposium (*Optimizing Prison Privatization*), South Royalton, Vt., Mar. 23, 2012
  Keynote speaker, *The Unfulfilled Promise of Prison Privatization*

- SCOTUScast (Federalist Soc'y), Jan. 26, 2012
  Post-decision podcast on *Minneci v. Pollard*, 132 S. Ct. 617 (2012)
- SCOTUScast (Federalist Soc'y), Nov. 3, 2011
  Post-argument podcast on *Minneci v. Pollard*, 132 S. Ct. 617 (2012)
- George Mason Univ. Law & Econ. Ctr., Arlington, Va., Nov. 3–4, 2011
  Discussant, *The Law and Economics of Search Engines and Online Advertising*
- Yale Law Sch. Federalist Soc'y, New Haven, Conn., Oct. 27, 2011
  Prison Vouchers
- Emory Law Sch. Christian Legal Soc'y, Sept. 26, 2011
  Do Faith-Based Prisons Work?
- Emory Law Sch. Federalist Soc'y, Sept. 21, 2011
  Discussant, David Cortman (Alliance Defense Fund) talk on *Bronx Household of Faith v. Board of Educ.*, 650 F.3d 30 (2d Cir. 2011)
- Emory Law Sch., Sept. 14, 2011
  Scholarly writing workshop
- West Liberty Univ. Economics Club, Wheeling, W. Va., Aug. 18, 2011
  Privatization and Its Discontents
- Emory/UGa legal scholarship workshop, Athens, Ga., July 14, 2011
  Privatization and the Elusive Employee-Contractor Distinction
- Atlanta Objectivist Society conference, May 28, 2011
  Tort Law: Necessary or Evil?
- Prisoners Education and Assistance Project, U. Penn. Law Sch., Philadelphia, Penn., Feb. 25, 2011
  Prison privatization debate
- Georgia Medievalists Group, Oxford, Ga., Feb. 5, 2011
  Property Rights and Contract Form in Medieval Europe
- Southern Econ. Ass'n meeting, Atlanta, Ga., Nov. 20, 2010
  Prison Vouchers
- Hous. L. Rev. Symposium, Nov. 3, 2010
  Comments on Richard Revesz paper on cost-benefit analysis and the environment
- Emory Law Sch. Federalist Soc'y, Oct. 27, 2010
  Is Law and Economics a Right-Wing Plot? (with Joanna Shepherd Bailey)
- Emory Law Sch., Sept. 15, 2010
  Scholarly writing workshop (with Hanah Metchis Volokh)
- Int'l Congress on Medieval Studies, Kalamazoo, Mich., May 13, 2010
  Property Rights and Contract Form in Medieval Europe
- Am. Law & Econ. Ass'n meeting, Princeton Univ., Princeton, N.J., May 7–8, 2010
  Why Do Judges Read Statutes?
- Soc. for Envt'l L. & Econ. meeting, Emory Law Sch., Mar. 26, 2010
  Discussant, *Environmental Decisionmaking and Benefit-Cost Analysis*
- Thrower Symposium (*The New New Deal: From De-Regulation to Re-Regulation*), Emory Law Sch. (Feb. 11, 2010)
  Panelist, *Re-Regulation and Government Expansion: A Historical Perspective*
- Emory Political Science Dep't workshop, Feb. 4, 2010
  Why Do Judges Read Statutes?

- Southern Econ. Ass'n meeting, San Antonio, Tex., Nov. 22, 2009
  Why Do Judges Read Statutes?
- Emory Law Sch. Federalist Soc'y, Oct. 5, 2009
  Is Law and Economics Conservative?
- Emory Law Sch. faculty workshop, Sept. 16, 2009
  Prison Vouchers
- Am. Law & Econ. Ass'n meeting, Univ. of San Diego Law Sch., May 15, 2009
  Property Rights and Contract Form in Medieval Europe
- Law & Economics Workshop, Harvard Law Sch., Cambridge, Mass., Mar. 3, 2009
  Property Rights and Contract Form in Medieval Europe
- Univ. of Houston Law Ctr. faculty workshop, Feb. 23, 2009
  Prison Vouchers
- Law & Economics Workshop, UT-Austin Law Sch., Feb. 9, 2009
  Why Do Judges Read Statutes?
- Liberty & Current Issues (Inst. for Humane Stud.), Catholic Univ., Washington, D.C., July 27–29, 2008
  The Limits of Privatization
- Am. Law & Econ. Ass'n meeting, Columbia Law Sch., New York, N.Y., May 16, 2008
  Privatization, Free-Riding, and Industry-Expanding Lobbying
- Int'l Studies Ass'n conference, San Francisco, Calif., Mar. 28, 2008
  The Economic Theory of Privatization
- George Washington Law Sch. faculty workshop, Washington, D.C., Feb. 20, 2008
  Privatization and the Law and Economics of Political Advocacy
- Property Law and Transactions in an Age of Globalization (Ctr. on Property, Citizenship, & Social Enterpreneurism), Chapman Law Sch., Orange, Calif., Feb. 16, 2008
  Property Rights and Contract Form in Medieval Europe
- Vanderbilt Law Sch. faculty workshop, Nashville, Tenn., Feb. 12, 2008
  Choosing Interpretive Methods: A Positive Theory of Judges and Everyone Else
- Washington Univ. Law Sch. faculty workshop, St. Louis, Mo., Feb. 5, 2008
  Choosing Interpretive Methods: A Positive Theory of Judges and Everyone Else
- Emory Law Sch. faculty workshop, Jan. 31, 2008
  Choosing Interpretive Methods: A Positive Theory of Judges and Everyone Else
- Duke Law Sch. faculty workshop, Durham, N.C., Dec. 10, 2007
  Choosing Interpretive Methods: A Positive Theory of Judges and Everyone Else
- Univ. of Pennsylvania Law Sch. faculty workshop, Philadelphia, Penn., Nov. 15, 2007
  Choosing Interpretive Methods: A Positive Theory of Judges and Everyone Else
- Georgetown Law Sch., Washington, D.C., Nov. 14, 2007
  Panelist on Fourth Amendment issues from journal write-on competition
- Northwestern Law Sch. faculty workshop, Chicago, Ill., Oct. 31, 2007
  Choosing Interpretive Methods: A Positive Theory of Judges and Everyone Else
- Georgetown Univ. Law Ctr. faculty workshop, Washington, D.C., Sept. 20, 2007
  Choosing Interpretive Methods: A Positive Theory of Judges and Everyone Else

- USC Law Sch. faculty workshop, Los Angeles, Calif., Sept. 17, 2007
  Choosing Interpretive Methods: A Positive Theory of Judges and Everyone Else
- UCLA Law Sch. faculty workshop, Sept. 14, 2007
  Choosing Interpretive Methods: A Positive Theory of Judges and Everyone Else
- Global Capitalism and Personal Freedom in the 21st Century (Глобальный капитализм и личная свобода в XXI веке) (Cato.ru), Alushta, Ukraine, Sept. 2–8, 2007
  The Legal Foundations of Capitalism (*Правовые основы капитализма*) (Russian)
  Twenty-Five Years of Environmental Legislation: What Americans Have Learned (*Двадцать-пять лет законодательства об охране окружающей среды: чему научились американцы*) (Russian)
- Third Annual Conglomerate Junior Scholars Workshop (online), July 9, 2007; see http://www.theconglomerate.org/2007/07/conglomerate--1.html
  Privatization and the Law and Economics of Political Advocacy
- Georgetown Univ. Law Ctr. summer faculty workshop, Washington, D.C., July 3, 2007
  Choosing Interpretive Methods: A Positive Theory of Judges and Everyone Else
- America's Future Found., Washington, D.C., June 20, 2007
  Panelist, *Thinkers vs. Doers Roundtable*
- Stanford/Yale Junior Faculty Forum, Stanford Law Sch., Stanford, Calif., May 19, 2007
  Property Rights and Contract Form in Medieval Europe
- Am. Law & Econ. Ass'n annual meeting, Harvard Law Sch., Cambridge, Mass., May 5, 2007
  Privatization and the Effectiveness of Monitoring Agencies
- Law & Economics Workshop, Harvard Law Sch., Cambridge, Mass., Apr. 12, 2007
  Privatization and the Effectiveness of Monitoring Agencies
- Privatization of U.S. National Security (Geo. Inst. for Int'l L. & Politics), Georgetown Univ., Washington, D.C., Mar. 20, 2007
  The Economic Theory of Privatization
- Law & Economics workshop, George Washington Law Sch., Washington, D.C., Mar. 19, 2007
  Privatization and the Law and Economics of Political Advocacy
- Georgetown Univ. Law Ctr. faculty workshop, Washington, D.C., Feb. 13, 2007
  Privatization and the Law and Economics of Political Advocacy
- Federalist Soc'y Faculty Conference, Washington, D.C., Jan. 5, 2007
  Privatization and the Law and Economics of Political Advocacy
- Georgetown Univ. Law Ctr. Federalist Soc'y, Washington, D.C., Oct. 3, 2006
  Privatization and the Law and Economics of Political Advocacy
- Georgetown Univ. Law Ctr. faculty workshop, Washington, D.C., Apr. 24, 2006
  Privatization and the Effectiveness of Monitoring Agencies
- Am. Enter. Inst. for Pub. Pol'y Res., Washington, D.C., May 26, 2004
  Did Workers Pay for the Expansion of Products Liability Law?
- Cornell Cos. meeting, Houston, Tex., Apr. 14, 2003
  A Tale of Two Systems: Cost, Quality, and Accountability in Private Prisons

- Ass'n of Private Correctional & Treatment Orgs. meeting, Charlotte, N.C., Jan. 12, 2003
  A Tale of Two Systems: Cost, Quality, and Accountability in Private Prisons
- Beyond Columbine (Independence Inst.), Denver, Colo., Aug. 20, 1999
  School Violence Prevention: Strategies to Keep Schools Safe
- Inst. for Humane Studs. conference, Los Angeles, Calif., June 20, 1999
  Talk on environmental policy
- Inst. for Humane Studs. conference for college student newspaper editors, Washington, D.C., Apr. 18, 1999
  Talk on environmental policy
- Liberty & Society (Inst. for Humane Studs.), Pitzer College, Claremont, Calif., June 25, 1998
  Talk on environmental policy
- Le Lycée Français de Los Angeles, commencement ceremony, June 15, 1998
  Talk on education policy
- La Cumbre Country Club, Santa Barbara, Calif., Mar. 4, 1998
  Talk on school violence
- San Diego Libertarian Party meeting, Jan. 10, 1998
  Race to the Top: The Innovative Face of State Environmental Management
- Race to the Top (Reason Pub. Pol'y Inst. & Nat'l Envt'l Pol'y Inst.), Washington, D.C., Nov. 20, 1997
  Introductory comments at conference
- Instituto Libertad y Desarrollo meeting, Santiago, Chile, Nov. 12, 1997
  25 Años de Regulación Ambiental en EE.UU.: Lecciones para Chile (Spanish)
- Fundación Alberdi public meeting, Mendoza, Argentina, Nov. 10, 1997
  Talk on recycling and solid waste
- Medio Ambiente Urbano, Fundación de Empresas' III Congreso Internacional, Córdoba, Argentina, Nov. 7, 1997
  Talk on recycling and solid waste
- Electronic Industries Ass'n meeting, San Francisco, Calif., Oct. 6, 1997
  Talk on advance disposal fees
- Alamar/Hope Ranch Republican Women's Club, Santa Barbara, Calif., May 16, 1997
  Talk on recycling and solid waste
- Crescenta Valley High School (La Crescenta, Calif.), Mar. 18, 1997; Oct. 31, 1997; Feb. 17, 1998; Apr. 16, 1998
  Talks on literature, poetry, and Advanced Placement English Literature exam preparation
- U.S. Environmental Protection Agency, Office of Enforcement and Compliance Assurance, San Francisco, Calif., March 17, 1997
  Testimony on the National Performance Measures Strategy
- A Safe Environment for Big Cities on the Threshold of the 21st Century (Экологически безопасная среда обитания больших городов на пороге XXI века) (UrbanEco 97 (American-Russian conference)), San Diego, Calif., Feb. 4–6, 1997
  Twenty-Five Years of Environmental Legislation: What Americans Have Learned

(*Двадцать-пять лет законодательства об охране окружающей среды: чему научились американцы*) (Russian)

- Le Lycée Français de Los Angeles, Dec. 17, 1996
  Talk on environmental policy
- Los Angeles City Council, Dec. 11, 1996
  Testimony on environmental justice
- International Polyester Week, Jamesburg, N.J., Oct. 7–10, 1996
  The FDA vs. Recycling: Has Food Packaging Law Gone Too Far?
- Los Angeles City Planning Comm'n, Aug. 8, 1996
  Testimony on environmental justice
- Steel Mill Wastes and By-Products conference, Pittsburgh, Penn., June 24–26, 1996
  Men of Steel, Regulations of Kleenex: How RCRA Has Recyclers Running Around in CERCLAs
- North Hollywood High School Zoo Magnet Center, Apr. 23, 1996
  Talk on environmental policy
- Liberty Tree Convention (Repub. Liberty Caucus), Santa Barbara, Calif., Nov. 11, 1995
  Moderated panel on affirmative action
- Conversations About Freedom (The New York Society for International Affairs, Inc. and Libertad, Inc.), The Aspen Institute, Wye, Md., Oct. 30, 1994
  Panelist, *Round Table Conversation: The Media, the Arts and Entertainment: The Need to Preserve Freedom*

Minor Non-Academic Activities
(Popular Press, Interviews, Media Appearances, etc.)

Privatization / Public Employees

- *Pension Protection and the Detroit Bankruptcy*, REASON.ORG, Apr. 2, 2014, http://reason.org/news/show/volokh-detroit-pension-protection
- *Eliminate the State's 'Rule' for Pensions?*, L.A. DAILY J. (& S.F. DAILY J.), Feb. 21, 2014, at 1
- *The Constitutional Protection of Public-Employee Pensions*, REASON.ORG, Feb. 19, 2014, http://reason.org/news/show/pensions-california-rule
- *Philosophical Objections to Prison Privatization*, REASON.ORG, Nov. 26, 2013, http://reason.org/news/show/israeli-private-prison-ruling
- *Privatization and the Constitutional Delegation of Coercive Power in Germany*, REASON.ORG, Oct. 30, 2013, http://reason.org/news/show/privatization-delegation-germany
- *The Revival of the Contract Clause*, REASON.ORG, Sept. 25, 2013, http://reason.org/news/show/pensions-contract-clause
- *A New Private Delegation Doctrine?*, REASON.ORG, Aug. 1, 2013, http://reason.org/news/show/private-delegation-doctrine-amtrak
- *Privatized Regulation and Antitrust*, REASON.ORG, July 1, 2013, http://reason.org/news/show/privatized-regulation-and-antitrust

- *Implications of the Louisiana Supreme Court Voucher Ruling*, REASON.ORG, June 4, 2013, http://reason.org/news/show/louisiana-supreme-court-vouchers
- *Are Federal Contractors Immune from Tort Suits Just Because the Government Is?*, REASON.ORG, May 9, 2013, http://reason.org/news/show/government-contractor-immunity
- *Recent Developments in the Federal Civil-Rights Liability of Federal Private Prisons*, in REASON FOUNDATION, ANNUAL PRIVATIZATION REPORT 2013 (Leonard Gilroy & Harris Kenny eds.), May 6, 2013, http://reason.org/news/show/apr-2013-federal-liability-prisons
- *Supreme Court Clarifies Standards for Qualified Immunity in Civil Rights Cases—Or Does It?*, REASON.ORG, Apr. 5, 2013, http://reason.org/news/show/privatization-qualified-immunity
- *What a Recent Labor-Relations Decision Teaches Us About the Meaning of "Public" and "Private"*, REASON.ORG, Mar. 21, 2013, http://reason.org/news/show/nlrb-public-private
- *Supreme Court Antitrust Ruling Supports Public-Private Neutrality, Reduces Barriers to Privatization*, REASON.ORG, Feb. 21, 2013, http://reason.org/news/show/scotus-antitrust-privatization
- appeared on WGCL-TV (CBS, Atlanta) on Atlanta public transit privatization, Sept. 27, 2012
- interviewed on a radio station in San Antonio on school violence, May 4, 1999
- *School Choice Could Help Alleviate Violence*, WALL ST. J., Apr. 29, 1999
- interviewed on a radio station in Lincoln, Neb., on school violence, Dec. 12, 1997
- *Environmental Regulation, in* WILLIAM D. EGGERS ET AL., PRIVATIZATION 1997: A COMPREHENSIVE REPORT ON CONTRACTING, PRIVATIZATION, AND GOVERNMENT REFORM
- *Private Consultants Clean Up Brownfields: State Environmental Agencies Lighten Their Loads*, PRIVATIZATION WATCH, Nov. 1997
- *"Welcome Back, Otter": Private-Sector Species Preservation*, PRIVATIZATION WATCH, Oct. 1997
- *Water-Users Take Control of Montana Conservation Projects*, PRIVATIZATION WATCH, Sept. 1997
- *Massachusetts Moves Toward Environmental Compliance Privatization*, PRIVATIZATION WATCH, Aug. 1996
- *Southern California Air District Partially Privatizes Permitting Program*, PRIVATIZATION WATCH, Aug. 1996
- *Jersey City Privatizes Water Department*, PRIVATIZATION WATCH, July 1996
- *Highway Departments Move Ahead with Performance Standards*, PRIVATIZATION WATCH, June 1996
- *States Encourage Private Environmental Compliance*, PRIVATIZATION WATCH, June 1996
- *FDA May Contract Out Drug and Device Approvals*, PRIVATIZATION WATCH, July 1995

Environment / Solid Waste and Recycling

- *Is Recycling Good or Bad—or Both?*, CONSUMERS' RES., Sept. 1997

- *Recycling and Deregulation: Opportunities for Market Development*, RESOURCE RECYCLING, Sept. 1996
- *FDA Rules Impede Recycling*, PLASTICS NEWS, May 20, 1996
- *Environment Might Benefit by Easing Waste Rule*, PATRIOT (Harrisburg, Pa.), May 17, 1996, *also appeared in* EVENING NEWS (Harrisburg, Pa.), May 17, 1996
- *Food Packaging Needs Speedier FDA OKs*, PLASTICS NEWS, May 13, 1996
- *Is the Government Discouraging Recycling?*, DAILY J. (Devils Lake, N.D.), Apr. 22, 1996, *also appeared in* INDEPENDENT (Gallup, N.M.), Apr. 25, 1996; BG NEWS (Bowling Green, Ohio), Apr. 26, 1996; MARTINEZ (CALIF.) NEWS-GAZETTE, Aug. 8, 1996
- *Bureaucracy Can Be a Barrier to Use of Recycled Materials*, PLASTICS NEWS, Mar. 25, 1996
- *Can Anybody Understand Our Hazardous Waste Law?*, SANTA BARBARA NEWS-PRESS, Jan. 21, 1996
- *Vague Food Packaging Laws Hurt Recycling*, FROZEN FOOD AGE, Dec. 1995
- *Intervention Is No Friend of the Earth*, ROANOKE (VA.) TIMES, Nov. 26, 1995, *also appeared in* BRYAN–C. STATION (TEX.) EAGLE, Oct. 27, 1995; DAILY PROGRESS (Charlottesville, Va.), Nov. 26, 1995; MONROE (MICH.) EVENING NEWS, Dec. 1, 1995; ANTELOPE VALLEY DESERT MAILER NEWS, Jan. 23, 1996

Environment / General

- *Shades of Green*, REASON, May 1998
- interviewed in Félix Ibáñez S., *Libre Mercado: Protector del Medio Ambiente* (Spanish), EL MERCURIO (Santiago, Chile), Nov. 19, 1997, at B26
- *25 Años de Regulación Ambiental en EE.UU.: Lecciones para Chile* (Spanish), Programa de Medio Ambiente Libertad y Desarrollo, Temas Ambientales No. 8, Oct. 1997
- *Carrots over Sticks*, WASH. MONTHLY, June 1997
- *Privileges and Immunities*, CAROLINA BUS., Feb. 1997
- *The "Regulatory Cuckoo Land,"* ORANGE COUNTY REG., Oct. 27, 1996, *also appeared in* J. COM., Oct. 24, 1996; BRIDGE NEWS, Oct. 17, 1996; EVANSVILLE (IND.) PRESS, Oct. 23, 1996; APPLETON (WIS.) POST-CRESCENT, Oct. 26, 1996; BIRMINGHAM (ALA.) NEWS, Oct. 27, 1996; DAILY PRESS (Newport News, Va.), Oct. 27, 1996
- *Environmental Goals Suffer When Right-to-Know Laws Go Wrong*, GREATER MILWAUKEE BUS. J., Oct. 5, 1996
- *What to Do About Punitive Damages*, INVESTOR'S BUS. DAILY, Aug. 7, 1996
- spoke on the environment to high school students, North Hollywood High School Zoo Magnet Center, Apr. 23, 1996
- *Tastes Great! More Polluting!*, REASON, Jan. 1996, *also appeared in* L.A. DAILY J., Dec. 14, 1995; S.F. DAILY J., Dec. 14, 1995
- *Nature's Nature*, REASON, July 1995 (reviewing GREGG EASTERBROOK, A MOMENT ON THE EARTH: THE COMING AGE OF ENVIRONMENTAL OPTIMISM (1995))
- *How Green Is Our Valley?*, REASON, Mar. 1995 (reviewing PETER MARSHALL, NATURE'S WEB: RETHINKING OUR PLACE ON EARTH (1st U.S. ed. 1994), WALLACE KAUFMAN, NO TURNING BACK: DISMANTLING THE FANTASIES OF ENVIRONMENTAL THINKING (1994), and CHARLES T. RUBIN, THE GREEN CRUSADE: RETHINKING THE ROOTS OF ENVIRONMENTALISM (1994))

- *Ban Chlorine? Let's Hope EPA Steers Clear of Fuzzy Logic*, KNIGHT-RIDDER FIN. NEWS, Sept. 9, 1994
- *Jefferson Group Weighs Risk*, CEI UPDATE, Feb. 1994
- *Don't Apply Human Morality to Amorality of Nature*, UCLA DAILY BRUIN, Jan. 19, 1990
- see also articles under "Privatization"

Food and Drug Law

- *Feel a Heart Attack Coming? Go to France*, WALL ST. J., Aug. 2, 1994, *reprinted in* CPR INNOVATOR, 4th Quarter 1994
- *Pruning the FDA*, NAT'L REV., Aug. 11, 1997
- *Software Pirates*, REASON, Nov. 1997
- appeared on the show *Pork* on the TV channel *America's Talking*, Dec. 25, 1995
- *Clinical Trials: Beating the FDA in Court*, REASON, May 1995
  - *Food und Drang Administration* (response to letters), REASON, Aug./Sept. 1995
- *Comparable Hurt*, REASON, Feb. 1995
- *Left to Their Own Devices*, REASON, Jan. 1995
- *Leaving Us to Our Own Devices*, RT: J. RESPIRATORY CARE PRAC., Dec./Jan. 1995
- *Kessler's Clever Maneuvers "Saved" U.S. Drug Regulator*, BRIDGE NEWS, Dec. 10, 1996, *also appeared in* SUNDAY PRESS DISPATCH (Victorville, Calif.), Dec. 15, 1996; HIGH POINT (N.C.) ENTERPRISE, Dec. 16, 1996; ASHEVILLE (N.C.) CITIZEN-TIMES, Dec. 16, 1996; SUNDAY SUN-JOURNAL (Lewiston, Me.), Dec. 22, 1996
- *Case of Sour Grapes Shows Suing the FDA Doesn't Pay*, KNIGHT-RIDDER FIN. NEWS, Jan. 4, 1996
- *Without a Cure*, DEFENDER, July 1995
- *Is the FDA Saving or Costing Lives?*, OAKLAND TRIB., Apr. 18, 1995
- *Udder Nonsense*, CEI UPDATE, Apr. 1994
- see also food packaging articles under "Environment / Solid Waste and Recycling"
- see also article under "Privatization"

Tobacco and Alcohol

- *Kessler's a Drag*, WALL ST. J., Aug. 8, 1995, *reprinted in* ANNETTE T. ROTTENBERG, ELEMENTS OF ARGUMENT: A TEXT AND READER (5th ed. 1996)
- *Rights Advocates Should Toast "44 Liquormart" Ruling*, L.A. DAILY J., June 18, 1996, *also appeared in* DAILY RECORDER (Sacramento, Calif.), July 2, 1996
- *Ad Bans Are a Bad Idea*, SAN MARINO (CALIF.) TRIB., Aug. 31, 1995, *also appeared in* CHICO (CALIF.) ENTERPRISE-REC., Sept. 3, 1995; ROME (GA.) NEWS-TRIB., Sept. 10, 1995; PASADENA (CALIF.) WKLY., Sept. 15, 1995; HERALD SUNDAY (Portsmouth, N.H.), Jan. 14, 1996
- interviewed on WJR radio (Detroit, Mich.), Aug. 8, 1995
- *Lighten Up*, CEI UPDATE, July 1994
- *Safety Is a Relative Thing for Cars; Why Not for Cigarettes?*, ADVERTISING AGE, Jan. 31, 1994
- *Alcohol and the Heart: A Review of the Literature, in* Petition of the Competitive Enterprise Institute to the Bureau of Alcohol, Tobacco and Firearms for a rule allowing alco-

holic beverage labels to carry statements on the health benefits of moderate consumption (May 9, 1995) (co-written with Sam Kazman and Ben Lieberman)

Education / Race / Affirmative Action

- *Law Review Has Strong Leadership*, HARV. L. RECORD, Oct. 23, 2003
- *Law Review Alums Respond to Law Review Alums*, HARV. L. RECORD, Oct. 9, 2003 (co-written with I. Glenn Cohen, Adam Raviv, and Matthew Stephenson)
- *Relax, Then Respond Intelligently to Fielding*, HARV. L. RECORD, Feb. 9, 2001
- *Quotas in India Have Yet to Create Harmony*, L.A. DAILY J., Nov. 5, 1996
- *Mr. Smith Goes to Sacramento*, DEFENDER, Jan./Feb. 1996
- interviewed about race relations at universities, *Which Way, L.A.?*, KCRW radio (Los Angeles, Calif.), Nov. 1, 1995
- *Students Can, and Should, Get Their Money Refunded*, UCLA DAILY BRUIN, Oct. 2, 1995
- *How Race Adds Up for UCLA Entry*, L.A. TIMES, July 18, 1995 (co-written with Shechao Charles Feng), *reprinted in* J. BLACKS HIGHER EDUC., Autumn 1995
- *Chicana/o Vandalism!*, UCLA DAILY BRUIN, May 18, 1993
- *Syllabus Controversy Unjustified*, UCLA DAILY BRUIN, Apr. 22, 1993
- intern, ExCEL (Excellent through Choice in Education League) (Spring 1992)
- see also articles under "Privatization"

Libertarianism / Free Market / Property Rights

- Interview, KOSMOS, Oct. 29, 2010, http://www.kosmosonline.org/group-post/interview-sasha-volokh
- *Cult of Capitalism Deserves More Than Ginn's Short Shrift*, HARV. L. RECORD, Sept. 14, 2001
- *Letter Author Knocks on Matt Wood*, HARV. L. RECORD, Nov. 10, 2000
- *As Martin Luther King Jr. Knew, Freedom Drives a Car*, BRIDGE NEWS, Jan. 15, 1997, *also appeared in* CORVALLIS (OR.) GAZETTE-TIMES, Jan. 24, 1997
- *Money Fuels Freedom at the Core of American Society*, UCLA DAILY BRUIN, Oct. 3, 1996
- *Quasimodo, Property and Sanctuary*, MIDDLETOWN (OHIO) J., Aug. 8, 1996, *also appeared in* MIAMI (OKLA.) NEWS-REC., July 30, 1996; OSHKOSH (WIS.) NW., Aug. 4, 1996; SAN MATEO COUNTY TIMES, Aug. 12, 1996; DAILY REV. (Hayward, Calif.), Aug. 12, 1996; TRI-VALLEY HERALD (Pleasanton & Danville, Calif.), Aug. 12, 1996; ARGUS (Fremont, Calif.), Aug. 12, 1996; NIAGARA GAZETTE (Niagara Falls, N.Y.), Aug. 13, 1996; TEX. CITY SUN, Aug. 18, 1996; CULPEPPER (VA.) STAR-EXPONENT, Aug. 19, 1996; VALLEY MORNING STAR (Harlingen, Tex.), Aug. 25, 1996
- 1995 FEDERAL DISASTER CALENDAR: A MONTHLY COMPENDIUM OF GOVERNMENT-SPONSORED FIASCOS, FROM THE IDIOTIC TO THE CATASTROPHIC (Competitive Enter. Inst. 1994)
- THE VIRTUAL HAND: CEI'S FREE-MARKET GUIDE TO THE INFORMATION SUPERHIGHWAY (Competitive Enter. Inst. 1994)

Guns

- *Lock and Load: Protecting Individual Rights, Preserving Freedom, Saving Lives*, HARV. INDEP., Nov. 14, 2002

- *Target Shooting Club Founder Urges More Gun Debates*, HARV. L. RECORD, Sept. 12, 2002
- interviewed on *Simply Put*, Bloomberg radio network, Apr. 27, 2002
- founder and president, Harvard Law School Target Shooting Club (2001–03)

Free Speech

- *Paper* Lion: *Why the Supreme Court Must Overturn TV Restrictions*, E-NET, July 24, 1996
- *Censoring the Louvre? Congress Just Might*, E-NET, Dec. 20, 1995
- see also items under "Tobacco and Alcohol"

Religion

- *Faithful Incentives*, REASON, Nov. 1997
- *Hollywood, God Don't Mix*, CINCINNATI ENQUIRER, Sept. 28, 1997, *also appeared in* BRIDGE NEWS, Sept. 19, 1997; JUNEAU EMPIRE, Sept. 24, 1997; ASHEVILLE (N.C.) CITIZEN-TIMES, Sept. 24, 1997; STAMFORD (CT.) ADVOCATE, Sept. 26, 1997; GREENWICH (CT.) TIME, Sept. 26, 1997; KENTUCKY ENQUIRER, Sept. 28, 1997; DAILY RECORD (Morristown, N.J.), Sept. 28, 1997; TALLAHASSEE DEMOCRAT, Sept. 28, 1997; SAN BERNARDINO (CALIF.) SUN, Oct. 12, 1997

Russia / Soviet Union

- *Ushka Comes to Shove*, NEW REP., Sept. 13, 1993
- *America Offers New Beginning*, UCLA DAILY BRUIN, Feb. 5, 1993
- *Gorbachev Doesn't Deserve Peace Prize*, UCLA DAILY BRUIN, Oct. 22, 1990
- *Glasnost: A Volokh's View*, LE PETIT JOURNAL, Apr. 1988, p. 15

Art & Literature

- ALEXANDER PUSHKIN: NEW TRANSLATIONS (trans. from Russian to English, 1999)
- TROIS ESSAIS SUR CHALIAPINE (trans. from Russian to French, 1998)
- performed in UCLA English Dept.'s marathon reading of Charles Dickens's *Bleak House*, May 9, 1997
- THE OCCASIONAL SCREENFUL, online poetry journal (co-edited with Eugene Volokh, 1995–96)
- performed in Gilbert & Sullivan's *Patience*, Georgetown Gilbert & Sullivan Soc., Mar. 1994 & Apr. 11, 2007
- co-founder, Univ. of Md. Chaucer Reading Group (1993–94)
- *Song of the Young Paleontologist*, 262 SCIENCE 1511 (n.s.) (1993)
- WESTWIND: UCLA'S JOURNAL OF THE ARTS (senior ed. & contributor, vol. 36, 1993)
- president, UCLA Chaucer Reading Group (1991–93)

Miscellaneous

- co-blogger on THE VOLOKH CONSPIRACY, volokh.com, 2002–present
- Graduate Summer Research Fellow, Inst. for Humane Studs. (Summer 2002)
- appeared on JEOPARDY! (ABC television), Nov. 9, 1996
- *Old Friend Provides Lasting Words of Wisdom*, UCLA SUMMER BRUIN, July 24–30, 1995
- newsletter editor, UCLA Regents Scholars Society (1992–93)

- parliamentarian, Bruin Republicans (1992–93)
- grader, UCLA Dep't of Mathematics (1992–93)
- *Viewpoint: Who's* [sic] *Point of View?*, UCLA DAILY BRUIN, Sept. 29, 1992
- membership director, Bruin Republicans (1991–92)
- lecture note taker, Associated Students UCLA (1990–92)
- *A Brief History of Greek Philosophy*, LE PETIT JOURNAL, May 1990, p. 10

Languages

- Fluent in French and Russian
- Somewhat fluent in Spanish and German
- Reading knowledge of Italian, Latin, Middle English, and Esperanto

RESPONDENT EXHIBIT RX-I

SUBPOENA DUCES TECUM

Provided by the Secretary of the Federal Trade Commission, and Issued Pursuant to Commission Rule 3.34(b), 16 C.F.R. § 3.34(b)(2010)

1. TO

Dr. Stephen McCarthy
Dept. of Plastics Engineering
University of Massachusetts Lowell
One University Avenue, Office, Ball 207
Lowell, MA 01854

2. FROM

UNITED STATES OF AMERICA
FEDERAL TRADE COMMISSION

This subpoena requires you to produce and permit inspection and copying of designated books, documents (as defined in Rule 3.34(b)), or tangible things, at the date and time specified in Item 5, and at the request of Counsel listed in Item 9, in the proceeding described in Item 6.

3. PLACE OF PRODUCTION

Emord & Associates, P.C.
3210 South Gilbert Road, Suite 4
Chandler, AZ 85286

4. MATERIAL WILL BE PRODUCED TO

Peter Arhangelsky

5. DATE AND TIME OF PRODUCTION

July 25, 2014, 5:00 PM EST

6. SUBJECT OF PROCEEDING

In the matter of ECM BioFilms, Inc., Docket No. 9358

7. MATERIAL TO BE PRODUCED

See Attached Schedule A for description of all documents and materials.

8. ADMINISTRATIVE LAW JUDGE

Chief Administrative Law Judge
D. Michael Chappell

Federal Trade Commission
Washington, D.C. 20580

9. COUNSEL AND PARTY ISSUING SUBPOENA

Jonathan W. Emord, Peter Arhangelsky, Eric Awerbuch
Emord & Associates, P.C. for Respondent, ECM BioFilms, Inc.

DATE SIGNED

July 7, 2014

SIGNATURE OF COUNSEL ISSUING SUBPOENA

GENERAL INSTRUCTIONS

APPEARANCE

The delivery of this subpoena to you by any method prescribed by the Commission's Rules of Practice is legal service and may subject you to a penalty imposed by law for failure to comply.

MOTION TO LIMIT OR QUASH

The Commission's Rules of Practice require that any motion to limit or quash this subpoena must comply with Commission Rule 3.34(c), 16 C.F.R. § 3.34(c), and in particular must be filed within the earlier of 10 days after service or the time for compliance. The original and ten copies of the petition must be filed before the Administrative Law Judge and with the Secretary of the Commission, accompanied by an affidavit of service of the document upon counsel listed in Item 9, and upon all other parties prescribed by the Rules of Practice.

TRAVEL EXPENSES

The Commission's Rules of Practice require that fees and mileage be paid by the party that requested your appearance. You should present your claim to counsel listed in Item 9 for payment. If you are permanently or temporarily living somewhere other than the address on this subpoena and it would require excessive travel for you to appear, you must get prior approval from counsel listed in Item 9.

A copy of the Commission's Rules of Practice is available online at http://bit.ly/FTCRulesofPractice. Paper copies are available upon request.

This subpoena does not require approval by OMB under the Paperwork Reduction Act of 1980.

FTC Form 70-E (rev. 1/97)

Renewed Resp. Mot. for Leave
Exh. RX-I

SCHEDULE "A" TO SUBPOENA DUCES TECUM DIRECTED TO

DR. STEPHEN MCCARTHY

INSTRUCTIONS

A. Documents must be delivered to Counsel for Respondent at the following address:

Emord & Associates, P.C.,
3210 South Gilbert Road, Suite 4
Chandler, AZ 85286

B. A complete copy of each document should be submitted even if only a portion of the document is within the terms of the numbered request. The document shall not be edited, cut or expunged and shall include all covering letters and memoranda, transmittal slips, appendices, tables or other attachments.

C. All information submitted shall be clearly and precisely identified as to the numbered request(s) to which it is responsive. Pages in the submission should be numbered consecutively, and each page should be marked with a unique "Bates" document tracking number.

D. Documents covered by these numbered requests are those which are in your possession or under your actual or constructive custody or control, whether or not such documents were received from or disseminated to any other person or entity, including attorneys, accountants, directors, officers and employees.

E. Documents that may be responsive to more than one numbered request need not be submitted more than once. However, your response should indicate, for each document submitted, each numbered request to which the document is responsive. Identification shall be by the Bates number if the documents(s) were so numbered when submitted or by author and subject matter if not so numbered.

F. Documents that have already been produced to ECM need not be submitted again. However, your supplemental response should indicate, for each document previously submitted, each numbered request to which the document is responsive. Identification shall be by the Bates number if the documents(s) were so numbered when submitted or by author and subject matter if not so numbered.

G. If any of the documentary materials requested in these numbered requests are available in machine-readable form (such as CD, DVD, hard disks, drums, core storage, magnetic tapes, etc.), state the form in which it is available and describe the type of computer or other machinery required to read the documents involved. If the information requested is stored in a computer or a file or record generated by a computer, indicate whether you have an existing program that will print the information in readable form and state the name, title, business address and telephone number of each person who is familiar with the program. Files should otherwise be produced in native format.

H. All objections to these numbered requests, or to any individual request, must be raised in the initial response or otherwise waived.

I. The Federal Trade Commission's Rules of Practice describes withholding requested material responsive to a subpoena under Rule 3.38A For your convenience, Rule 3.38A states:

> (a) Any person withholding material responsive to a subpoena issued pursuant to §3.34 or §3.36, written interrogatories requested pursuant to §3.35, a request for production or access pursuant to §3.37, or any other request for the production of materials under this part, shall assert a claim of privilege or any similar claim not later than the date set for production of the material. Such person shall, if so directed in the subpoena or other request for production, submit, together with such claim, a schedule which describes the nature of the documents, communications, or tangible things not produced or disclosed - and does so in a manner that, without revealing information itself privileged or protected, will enable other parties to assess the claim. The schedule need not describe any material outside the scope of the duty to search set forth in §3.31(c)(2) except to the extent that the Administrative Law Judge has authorized additional discovery as provided in that paragraph.
>
> (b) A person withholding material for reasons described in §3.38A(a) shall comply with the requirements of that subsection in lieu of filing a motion to limit or quash compulsory process.

J. The Federal Trade Commission's Rules of Practice describes motions to quash and/or limit subpoenas under Rule 3.34(c). For your convenience, Rule 3.34 states in relevant part:

> (c) *Motions to quash; limitation on subpoenas.* Any motion by the subject of a subpoena to limit or quash the subpoena shall be filed within the earlier of 10 days after service thereof or the time for compliance therewith. Such motions shall set forth all assertions of privilege or other factual and legal objections to the subpoena, including all appropriate arguments, affidavits and other supporting documentation, and shall include the statement required by §3.22(g). Nothing in paragraphs (a) and (b) of this section authorizes the issuance of subpoenas except in accordance with §§3.31(c)(2) and 3.36.

K. Some documents that you are requested to provide may be confidential. In the Protective Order dated October 22, 2013, Chief Administrative Law Judge D. Michael Chappell ordered that a party conducting discovery from third parties shall provide such third parties a copy of the Protective Order so as to inform third parties of his, her, or its rights. *See* ALJ Protective Order at 2, ¶4. Accordingly, a copy of the Protective Order is attached with this subpoena.

L. If any requested material is withheld based on a claim of privilege, submit together with such claim a schedule of the items withheld. For each item withheld, the schedule should state: (a)

the item's type, title, specific subject matter and date; (b) the names, addresses, positions and organizations of all authors or recipients of the item; and (c) the specific grounds for claiming that the item is privileged. If only part of a responsive document is privileged, all non-privileged portions of the document must be submitted.

DESCRIPTION OF DOCUMENTS REQUESTED

Please produce the original or copies of the following documents (the term "documents" shall include all records, books of account, worksheets, checks, instructions, specifications, manuals, reports, books, periodicals, pamphlets, publications, raw and refined data, memoranda, graphs, drawings, notes, lab books, advertisements, list studies, meeting minutes, working papers, transcripts, magnetic tapes or discs, punch cards, computer printouts, letters, correspondence,[1] agreements, drafts of agreements, telegrams, email, drafts, proposals, employee records, customer records, log files recommendations, and any other data recorded in readable and/or retrievable form, whether typed, handwritten, reproduced, magnetically recorded, coded, or in any other ay made readable or retrievable):

1. All documents received or possessed before engagement as an expert in Docket No. 9358 that concern ECM BioFilms, Inc., any past and present employee or principal of ECM, and/or the ECM additive.

2. All documents, materials, correspondence, forms, marketing material, and testing used or referenced to form any and all opinions you may offer in this case.

[1] The term "correspondence" is intended, used, and defined in its broadest sense allowable under the FTC Rules of Practice. Such term includes, but is not limited to, emails, documents appended to emails, reports and any other written or electronic document of any kind that is communicated from the subpoena recipient or its agents to any and all other persons and entities.

3. All contracts, retainers, engagement letters between you and any public or private firm that manufactures, sells, and/or produces biodegradable and/or compostable products in direct or indirect competition with ECM's additive technology.

4. All correspondence between you and any public or private firm that manufactures, sells, and/or produces biodegradable and/or compostable products concerning: (1) the biodegradability of plastics generally; (2) the definition of "biodegradable" generally or in context with plastics; or (3) the ability of plastics to biodegrade.

5. All correspondence, contracts, retainers, data, agreements and other documents transmitted to you by, and from you to, Biodegradable Products Institute (BPI), Steve Mojo, or any other BPI employee concerning BPI certifications.

6. All reports, analyses, assessments, tests, related summaries, and conclusions issued to any public or private firm that manufactures, sells, and/or produces biodegradable and/or compostable products, concerning the ability of such products to biodegrade in landfills or composting environments.

7. All correspondence, contracts, retainers, data, and/or agreements concerning research, funding, grants, or studies performed by you during your employment at the University of Massachusetts, Lowell ("UMass") related to Metabolix, Inc.

8. All correspondence, contracts, retainers, data, and/or agreements concerning research, funding, grants, or studies performed by you during your employment at UMass related to 3M Corporation.

9. All copies of receipts, check stubs, bank ledgers, and other documents identifying and revealing all payments you have received directly or indirectly from patents for

biodegradable or compostable polymers concerning patented articles in which you are listed on the patent as an inventor.

10. All pleadings, expert reports, documents, and correspondence related to any law suit, administrative proceeding, or arbitration in which you served as a consulting witness or expert witness concerning biodegradable polymers and plastics.

11. All contracts, agreements, memoranda of understanding, correspondence, or documents that involve or concern compensation you receive(d) owing to, or stemming from, grant or research money paid to UMass.

12. All studies, reports, and articles, or peer-reviewed literature based on research performed under the following research grants at UMass, and listed in your Curriculum Vitae:

a. Metabolix, "Development of Novel of Biodegradable Materials, $1,500,196

b. NSF Center for Biodegradable Polymer Research, $1,200,000 Industrial Members (8/93-present), Principal Investigator

c. Polymer Degradation Research Center, $475,000, Industrial Members (8/89-8/93)

d. Digital, "Plastics Materials Research", $458,706

e. Metabolix Inc., Performance of PHA Derived Chemicals and Polyols in Polyurethane, $141,465

f. 3M, "Composting Research", $155,000

g. Warner Lambert, "Biodegradable Polymer Research", $116,591

h. National Science Foundation, "Biodegradable Polymer Research Center", $110,000 (8/93-8/95)

i. Department of the Army, "Polymer Degradation Research", $104,000

j. Institute for Plastics Innovation, "Injection Molding Research", $75,000

k. Massachusetts Centers of Excellence, "Institute for Plastics Innovation", $75,000

l. Metabolix Inc., Performance of Polyhydroxyalkanote Derived Chemicals and Polyols in Polyurethane, $71,465

m. Battelle, "Biodegradable Packaging Development", $59,865

n. DuPont Corian, $50,000

o. Invista, "Evaluation of Plasticizers", $ 28,000

p. Massachusetts Centers of Excellence, "Polymer Degradation Research", $25,000

13. All correspondence, documents, communications, or information exchanged between you and Dr. Ramani Narayan.

14. All correspondence (not subject to attorney client or work-product privilege and received before engagement as an expert in Docket No. 9358) with any employee and/or representative of the Federal Trade Commission concerning biodegradable plastics.

15. All correspondence with any witness, person, and/or consultant used to help form any opinion you have in this case.

16. All documents revealing shares of stock or ownership interests held by you in any company involved with plastics, biodegradable products or technologies, and/or compostable products or technologies, but excluding any shares of publicly traded securities unless acquired or obtained in exchange for services.

17. All correspondence between you and any private company concerning ECM BioFilms.

18. All documents and correspondence between you and the authors of the article Gómez, EF, Michel Jr., FC. "Biodegradability of conventional and bio-based plastics and natural fiber composites during composting, anaerobic digestion and long-term soil incubation" Polymer Degradation and Stability. Vol. 98 (December 2013): 2583-2591.

19. All conflict of interest forms or agreements completed or signed by you.

20. All documents concerning ASTM, including, but not limited to, correspondence in which you presented a proposal, voted on a proposal, or opposed a proposal then undergoing active consideration by the ASTM.

21. Regardless of the date, if you have ever served as an expert in any other proceeding, copies of all expert reports and testimony given by you in those proceedings.

INSTRUCTIONS FOR COMPLIANCE BY DELIVERY OF DOCUMENTS

If documents are delivered by hand, overnight delivery service, certified mail, or any other means your response shall be accompanied by an affidavit, executed by you that provides:

> The names, addresses, positions, and organizations of all persons whose files were searched and all persons who participated in or supervised the collection of the documents[2], and a brief description of the nature of the work that each person performed in connection with the collecting the documents.
>
> A statement that the search was complete and that responsive documents are being produced.
>
> A statement as to whether the documents were made at or near the time of the occurrence of the matters set forth in such documents, kept in the course of your regularly conducted business, whether it was your regular practice to make and keep such documents, and the custodian of records and/or other executive(s) and/or employees of the University of Massachusetts, Lowell who have knowledge of such matters, can authenticate the documents and materials produced, and who can testify to such matters.
>
> A statement as to whether any document called for by the subpoena has been misplaced, lost or destroyed. If any document has been misplaced, lost, or destroyed, identify: type of documents the date (or approximate date) of the documents, subject matter of the documents, all persons to whom it was addressed, circulated, or shown; its date of destruction, or when it was lost or misplaced; the reason it was destroyed, lost or misplaced; and the custodian of the documents on the date of its destruction, loss, or misplacement.
>
> A declaration that states:
>
> I declare (or certify, verify, or state) under penalty of perjury that the forgoing is true and correct.
>
> Executed on [date].
>
> [Signature of party executing the declaration]

[2] "Document" and "documents" as used in this Attachment are defined in this subpoena's "Description of Documents Requested" section.

Respectfully submitted,

/s/ Jonathan W. Emord

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ORIGINAL

UNITED STATES OF AMERICA
FEDERAL TRADE COMMISSION
OFFICE OF ADMINISTRATIVE LAW JUDGES

In the Matter of	)	
ECM BioFilms, Inc., a corporation, also d/b/a Enviroplastics International, Respondent.	)	DOCKET NO. 9358

PROTECTIVE ORDER GOVERNING DISCOVERY MATERIAL

Commission Rule 3.31(d) states: "In order to protect the parties and third parties against improper use and disclosure of confidential information, the Administrative Law Judge shall issue a protective order as set forth in the appendix to this section." 16 C.F.R. § 3.31(d). Pursuant to Commission Rule 3.31(d), the protective order set forth in the appendix to that section is attached verbatim as Attachment A and is hereby issued.

ORDERED:

D. Michael Chappell
Chief Administrative Law Judge

Date: October 22, 2013

ATTACHMENT A

For the purpose of protecting the interests of the parties and third parties in the above-captioned matter against improper use and disclosure of confidential information submitted or produced in connection with this matter:

IT IS HEREBY ORDERED THAT this Protective Order Governing Confidential Material ("Protective Order") shall govern the handling of all Discovery Material, as hereafter defined.

1. As used in this Order, "confidential material" shall refer to any document or portion thereof that contains privileged, competitively sensitive information, or sensitive personal information. "Sensitive personal information" shall refer to, but shall not be limited to, an individual's Social Security number, taxpayer identification number, financial account number, credit card or debit card number, driver's license number, state-issued identification number, passport number, date of birth (other than year), and any sensitive health information identifiable by individual, such as an individual's medical records. "Document" shall refer to any discoverable writing, recording, transcript of oral testimony, or electronically stored information in the possession of a party or a third party. "Commission" shall refer to the Federal Trade Commission ("FTC"), or any of its employees, agents, attorneys, and all other persons acting on its behalf, excluding persons retained as consultants or experts for purposes of this proceeding.

2. Any document or portion thereof submitted by a respondent or a third party during a Federal Trade Commission investigation or during the course of this proceeding that is entitled to confidentiality under the Federal Trade Commission Act, or any regulation, interpretation, or precedent concerning documents in the possession of the Commission, as well as any information taken from any portion of such document, shall be treated as confidential material for purposes of this Order. The identity of a third party submitting such confidential material shall also be treated as confidential material for the purposes of this Order where the submitter has requested such confidential treatment.

3. The parties and any third parties, in complying with informal discovery requests, disclosure requirements, or discovery demands in this proceeding may designate any responsive document or portion thereof as confidential material, including documents obtained by them from third parties pursuant to discovery or as otherwise obtained.

4. The parties, in conducting discovery from third parties, shall provide to each third party a copy of this Order so as to inform each such third party of his, her, or its rights herein.

5. A designation of confidentiality shall constitute a representation in good faith and after careful determination that the material is not reasonably believed to be already in the public domain and that counsel believes the material so designated constitutes confidential material as defined in Paragraph 1 of this Order.

6. Material may be designated as confidential by placing on or affixing to the document containing such material (in such manner as will not interfere with the legibility thereof), or if an entire folder or box of documents is confidential by placing or affixing to that folder or box, the designation "CONFIDENTIAL – FTC Docket No. 9358" or any other appropriate notice that identifies this proceeding, together with an indication of the portion or portions of the document considered to be confidential material. Confidential information contained in electronic documents may also be designated as confidential by placing the designation "CONFIDENTIAL – FTC Docket No. 9358" or any other appropriate notice that identifies this proceeding, on the face of the CD or DVD or other medium on which the document is produced. Masked or otherwise redacted copies of documents may be produced where the portions deleted contain privileged matter, provided that the copy produced shall indicate at the appropriate point that portions have been deleted and the reasons therefor.

7. Confidential material shall be disclosed only to: (a) the Administrative Law Judge presiding over this proceeding, personnel assisting the Administrative Law Judge, the Commission and its employees, and personnel retained by the Commission as experts or consultants for this proceeding; (b) judges and other court personnel of any court having jurisdiction over any appellate proceedings involving this matter; (c) outside counsel of record for any respondent, their associated attorneys and other employees of their law firm(s), provided they are not employees of a respondent; (d) anyone retained to assist outside counsel in the preparation or hearing of this proceeding including consultants, provided they are not affiliated in any way with a respondent and have signed an agreement to abide by the terms of the protective order; and (e) any witness or deponent who may have authored or received the information in question.

8. Disclosure of confidential material to any person described in Paragraph 7 of this Order shall be only for the purposes of the preparation and hearing of this proceeding, or any appeal therefrom, and for no other purpose whatsoever, provided, however, that the Commission may, subject to taking appropriate steps to preserve the confidentiality of such material, use or disclose confidential material as provided by its Rules of Practice; sections 6(f) and 21 of the Federal Trade Commission Act; or any other legal obligation imposed upon the Commission.

9. In the event that any confidential material is contained in any pleading, motion, exhibit or other paper filed or to be filed with the Secretary of the Commission, the Secretary shall be so informed by the Party filing such papers, and such papers shall be filed *in camera*. To the extent that such material was originally submitted by a third party, the party including the materials in its papers shall immediately notify the submitter of such inclusion. Confidential material contained in the papers shall continue to have *in camera* treatment until further order of the Administrative Law Judge, provided, however, that such papers may be furnished to persons or entities who may receive confidential material pursuant to Paragraphs 7 or 8. Upon or after filing any paper containing confidential material, the filing party shall file on the public record a duplicate copy of the paper that does not reveal confidential material. Further, if the protection for any such material expires, a party may file on the public record a duplicate copy which also contains the formerly protected material.

10. If counsel plans to introduce into evidence at the hearing any document or transcript containing confidential material produced by another party or by a third party, they shall provide advance notice to the other party or third party for purposes of allowing that party to seek an order that the document or transcript be granted *in camera* treatment. If that party wishes *in camera* treatment for the document or transcript, the party shall file an appropriate motion with the Administrative Law Judge within 5 days after it receives such notice. Except where such an order is granted, all documents and transcripts shall be part of the public record. Where *in camera* treatment is granted, a duplicate copy of such document or transcript with the confidential material deleted therefrom may be placed on the public record.

11. If any party receives a discovery request in any investigation or in any other proceeding or matter that may require the disclosure of confidential material submitted by another party or third party, the recipient of the discovery request shall promptly notify the submitter of receipt of such request. Unless a shorter time is mandated by an order of a court, such notification shall be in writing and be received by the submitter at least 10 business days before production, and shall include a copy of this Protective Order and a cover letter that will apprise the submitter of its rights hereunder. Nothing herein shall be construed as requiring the recipient of the discovery request or anyone else covered by this Order to challenge or appeal any order requiring production of confidential material, to subject itself to any penalties for non-compliance with any such order, or to seek any relief from the Administrative Law Judge or the Commission. The recipient shall not oppose the submitter's efforts to challenge the disclosure of confidential material. In addition, nothing herein shall limit the applicability of Rule 4.11(e) of the Commission's Rules of Practice, 16 CFR 4.11(e), to discovery requests in another proceeding that are directed to the Commission.

12. At the time that any consultant or other person retained to assist counsel in the preparation of this action concludes participation in the action, such person shall return to counsel all copies of documents or portions thereof designated confidential that are in the possession of such person, together with all notes, memoranda or other papers containing confidential information. At the conclusion of this proceeding, including the exhaustion of judicial review, the parties shall return documents obtained in this action to their submitters, provided, however, that the Commission's obligation to return documents shall be governed by the provisions of Rule 4.12 of the Rules of Practice, 16 CFR 4.12.

13. The provisions of this Protective Order, insofar as they restrict the communication and use of confidential discovery material, shall, without written permission of the submitter or further order of the Commission, continue to be binding after the conclusion of this proceeding.