ORIGINAL

PUBLIC DOCUMENT

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 MOTION FOR SANCTIONS

Respondent ECM BioFilms, Inc. ("ECM") hereby moves for sanctions against Complaint Counsel for violation of Rules 3.31 and 3.37. Rules 3.31 and 3.37 aim, in part, to avoid unfair advantage achievable when a party possessed of a document required to be produced withholds that document until the moment of deposition of a key witness, endeavoring through surprise to achieve an unfair advantage. Notwithstanding a direct, specific document production request by Respondent, Complaint Counsel engaged in precisely that forbidden conduct in the deposition of ECM President Robert Sinclair on February 19, 2014. Complaint Counsel withheld a document material to the case until the afternoon of the second day of examination of ECM President Robert Sinclair in an effort to surprise that witness and thereby gain an unfair advantage. The transcript reveals the conduct to be clear and egregious. *See* Exh. RX-A, at 365-79 (Tr. of Sinclair Depo.).

On the deposition record, Complaint Counsel revealed that the document in question was withheld from Respondent for at least 5 days before his deposition, a time during which Complaint Counsel engaged in email communication with Respondent's counsel but never supplied or revealed the existence of the document in question. By its admission at the

deposition, Complaint Counsel withheld the document from at least February 14th until February 19th at 1:24 PM whereupon, in the middle of the second day of examination of Robert Sinclair, Complaint Counsel produced the document for the first time and, over objection from Respondent's counsel, examined the witness concerning it.

Complaint Counsel thereby violated Rules 3.37(b) and 3.31(e)(2). The ambush tactic employed is one commonly condemned as sanctionable. *See Only The First, Ltd. V. Seiko Epson Corp.*, 822 F.Supp. 2d 767, 778 (N.D. Ill. 2011) ("The rationale behind Rule 37 is to avoid unfair 'ambush' in which a party advances new theories or evidence to which its opponent has insufficient time to formulate a response"). The most appropriate sanction under the circumstances is to rule the document inadmissible in these proceedings; accordingly, Respondent seeks that sanction from the court.

Respectfully submitted,

/s/ Jonathan W. Emord

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DATED: February 28, 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 FOR SANCTIONS

Under Rule 3.38, ECM hereby moves for sanctions against Complaint Counsel for the deliberate violation of Rules 3.31 and 3.37. Under Rule 3.38(b), the ALJ may act on the violation by prohibiting the violator from introducing or relying on the document improperly withheld. *See* 16 CFR 3.38(b)(4). Here Complaint Counsel received a document that was directly responsive to Respondent's extant production requests. *See* Exh. RX-B, at 7 (Requests 1, 3). That document (attached hereto as Exhibit RX-C) is a scientific article, published on October 1, 2013 entitled, Eddie F. Gomez and Frederick C. Michel Jr., "Biodegradability of conventional and bio-based plastics and natural fiber composites during composting, anaerobic digestion and long-term soil incubation" *Polymer Degradation and Stability* 98 (2013) 2583-2591 (hereinafter "Article").[1] Complaint Counsel was obliged to supplement its document requests when it received the article but did not. *See* 16 C.F.R. § 3.31(e)(2). Indeed, possessed of copies of the article transported from Washington to the Painesville, Ohio site of the deposition, Complaint Counsel withheld them until the afternoon of the second day of the

[1] The study was marked as Complaint Counsel's Exhibit 23 in Sinclair's deposition.

Sinclair deposition, whereupon one of Complaint Counsel, Katherine Johnson, endeavored to ambush ECM's Sinclair by springing it upon him 12 hours after the start of his deposition. The deposition transcript captures the event and the objections made to the improper tactic. *See* Exhibit RX-A, at 365-79. Despite objection, and Johnson's admission of the improper withholding, she nevertheless interrogated Sinclair about the article, achieving the ambush. There being no privilege at stake, Respondent was obliged under the rules to permit the examination to continue.

The FTC's rules of practice contemplate orderly proceedings that avoid ambush tactics of this kind. The rules aim to eliminate unfair surprise, especially arising from the wrongful withholding of documents first revealed in deposition. Because Complaint Counsel brazenly violated the rules, and sought to gain an unfair advantage thereby, reasonable sanctions are warranted. Although his Honor is encouraged to impose any reasonable sanction that will dissuade recurrence, at a minimum the article in question should be deemed inadmissible.

BACKGROUND

On December 3, 2013, Respondent served on Complaint Counsel its Initial Document Requests. Request 1 stated:

> Provide all documents that concern whether plastics in general and ECM Plastics in particular will break down and decompose into elements found in nature after customary disposal or in a landfill.

See Resp. First Set of Requests for Production of Documents at 7 (Exh. RX-B). Complaint Counsel responded as follows on January 2, 2014:

> Complaint Counsel objects to Request for Production 1 on the grounds that a request for documents concerning plastics in general is overly broad, vague, and ambiguous. Subject to and without waiving the foregoing objections, Complaint Counsel will produce responsive, non-privileged documents.

See Exh. RX-D, at 3-4 (Compl. Counsel's Resp. to Respondent's First Set of Requests for Documents). Complaint Counsel produced documents on January 2, 2014 and January 13, 2014, respectively, that did not include the Gomez and Michel article.

On February 18th and 19th, 2014, one of Complaint Counsel, Katherine Johnson, deposed ECM's President Robert Sinclair. At 1:24pm on the second day of the deposition, eleven hours after its start, Complaint Counsel marked the Gomez and Michel article and revealed its existence for the first time (neither Sinclair nor his counsel had seen the document before). *See* Exh. RX-A, at 366:15. Sections of the document were electronically highlighted. *See* Exh. RX-C, at 2583, 2585, 2586-87, 2589-90. Complaint Counsel questioned Sinclair in detail about the tests referenced in it purportedly run on ECM's product. *See* Exh. RX-A, at 366-71. Respondent's counsel objected to the ambush tactic. *See id.* at 371-79. Katherine Johnson admitted on the record that she possessed the document since at least Friday, February 14, 2014 (*id.* at 372:3-5), five days before the deposition commenced. She further admitted that she could have produced the document but did not. *See id.* at 372:13. Moreover, she specifically stated that she could have produced the document the morning of the second day of the deposition. Having not complied with the rules, she contented herself with the following observation: "Well, you have a copy now." *See id.* at 372:17-19.[2] In addition, she admitted that she decided to use the document in the Sinclair deposition on Saturday, February 15, 2014, four days before the deposition (and at a time when she was in email contact with Respondent's counsel). *Id.* at 374:14-15. When asked why she withheld the document, not permitting a fair opportunity for

[2] Complaint Counsel corresponded electronically with Respondent's counsel at 9:03PM Eastern Friday, February 14. *See* Exh. RX-E. Moreover, the Gomez and Michel article is a downloadable electronic file readily communicated by email. *See* http://dx.doi.org/10.1016/j.polymdegradstab.2013.09.018 (last visited Feb. 25, 2014).

advance review, she stated: "This is your opportunity," *Id.* at 375:1-2, meaning the very moment of examination was the opportunity for the witness to examine it.

Over Respondent's objection, Complaint Counsel questioned Sinclair, a non-scientist, on the scientific article, which fell squarely within Respondent's Rule 3.37(a) Document Requests served December 3rd. *See id.* at 365-79;[3] *see also* Exh. RX-B.

The decision to withhold a document clearly responsive to Respondent's document request, and then spring it on the witness during deposition, was in bad faith, aiming to achieve an unfair advantage. That ambush tactic is strongly disfavored and judicially condemned.[4]

Finally, the article subject to this motion invites criticism that is elucidated upon reflection. Among the aspects revealing the study to be unreliable, the authors claim to have tested a representative ECM plastic product and allegedly found little evidence of degradation. *See* Exh. RX-C, at 2585-87. However, the polypropylene plastics (PP) tested are not representative of plastics containing ECM's additive (the vast majority of which are not PP) and the actual concentration of the additive in the plastic tested is not revealed. Moreover, the

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[3] Respondent's counsel explained that ECM was prejudiced by the untimely disclosure. *See* Exh. RX-A, at 372-74.

[4] At deposition, Respondent's counsel stated he would bring this matter before the ALJ. Thus on notice, Complaint Counsel interfered with Respondent's bringing of the motion and preparation for depositions the week of March 3, by designating the Sinclair deposition transcript "not for sale/release." ECM ordered transcripts for delivery Wednesday, February 26, 2014. When the transcript did not appear, ECM contacted For the Record. On February 27, 2014, that reporting service informed ECM that a transcript had already been delivered to Complaint Counsel but the transcript would not be delivered to ECM because Complaint Counsel had designated it "not for sale/release." At our urging, the reporter emailed Complaint Counsel and asked for a redesignation but received no timely response. Late on February 27, 2014, after Respondent's counsel insisted on ECM's right to the transcript to the court reporter, the redesignation finally occurred. That obstruction prejudiced ECM, denying Respondent's counsel time to review the transcript before depositions of ECM employees scheduled the week of March 3rd. That delay also deprived ECM of the record in support of the present motion for sanctions, delaying submission of the motion.

authors fail to explain exclusion of one of two ECM products from an anaerobic testing battery, or if they included it, they omitted the results from publication. *See* Exh. RX-C, at 2586-87.[5] Finally, the objectivity of the study's lead author, Dr. Frederick C. Michel, Jr., is in question. He has aligned himself with interests favoring compostable plastics products, which products compete directly with ECM's biodegradable plastics.[6]

ARGUMENT

Rule 3.38 authorizes sanctions when a party attempts to achieve unfair advantage through violation of the discovery rules. *See* 16 C.F.R 3.38(b). A party may seek relief "as may be sufficient to compensate for withheld testimony, documents, or other evidence." *See* 16 C.F.R 3.38(c). *See Matter of the Grand Union Co.*, 102 F.T.C. 812, 1983 WL 486347 at 136, 207 (1983). Sanctions are appropriate where the party's failure to comply is unjustified. *Id.*; *see also In the Matter of Mkt. Dev. Corp., et al.*, 95 F.T.C. 100, *86 (1980). There can be no justification for the failure to divulge in advance of a deposition a document subject to production that a deposing party intends to use for examination.

The discovery rules, including the duty to timely supplement discovery responses, are to prevent unfair surprise. *See, e.g., Coles v.* Perry, 217 F.R.D. 1, 4 (D.D.C. 2003) (excluding documents that were improperly withheld so as not "[t]o permit that stratagem and let a party use at trial evidence it did not disclose during discovery ... [Condoning such a tactic] would gut the

[5] ECM will produce evidence of multiple ASTM D5511 tests conducted under similar conditions on ECM additive containing plastics, showing that such plastics biodegrade significantly when compared to control.

[6] *See* Dr. Frederick C. Michel, Jr., Online Biography, Ohio State University, *available at*, http://www.oardc.ohio-state.edu/michel/CompostResearchmembers.htm (last visited Feb. 25, 2014) (explaining that the author participates in the OSU's Compose Research Group).

discovery rules"); *Huynh v. J.P. Morgan Chase & Co.*, CIV 06-0001-PHX-RCB, 2008 WL 2789532, at *25 (D. Ariz. July 17, 2008); *Bishop v. City of Macon*, 189 F.R.D. 494, 496 (M.D. Ga. 1999) ("The primary purpose of liberalized civil discovery rules is to prevent surprise to a litigant's opponent"). While we may excuse a lapse in the duty to produce a documents provided sound reasons support such a lapse, we cannot excuse intentional withholding aimed at achieving unfair advantage in a deposition. This Court should condemn the ambush tactic, establishing clear precedent that reigns in Complaint Counsel.

A. Complaint Counsel Violated Rules 3.31 and 3.37

Rule 3.31(e) compels supplementation to discovery responses. *See* 16 C.F.R. § 3.31(e)(2) ("A party is under a duty to amend in a timely manner a prior response . . . [that] is in some material respect incomplete or incorrect").

The intentional withholding of the article until the second day of Sinclair's deposition whereupon it was produced in surprise, ambush fashion is a per se violation of the continuing obligation to seasonably supplement document production. Counsel arrived at 9AM the morning of the first day of Sinclair's deposition with printed copies of the exhibit in tow yet even withheld the document, waiting until the afternoon of the second day in an effort to achieve an ambush. *See* Exh. RX-A, at 374:14-15. "Timely" production under Rule 3.31(e)(2) demanded provision of the article to Respondent before the deposition of Sinclair commenced; indeed, at the very moment it was discovered or, if not then, certainly four days before, on the preceding Saturday, when Katherine Johnson decided she would use it in the Sinclair deposition.

B. Complaint Counsel's Withholding Was Willful And Unjustified

As explained hereinabove and revealed in the attached deposition transcript, the withholding was willful.[7]

The parties spent more than 12 hours in Sinclair's deposition over two days before Katherine Johnson revealed the article she possessed five days before. *See* Exh. RX-A, at 365. The parties had corresponded by email the weekend before the deposition, yet Complaint Counsel made no mention of the article in that correspondence. *See* Exh. RX-E. On the record Johnson says that she acquired the document on Friday, February 14th, and resolved to use it in the deposition on Saturday, February 16th. We cannot presume her ignorant of the rules or, even were she, excusable for that ignorance. She could have supplied Respondent with a copy of the document by email on Friday, on Saturday, or on any day thereafter preceding the deposition. Moreover, Complaint Counsel produced multiple copies of the document at deposition, copies sufficient for the witness and Respondent's counsel, indicating that she travelled from Washington with the copies and thus had the opportunity before the start of the deposition to supply physical copies for Respondent's review.

Complaint Counsel withheld the article to facilitate an ambush of Sinclair at his deposition, aiming thereby to achieve an unfair advantage, thereby acting in bad faith. *See F.T.C. v. Affiliate Strategies, Inc.*, 09-4104-JAR, 2011 WL 2084147 at 9 (D. Kan. May 24, 2011) ("It [was] difficult for the Court to understand how WPS could not have produced this document earlier if it had been acting in good faith").

[7] Complaint Counsel's Notice of Deposition indicated that they planned to discuss "scientific tests relevant or potentially relevant to the biodegradability of plastic..." *See* Exh. RX-F, at ¶10.

C. Complaint Counsel's Failure Violation of Discovery Obligations Prejudices ECM

Ostensibly planning to impeach or discredit Sinclair with a negative study, and undermine his prior testimony, Complaint Counsel asked him, a non-scientist, to verify facts from and draw conclusions concerning the scientific article he first witnesses in deposition. *See* Exh. RX-A, at 377:1-21. His testimony would have been more informed had he possessed the withheld article in advance of the deposition and had an opportunity to seek input from consulting scientists. He was therefore deprived of an opportunity to testify fully on the topics identified in Complaint Counsel's Rule 3.33(c)(1) Notice of Deposition. *See* Exh. RX-F, at ¶10.

D. Document Exclusion Is the Customary Remedy

One of the sanctions specifically referenced in Rule 3.38(b)(4) is the exclusion of "documents or other evidence ... improperly withheld or undisclosed..." 16 C.F.R. § 3.38(b)(4). "For further guidance in assessing the proper type of sanction, the ALJ may look to precedent under Federal Rule of Civil Procedure 37(b)(2), which is substantially similar in both purpose and language to Rule 3.38(b)." *Matter of the Grand Union Co.*, 102 F.T.C. 812, 1983 WL 486347, at *208 (1983). "When a party seeks to frustrate [the process] by disobeying discovery orders, thereby preventing disclosure of facts essential to an adjudication on the merits, severe sanctions are appropriate." *Daval Steel Products, a Div. of Francosteel Corp. v. M/V Fakredine*, 951 F.2d 1357, 1365 (2d Cir. 1991) (interpreting 37(b)(2)). Courts have held that willful non-disclosure is grounds for dismissal. *See S. New England Tel. Co. v. Global NAPs, Inc.*, 251 F.R.D. 82, 90 (D. Conn. 2008) *aff'd*, 624 F.3d 123 (2d Cir. 2010) ("Dismissal is appropriate if there is a showing of 'willfulness, bad faith, or fault on the part of the sanctioned party'"). Short

of dismissal (*id.*), the precedent and rule supports exclusion of the evidence wrongfully withheld. *See* 16 C.F.R. § 3.38(b)(4).

CONCLUSION

For the foregoing reasons, Respondent respectfully requests that his Honor specifically rule that Complaint Counsel violated the discovery rules and hold inadmissible the article entitled Eddie F. Gomez and Frederick C. Michel Jr., "Biodegradability of conventional and bio-based plastics and natural fiber composites during composting, anaerobic digestion and long-term soil incubation" *Polymer Degradation and Stability* 98 (2013) 2583-2591, which was wrongfully withheld by Complaint Counsel in violation of Rules 3.31 and 3.37, and was intended for use as an ambush tactic in the deposition of Robert Sinclair.

Respectfully submitted,

/s/ Jonathan W. Emord

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DATED this 28th day of February 2014.

STATEMENT CONCERNING CONFIDENTIALITY

The undersigned Respondent's Counsel hereby states that the content of the foregoing motion, memorandum, and excerpted sections of otherwise confidential exhibits do not contain confidential information under this Court's Protective Order and, so, ECM hereby files this motion to the public docket.

DATED: February 28, 2014.

/s/ Jonathan W. Emord

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STATEMENT CONCERNING MEET AND CONFER

Pursuant to Rule 3.22(g), 21 C.F.R. § 3.22(g), the undersigned counsel certifies that, on February 19, 2014, during the deposition of Robert Sinclair, and then again on February 28, 2014, Respondent's counsel conferred with Complaint Counsel in a good faith effort to resolve by agreement the issues raised in the foregoing Motion for Sanctions. The parties have been unable to reach an agreement on the issue raised in the attached motion.

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**

[PROPOSED] ORDER GRANTING RESPONDENT ECM BIOFILMS, INC.'S MOTION FOR SANCTIONS

This matter having come before the Administrative Law Judge on February 28, 2014, upon a Motion for Sanctions ("Motion") filed by Respondent ECM BioFilms, Inc. ("ECM") pursuant to Commission Rule 3.38(b), 16 C.F.R. § 3.38(b), for an Order sanctioning Complaint Counsel.

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 and Complaint Counsel shall be precluded from introducing into evidence or otherwise relying on, in support of any claim or defense, the article identified in Exhibit RX-C of ECM's Motion, entitled: Eddie F. Gomez and Frederick C. Michel Jr., "Biodegradability of conventional and bio-based plastics and natural fiber composites during composting, anaerobic digestion and long-term soil incubation" *Polymer Degradation and Stability* 98 (2013) 2583-2591.

ORDERED:

_____
D. Michael Chappell
Chief Administrative Law Judge

Date:

CERTIFICATE OF SERVICE

I hereby certify that on February 28, 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.

DATED: February 28, 2014

/s/ Jonathan W. Emord
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Telephone: 202-466-6937

EXHIBIT RX-A

UNITED STATES OF AMERICA

BEFORE THE FEDERAL TRADE COMMISSION

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

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Deposition of

ROBERT SINCLAIR-VOLUME II

TRANSCRIPT CONFIDENTIAL

PURSUANT TO PROTECTIVE ORDER

February 19, 2014
9:17 a.m.

Taken at:
ECM BioFilms, Inc.
100 South Park Place
Painesville, Ohio

Jill A. Kulewsky, RPR, Notary Public

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APPEARANCES:

On behalf of ECM BioFilms, Inc.:

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some block copolymer. Boy, that's a long time ago. I don't recall exactly what it was. I think it was a block copolymer that we ran. 13:22:46

Q. What's a block copolymer?

A. It's a variation of other resins that, again, we wouldn't know exactly because the company we were dealing with wouldn't give us exact things of what they're running. 13:23:14

Q. But it was a copolymer that had the additive in it?

A. Yes. In other words, we would run -- I'm sure it was run with and without our additive. 13:23:32

Q. And ECM commissioned the test?

A. I wouldn't swear to that one way or the other. Yes, I think we did. I think we did on that one. I think we did. 13:23:48

Q. And do we have the results of this test? Have these been turned over?

A. You know, until you mentioned that right now is the first it's ever come into my mind, but I will make sure that I dig them up because I'm sure I've got them somewhere. I will get that over to you. 13:23:58

Q. You also said that there was

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another aerobic OWS test that you were going to -- 13:24:12

A. Again, we're going to try to scour as soon as I have a chance. I got to get off of those e-mails. After I do that, that's the next one. It takes an enormous amount of time. 13:24:33

- - - - -

(Thereupon, Deposition Exhibit 23, A Document Entitled Polymer Degradation And Stability, was marked for purposes of identification.)

- - - - -

MS. JOHNSON: Let the record show that I'm marking a document entitled Biodegradability of Conventional and Bio-Based Plastics and Natural Fiber Composites During Composting, Anaerobic Digestion and Long-Term Soil Incubation dated October 1st, 2013. Take a moment to look at this. There are some markings in this document, they're not mine, so I'm not waiving attorney work product. 13:25:53 13:26:29

Q. Do you know who Eddie F. Gomez or Frederick C. Michel, Jr. are? They're the

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authors. Have you heard their name? Do you know who they are? 13:26:57

A. No, they don't seem familiar to me.

Q. Have you seen this article before?

A. I don't believe so.

Q. You can take a few minutes to look through it. Do you want to just flip through it if you want? 13:27:14

MR. EMORD: I'm going to put an objection on the record to state that the witness has testified that he's not previously seen this before. It purports to be a publication of a scientific study or test and the witness is not an expert, so with that caveat in mind, you can ask your questions. 13:28:10

Q. Mr. Sinclair, do you have any reason to believe that the Department of Food, Agriculture and Biological Engineering at Ohio State University would be biased against you? 13:28:36

A. In the fact that one of the primary people that is biased against us is Cargill, they -- the Department of Agriculture may well be. I don't know that. 13:28:56

Q. Well, I don't understand what's the relationship between Cargill and --

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A. Cargill is NatureWorks, and NatureWorks is PLA, and they were one of the primary constituent members of the BPI and have been for a long time and they've been one of the primary motor engines behind the general attacks on our technology. 13:29:11 13:29:34

Q. And what does it have to do with Ohio State University?

A. Again, I don't know.

Q. I'm just asking.

A. I'm just saying, you asked me would there be any reason why I would have question of these people, and I would say that would be the only question I would have. 13:29:42

Q. So if they had no ties to Cargill or who else did you mention? 13:29:59

A. BPI, Narayan, and that whole bit.

Q. If they had no connections to those companies, you would feel they weren't biased against you?

MR. EMORD: Again, calls for speculation. 13:30:21

A. I would not know. I would not know.

Q. Anyway, did you know that your ECM

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MasterBatch Pellet was going to be the subject of a study? Did you provide samples -- 13:30:36

A. I do not believe I knew of it. I don't recall these gentlemen and I don't recall anybody requesting anything from us from Ohio State. 13:30:59

Q. There is obviously a lot of information in the article, but the conclusion, which is at the end, towards the end, it's marked 4, Conclusion, says "Plastics containing additives that supposedly confer biodegradability to polymers such as polyethylene and polypropylene did not improve the biodegradability of these recalcitrant polymers." 13:31:41

MR. EMORD: I'll object to the fact that the entire sentence in which that statement was usurped was not read into the record and I'll now read it into the record. "While some of the bio-based plastics and natural fibers biodegraded to an appreciable extent, plastics containing additives that supposedly" and then so on as counsel read. 13:31:57 13:32:09

Q. Do you know what a bio-based plastic is?

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A. I know what they are terming that, yes. 13:32:20

Q. And that's not a technology that's similar to your additive, correct?

A. No. Well, in other words, our stuff could be used in the bio-based plastics. 13:32:39 In other words, a bio-based plastic is simply taking what they call more recently used carbon. In other words, carbons that are out there in the environment in an active form as opposed to carbons that are in some more fossil 13:32:59 form, and you can make any polymer from those carbons.

In other words, you could make standard polyethylene. A company down in Brazil makes standard polyethylene using 13:33:20 bio-based carbon. In other words, where they obtain that carbon from the remains of sugar cane. So bio-based has nothing to do with biodegradability as a function.

In other words, if they make 13:33:44 polyethylene with bio-based carbon, that polyethylene is no more biodegradable than is a standard polyethylene that was made from a natural gas or from petroleum.

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Q. Let's go to Section 2.4. I'm sorry, the pages aren't numbered. I think at the top it's 2586. 13:34:00

A. Okay.

MR. EMORD: Take a moment to read the whole section before you respond. 13:34:32

A. Frankly, again, showing me a document, I'm not going to make a whole bunch of conclusions from anything in this document without having thought about it, giving it over to experts, whatever the case is. This isn't just a -- 13:34:47

MR. EMORD: Gotcha? Yeah, it's not a gotcha. Read that Section 2.4 through just so you have some context in which to answer the questions, realizing that counsel has not supplied us with a copy of this document before the deposition and first supplied it to you a few moments ago. So take a moment and look at 2.4, read it in its entirety, and then we'll see what they're going to do with it. 13:35:02 13:35:14

May I ask, counsel, when you first got a copy of this document? It's dated 2013, the publication date. It indicates it was available online on 1, October, 2013, I don't

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know where online, but when did you first come to acquire a copy of this document? 13:35:40

MS. JOHNSON: I could verify the exact date and time if you just give me a minute. I think it was Friday.

MR. EMORD: Did you have the ability on Friday to send me a copy of it? 13:35:50

MS. JOHNSON: I don't believe so, but I might have.

MR. EMORD: No? Could someone on your staff have supplied me with a copy of the document? 13:35:59

MS. JOHNSON: Possibly.

MR. EMORD: So we could have been given a copy of the document so we could confirm -- 13:36:07

MS. JOHNSON: Well, you have a copy now. So if you want to take some time and take a look at it, that's totally fine.

MR. EMORD: Under the production order and under our request for production of documents, this would be due. 13:36:13

Now, we've had a lot of conversations and arguments over production, and you've demanded rapid production and we've

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worked as diligently as we can to get you the documents. To the extent that we've argued over it, we've gone to the court. 13:36:23

In this instance you have a document that is a scientific document that you're going to examine this witness about, which in itself is improper, but let's say you go ahead and do that, but the point is, you had this document, you were able to give me a copy of it, I could have conferred with scientists who we've worked with on this and I could have had a better understanding of it to represent my client. You're right in the middle of a deposition, you're not giving us that opportunity, you expect us to give it to you, and so you're not giving us that same courtesy. 13:36:35 13:36:50 13:37:03

MS. JOHNSON: I'm sorry, you gave us a 20,000 page PDF containing vital e-mails sometime over the weekend and you expected us to evaluate it. Are we on the record?

MR. EMORD: Yes, we are. 13:37:19

MS. JOHNSON: All right.

MR. EMORD: And we informed you of the production of those documents and when we would provide them to you, and we said we would

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get them to you as rapidly as possible. You set the date for this deposition, we didn't set it. If you wanted to change the date for that deposition to review those documents, we certainly would have cooperated with you. This is another matter. You gave us no advanced notice of this document. None. You had it on Friday, you knew you were going to use it in a deposition -- 13:37:26 13:37:38

MS. JOHNSON: I did not know I was going to use it. 13:37:48

MR. EMORD: When did you decide you were going to use it?

MS. JOHNSON: We packed up our stuff on Saturday afternoon.

MR. EMORD: This is highlighted. Who did the highlighting on the document? 13:37:54

MS. JOHNSON: I'm not going to reveal that.

MR. EMORD: Well, either someone on your staff did the highlighting on the document or it's one of your scientific consultants, but in any event, you did not turn this document over to us when you had the opportunity to do it and -- 13:38:00

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MS. JOHNSON: This is your opportunity. 13:38:07

MR. EMORD: -- you're doing an examination based on it, and I want to make it absolutely clear, abundantly clear --

MS. JOHNSON: Yes, please do. 13:38:16

MR. EMORD: -- that this is grossly unfair because you did not give us a chance to look at a scientific document that you're using as a basis to examine a non-scientific witness, but in any event, this document you had in your possession, it is subject to our production request, and you did not turn it over. You didn't turn it over yesterday during the deposition, you didn't turn it over -- 13:38:30

MS. JOHNSON: I apologize for that. 13:38:45

MR. EMORD: You didn't turn it over until the immediate moment when you began this deposition. We've been here all day long. It is now in the afternoon, it is what -- what time is it, it's 20 to 2, you've been here since 9 in the morning, you didn't turn it over to us before. The first time you turned it over to us you began asking the witness questions about it. 13:38:55

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MS. JOHNSON: Would you like to take a few moments to read it, we can take a break? 13:39:13

MR. EMORD: No, he's not a scientific expert, it's totally improper --

MS. JOHNSON: I'm not going to ask him about the science. I'm not asking about the science, I just wanted to ask him one or two questions about the document. 13:39:20

MR. EMORD: I want to make this clear because I am going to take this up, whether it's with your superiors, whether it's with the Judge, this is an important matter. I don't want this to happen again in a deposition. I don't want these future depositions to go on where you do this kind of thing. Will you tell me on the record that you won't do this in the future? 13:39:26 13:39:37

MS. JOHNSON: Well, certainly if I have an opportunity to produce a document before the date of the deposition, I will do so. 13:39:48

MR. EMORD: All right. We will continue.

BY MS. JOHNSON:

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Q. You said before, Mr. Sinclair, that the ASTM 5511 test is a state of the art test, correct? 13:39:59

A. That's correct.

Q. Does it appear that that was the test that was identified in this study? 13:40:10

A. Yeah, I think it's very important in the second paragraph of 2.4 that you have indicated that I read that they do say these conditions resemble those found in high solid AD digesters and in biologically active landfills but not in typical landfills where water is excluded and removed. 13:40:30

In other words, they are talking about biologically active landfills, and we can show from the EPA documents that all landfills that receive municipal solid waste are biologically active. So I appreciate you bringing this to our attention. That's another confirmation of what we've been saying all along. 13:40:50 13:41:04

Q. So --

A. Beyond that, I can't make any conclusions or --

Q. I didn't ask you to. I didn't ask

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you anything else. 13:41:16

A. I thought you did.

THE WITNESS: If you could, reread her question to me.

THE NOTARY: Question: "Does it appear that that was the test that was 13:40:08 identified in this study?"

A. That's making a conclusion of how they ran the test, what they did. I don't know anything of that. I can't tell.

Q. All right. 13:41:37

A. This is their report of their testing. I have no idea what they've done, other than what they're saying pointblank, and you can read it as well as I can.

Q. Let's move on to some of the 13:41:48 customer communications and hopefully we can go a little faster.

Actually, I did want to ask you a question about the formation of ECM. Did you sign any documents in 1998 indicating that you 13:42:37 were the President of the company?

A. Yeah, that would have been initial formation of the company and then quickly the President would have been the -- I believe I

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was, you know, at the very formation the sole shareholder and then would disburse those shares -- it was just a matter of formality. 13:42:53

Q. But when I asked you yesterday whether you were President in 1998, I think you said you did not become President until 2000? 13:43:12

A. Yeah, that was again a technicality.

Q. I just wanted to be sure I understood. You were President from the very beginning? 13:43:23

A. I had forgotten all about that, again, the formation of the company and how we had done it at that time. Now that you refreshed my memory, we did it where we formed the company, again without any assets, without anything, and I was the 100 percent shareholder, and then we had the share subscription for everybody else and everybody got their regular percentages that they had in Microtec in the next phase. So now that you've brought that to mind, that is correct. 13:43:34 13:43:51

Q. And when was your brother President again?

A. Well, again, he would have been the

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EXHIBIT RX-B

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**

RESPONDENT'S FIRST SET OF REQUESTS FOR PRODUCTION OF DOCUMENTS

Respondent ECM BioFilms, Inc. ("ECM"), by counsel and pursuant to Rule 3.37 of the Federal Trade Commission's Rule of Practice for Adjudicative Proceedings ("Rules"), hereby requests that Complaint Counsel for the Federal Trade Commission produce the following documents and/or tangible things for inspection and copying at Emord & Associates, P.C., 3210 South Gilbert Road, Suite 4, Chandler, Arizona, 85286, or at such time and place as may be agreed upon by all counsel.

INSTRUCTIONS

1. These instructions and definitions should be construed to require responses or production based on all information within the Federal Trade Commission's possession, domain, custody, or control, including such information within the personal knowledge of those employed by the FTC and by those acting on the FTC's behalf.

2. If you are unable to produce a document or item requested, please state in writing why you cannot produce the document or thing and, if your inability to produce the document or thing is because it is not in your possession, dominion, control, or that of a person from whom

you could obtain it, state the name, address, and telephone number of any person or entity you believe may have the original or a copy of any such document or thing.

3. Your response is required within 30 days after service of these Requests per 16 C.F.R. § 3.37(b).

4. If you object to any of the requests, answer to the extent that each request or part thereof is not objectionable, and state the precise part of the request to which you intend to object. Please provide each ground for such objection in sufficient detail to permit Respondent's counsel to evaluate the legal sufficiency of same.

5. If, in answering these Requests, you encounter any ambiguities when construing a request, instruction, or definition, your response shall state the matter deemed ambiguous and the construction used in responding.

6. Where a claim of privilege is asserted in responding or objecting to any discovery demanded in these Requests and information is not provided on the basis of such assertion, you shall, in your response, identify the nature of the privilege claimed, together with the following information: (a) the date of the responsive document(s); (b) the sender of the document(s); (c) the addressee(s) or recipient(s); (d) the number of pages; (e) the subject matter; (f) the basis for which the privilege is claimed; (g) the names of all persons to whom copies of any part of the document(s) were furnished; (h) the present location of the document(s) and all copies thereof; and (i) each person who has ever had possession, custody, or control of the document(s), to the extent known.

7. If the requested document(s) are maintained in a file, the entire file folder is included in the request for production of those documents generally, to the extent such production is reasonably necessary for context.

8. You are under a continuing obligation to supplement your answers to these document production requests under Rule 3.31(e). Every Request for Production herein shall be deemed a continuing Request for Production, and the FTC is to supplement its answers promptly if and when it obtains responsive documents which add to or are in any way inconsistent with the FTC's initial production.

9. Unless the context clearly requires otherwise, the singular form of any term used herein shall include the plural, and vice versa. The present tense of any verb shall include the past tense, and vice versa. Similarly, the masculine gender shall include the feminine, and vice versa.

10. The terms "and" and "or" in these Requests shall be construed conjunctively or disjunctively as necessary, to make the applicable sentence or phrase inclusive rather than exclusive and to ensure a complete, thorough, and accurate response.

11. Unless otherwise stated, the relevant time period for purposes of these Requests is the time period between January 1998 and the date of hearing in this case.

DEFINITIONS

Notwithstanding any specific definition set forth below, each word, term, or phrase used in these Requests is intended to have the broadest meaning permitted under the Rules of Practice of the Federal Trade Commission.

1. The terms "Complaint Counsel," "you," "your," "FTC," "Complainant," or "Commission" are interchangeable in meaning and are to be understood to include all employees, agents, attorneys, consultants, representatives, officers, and persons acting or purporting to act on behalf of the United States Federal Trade Commission, other than the

entities that are identified in Practice Rule 3.35(a) as individuals or entities outside the scope of discovery for purposes of these requests.

2. The term "Document" means documents and other tangible things as defined in the broadest sense permissible under the Rules of Practice of the Federal Trade Commission and shall include, without limitation, all written (whether handwritten, typewritten, computer printed or otherwise generated), recorded, graphic or visual matter of material of any kind in original format or, if an original is not available, any copies, as well as any non-identical copies (regardless of origin and whether or not including additional writing thereon or attached thereto) and whether or not still in existence and drafts of any: books, papers, photographs, video tapes, movie films, tapes or other photographic recordings, microfilm, microfiche, computer printouts, audio or video tape recordings, magnetic tapes, punch cards, records, reports, letters or any correspondence, electronic mail ("e-mail") or similar electronic communications, telegrams, telexes, memoranda, notes, field notes, marginal notations, complaints, contracts, studies, affidavits, agendas, minutes, resolutions, diaries, appointment books, calendars, desk calendars, analysis, work papers, statistical reports, circulars, charts, transcripts, bills, invoices, receipts, worksheets, checks, logs, ledgers, payrolls, tax records, audits, reviews, sketches, graphs or graphics, pamphlets, brochures, manuals, financial reports, financial summaries, summary statements, lists, agreements, purchase orders, expense records, purchase and sale statements or their equivalent, depositions, interview transcripts or their equivalent, press releases in publications, discs, data cells, drums, printouts, data compilations, maps, lawsuits including all pleadings or memoranda submitted to or for submission to any court, administrative agency, association, or Governmental tribunal, whether in or outside the United States, text messages, phone logs, phone bills, internet social networking posts or entries, internet web posts or entries

of any kind, any and all other types of tangible things in whatever form upon or in which information is or may be recorded, whether mechanical, electronic or handwritten, including any physical file or its equivalent in which any such document or tangible thing has been or is stored or maintained. .

3. The term "Correspondence" is used in the broadest sense to include any communication through the exchange of written or spoken word, including, but not limited to any such exchange through letters, electronic mail ("e-mail") or similar electronic communications, text messages, SMS messages or similar electronic communications, telegrams, telexes, memoranda, facsimiles, notes, cards, and phone conversations and records thereof.

4. The term "Person" is used in the broadest sense to include natural persons, public or private corporations, charitable or non-charitable corporations, and their subsidiaries that are divisions, proprietorships, partnerships, Governmental entities, associations, organizations, groups, trusts, estates, and any other form of an entity or organization. Any reference herein to a party that is a corporation, partnership, or any entity other than a natural person, shall include reference to all past and present subsidiaries, affiliates, directors, officers, employees, and agents of the entity.

5. The term "Personnel" is used in the broadest sense to include natural persons, Governmental entities, and any other form of an entity or organization employed by or acting as agents for Complainants including their respective attorneys, agents, employees, and all persons acting on their behalf including, without limitation, the other Complainants and their agents.

6. The terms "Pertaining to" or "Concerning" mean relating to, referring to, constituting, containing, embodying, reflecting, identifying, stating, dealing with, or is in any

way pertinent to or associated with the specified subject, including documents concerning the preparation of other documents.

7. The terms "Article" or "Publication" shall refer to all pieces of writing including, but not limited to, newspaper pieces, magazine pieces, and information released or appearing in scientific peer-reviewed journals.

8. The term "Communication" shall include any oral statement, dialogue, colloquy, discussion or conversations, and also means any transfer of thoughts or ideas between persons by means of documents, and includes any transmittal of information in the form of oral or written facts, ideas, inquiries, or data transfer from one location to another by electronic or similar means, including without limitation, writings, telephonic conversations and oral conversations other than telephonic conversations, SMS messaging, and internet web posts.

9. The term "ECM" or "Respondent" shall include, without limitation, ECM BioFilms, Inc., its agents, employees, officers, or anyone else acting on its behalf.

10. The term "Complaint" as used throughout these requests for production shall refer to the Complaint filed by the Federal Trade Commission against ECM BioFilms, Inc., Docket No. 9358 (Oct. 28, 2013).

11. The terms "test," "analysis," "protocol," "study," "survey," "data," or "experiment," shall include, without limitation, any procedure intended to establish the quality, credibility, veracity, plausibility, performance, or reliability of scientific theories, concepts, or ideas, or any measurement (whether or not "scientific" or valid) of human, scientific, or other facts and statistics collected together for reference or analysis.

12. The term "plastic" as used throughout these requests shall collectively refer to any synthetic material made from a wide range of polymers such as polyethylene, PVC, nylon, and others, including, but not limited to, all thermoplastics and thermosets.

13. The term "ECM Plastic" means any plastic product treated with or incorporating an ECM additive.

14. The term "ECM Additive" means the additive manufactured by ECM for inclusion in plastics products as a component of the finished plastic.

15. The term "biodegradation" and any variation thereof means decomposition or degradation by or through the action of biological and biochemical agents.

REQUESTS

Request 1. Provide all documents that concern whether plastics in general and ECM Plastics in particular will break down and decompose into elements found in nature after customary disposal or in a landfill.

Request 2. Provide all documents, whether prepared by or for the Commission or any other entity, concerning consumer perception, comprehension, or recall (including, but not limited to, copy tests, marketing or consumer surveys and reports, penetration tests, recall tests, audience reaction tests, and communication tests) of plastics biodegradability; biodegradability in general; landfill composition; or conditions of customary waste disposal.

Request 3. Provide all documents that support or call into question your conclusion that ECM's biodegradable claims for degradation are false.

Request 4. Provide all documents that support or call into question your conclusion that consumers likely interpret unqualified degradable claims to mean that the entire product or

package will completely decompose into elements found in nature within one year after customary disposal.

Request 5. Provide all documents relating to your contention that express or implied representations made in or implied by ECM BioFilm's written advertising or promotional materials are false or misleading.

Request 6. Provide all correspondence between FTC and ASTM and ASTM present and past members, officers, directors, or agents.

Request 7. Provide all documents pertaining to the ASTM standards which concern plastics biodegradability, or concern ASTM policies, membership, or revisions to standards.

Request 8. Provide all documents that relate to your contention that end-consumers (as opposed to ECM's trade customers) view, understand, or rely on ECM's written advertising materials.

Request 9. Provide all documents relating to any investigation conducted by you or on your behalf relating to any advertising claims or representations concerning the ECM MasterBatch Pellets, or any other ECM plastics additive.

Request 10. Produce all documents concerning your contention that landfills are generally anaerobic environments that lack oxygen and that restrict the amount of liquid infiltration or moisture content.

Request 11. Provide all documents concerning plastics chemistry, formation, polymerization, formulation, mineralization, enzymatic degradation, or depolymerization in biodegradable and non-biodegradable polymers.

Request 12. Provide all documents relating to your contention that ECM's tests were not designed to support its claims, and that the data from ECM's testing is invalid or cannot support reliable conclusions.

Request 13. Produce all documents concerning the period of time under which conventional plastics generally biodegrade, including documents supporting your contention that plastics will normally require hundreds of thousands of years to biodegrade.

Request 14. Produce all documents concerning your definition of "competent and reliable" scientific evidence as that definition concerns biodegradation claims for plastics in general and ECM' express and/or implied claims challenged by the FTC.

Request 15. Provide all documents relating to any advertisement or promotional material for the ECM MasterBatch pellets, other than documents produced by Respondents in pre-complaint disclosures or discovery.

Request 16. Produce all documents identified in any answer to an Interrogatory propounded by ECM or on which you rely in answering any Interrogatory propounded by ECM.

DATED this 3rd day of December 2013

Respectfully submitted,

/s/ Jonathan W. Emord

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CERTIFICATE OF SERVICE

I hereby certify that on December 3, 2013, I caused a true and correct copy of the paper original of the foregoing **RESPONDENT'S INITIAL DOCUMENT REQUESTS** to be served as follows:

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

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I further 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.

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EXHIBIT RX-C

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Biodegradability of conventional and bio-based plastics and natural fiber composites during composting, anaerobic digestion and long-term soil incubation

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ABSTRACT

Plastics are a major constituent of municipal solid waste that pose a growing disposal and environmental pollution problem due to their recalcitrant nature. To reduce their environmental impacts and allow them to be transformed during organic waste recycling processes, various materials have recently been introduced to improve the biodegradability of plastics. These include conventional plastics amended with additives that are meant to enhance their biodegradability, bio-based plastics and natural fiber composites. In this study, the rate and extent of mineralization of a wide range of commercially available plastic alternative materials were determined during composting, anaerobic digestion and soil incubation. The biodegradability was assessed by measuring the amount of carbon mineralized from these materials during incubation under conditions that simulate these three environments and by examination of the materials by scanning electron micrography (SEM). The results showed that during a 660 day soil incubation, substantial mineralization was observed for polyhydroxyalkanoate plastics, starch-based plastics and for materials made from compost. However, only a polyhydroxyalkanoate-based plastic biodegraded at a rate similar to the positive control (cellulose). No significant degradation was observed for polyethylene or polypropylene plastics or the same plastics amended with commercial additives meant to confer biodegradability. During anaerobic digestion for 50 days, 20–25% of the bio-based materials but less than 2% of the additive containing plastics were converted to biogas (CH_4 + CO_2). After 115 days of composting, 0.6% of an additive amended polypropylene, 50% of a plastarch material and 12% of a soy wax permeated paper pulp was converted to carbon dioxide. SEM analysis showed substantial disintegration of polyhydroxyalkanoate-based plastic, some surface changes for other bio-based plastics and coconut coir materials but no evidence of degradation of polypropylene or polypropylene containing additives. Although certain bio-based plastics and natural fibers biodegraded to an appreciable extent in the three environments, only a polyhydroxyalkanoate-based resin biodegraded to significant extents during the time scale of composting and anaerobic digestion processes used for solid waste management.

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1. Introduction

Plastics are synthetic and semi-synthetic polymeric compounds, derived primarily from fossil carbon sources such as crude oil and natural gas. Their mechanical properties and characteristics such as low-cost, durability and processability, have led to their widespread use for diverse applications. However most commonly used plastics are very resistant to biological degradation [1]. This has led to major challenges for waste management operations especially those that are moving toward more sustainable waste management practices such as recycling, composting and anaerobic digestion.

It is estimated that of the 31 million tons of plastic waste generated annually in the U.S. only 8% is recycled [2]. Therefore, a large percentage of plastic waste is currently landfilled, or released into the environment. Throughout the world, roadsides, parks, beaches, oceans and natural areas are inundated with plastic debris pollution [3]. Waste management systems are also affected by high volumes of plastics that are often commingled with organic wastes (food scraps, wet paper, yard trimmings, soil and liquids), making it difficult and impractical to recycle both organic fractions and/or the plastics mixed with them without expensive cleaning, separation and sanitizing procedures [4].

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The fact that plastics are made from non renewable resources and their persistence in the environment and during organic recycling has resulted in global concern and intensive efforts to develop plastic materials that not only have acceptable prices and similar performance to conventional plastics, but also are made from renewable feedstocks and/or undergo biodegradation in a reasonable amount of time without leaving toxic residues [5].

Although biodegradable bio-based plastics are meant to improve the sustainable use of resources, a complete life-cycle analysis including disposal must be conducted [6] to insure that the solution is not worse than the problem. Many factors impact the life-cycle carbon balance of plastics including the source of the feedstock used to make them, whether the material is recycled and the extent and type of biodegradation during disposal. For example, most plastics are derived largely from fossil sources such as natural gas or crude oil [7]. However the monomers used to make them can also be made from renewable resources. In Brazil, ethylene, the building block of one of the most widely used plastics, polyethylene [8] is made from ethanol derived from sugar cane. Although made from a biomass feedstock, this type of polyethylene is still essentially not biodegradable. On the other hand, petroleum can also be used to make plastics that are biodegradable. The lactic acid used to make polylactic acid (PLA) can be produced both by fermentation and synthetically from petroleum [9], and either type is biodegradable. On this basis, plastics can be classified into four types with respect to whether they are biodegradable and the source of the feedstock used to make them. These four types are conventional plastic, bio-based plastic, biodegradable plastic and biodegradable bio-based plastic (Table 1). Understanding the environmental benefits of these four classes of materials (Table 1) and the impact of their use on GHG emissions can be confusing and is not always straightforward.

Plastics made from petroleum, such as polyethylene, have a well-defined life cycle. When landfilled, the carbon in the plastic will be sequestered and not contribute to global warming. Recycled polyethylene may contribute even less fossil CO_2 to the environment if less energy is used to recycle it than is used to make it in the first place. In these cases, conventional plastics may have less impact on GHG emissions that those designed to biodegrade.

For reasons presented above, efforts have been made to develop durable plastics made from renewable biomass feedstocks [5]. These are called "bio-based plastics". On balance this type of plastic offers a great potential to reduce greenhouse gases in the atmosphere by sequestering carbon. This is because atmospheric CO_2 is fixed into the carbohydrates used as their feedstock. If the plastic is eventually landfilled, this carbon will become locked for millennia within the landfill and on balance reduce atmospheric CO_2. However these plastics also pose pollution problems [10].

Biodegradable bio-based plastics, are also made from biomass but are designed to be compostable and/or biodegradable. These types include PLA and polyhydroxyalkanoates-based resins (PHA) made from corn. This class of polymer is carbon neutral from the standpoint of the carbon in the plastic, but a substantial amount of fossil energy is used to produce the plastic and the biomass feedstocks.

Table 1
Classes of plastics.

Class	Source	Biodegradable	Example	Reference
I	Petroleum/natural gas	No	Polyethylene, polypropylene.	[7]
II	Petroleum/natural gas	Yes	PLA[a] from petroleum.	[9]
III	Biomass (Corn, sugar cane, etc)	No	Polyethylene derived from corn ethanol.	[8]
IV	Biomass (Corn, sugar cane, etc)	Yes	PHA[b], PLA derived from starch.	[14]

[a] Polylactic acid.
[b] Polyhydroxyalkanoates-based resin.

The class with perhaps the greatest potential to contribute to greenhouse gas emissions is biodegradable plastics made from petroleum. This is because not only is fossil energy used to produce them in the first place, but fossil carbon is released when the material ultimately biodegrades. If this biodegradation occurs in a landfill, then it usually will generate methane (CH_4), which is a greenhouse gas with 21 times the warming potential of CO_2. Most landfills do a poor job of capturing this gas, even those with methane recovery systems [11]. So landfilled biodegradable plastics, eventually contribute both methane and carbon dioxide to the atmosphere when they degrade.

Some novel polymers combine both biomass and fossil derived resins to decrease production prices, increase the bio-based content and improve material performance [5] (e.g. a plastarch containing a blend of a starch-based polymer and conventional plastics such as polypropylene). The biogenic renewable carbon contained in these and other biomaterials can be determined from the radioactive C_{14} signature of the product [12]. Yet these hybrid materials likely are neither recyclable nor completely biodegradable and therefore are likely worse than conventional plastics from a GHG emissions perspective.

Composting plays an important and growing role in sustainable organic waste management and recycling. However, plastics are one of the main contaminants in composts. Biodegradable plastics are meant to address this problem. Composting of these materials also reduces their environmental impact in that they will largely be converted to CO_2 and not to CH_4 as they would be in a landfill. Since this CO_2 was originally fixed from the atmosphere into renewable biomass, on balance it will not increase atmospheric CO_2.

Biodegradation is the mineralization of materials as a result of the action of naturally-occurring microorganisms such as bacteria and fungi [13]. The biodegradation of plastics is limited by their molecular weight, chemical structure [14], water solubility and the fact that most plastics are xenobiotic. That is, they were not present in the environment until very recently so that the evolution of metabolic pathways necessary for their biodegradation, a process that takes millions of years, has yet to occur.

In contrast, the biodegradation of natural polymers, such as starch or cellulose by microorganisms occurs relatively rapidly. It begins with the excretion of extracellular enzymes that depolymerize these materials. Once the polymer is reduced to a size that is water soluble and able to be transported through the cell wall, microbial metabolic pathways can then mineralize it [15]. Even though microorganisms drive the biodegradation process, other non-biotic chemical processes such as photo-oxidation and chemical degradation may also take place before or in parallel.

Biodegradable materials are used in diverse applications. Many different biodegradable plastics are used for food packaging and for waste containment. They have also been developed for medical applications, including medical devices and for drug delivery [16]. Biodegradable plastics are used widely in agriculture, as mulching films and low tunnels [17,18] as well as guide strings and plant nursery containers [19]. The physical properties and performance of biodegradable plastics made from PLA and natural fibers were found to be similar to conventional plastics for greenhouse crop production [20]. In addition, biodegradable potting containers have gained a high degree of acceptance among consumers [21].

Recently, various materials have begun to be marketed that claim to be biodegradable or compostable. Terms such as "degradable", "oxo-biodegradable", "biological", "compostable" and "green" are often used to describe and promote different

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plastics. These materials include conventional plastics amended with additives meant to enhance biodegradability as well as bio-based plastics and natural fiber composites. There has been little research on the extent to which these materials truly degrade and/or biodegrade over the time scale of waste management processes such as composting and anaerobic digestion (AD) or in natural settings [22].

The objective of this study was to compare the relative biodegradability of a range of novel plastics and natural fiber composites during composting, AD and in soil conditions. The hypothesis was that materials that are referred to as biodegradable, compostable (or similar terms), and plastics containing additives designed to enhance biodegradability, mineralize during the time scale of waste treatment processes and in reasonable amounts of time in the environment and at rates comparable to natural materials known to be biodegradable and or compostable (e.g. cellulose paper).

2. Materials and methods

Standardized laboratory-scale experiments were conducted to study the biodegradability of various materials during soil incubation, composting and AD conditions [23–25]. The extent of biodegradation was calculated by measuring the average carbon (CO_2 and or CH_4) mineralized from each treatment minus the average carbon evolved from blanks, and dividing this by the total amount of sample carbon added to each treatment. Reactors containing only the inoculum (AD), soil (soil tests) or compost (compost tests) were used as blanks.

2.1. Materials

Materials tested included plastics designed to be biodegradable, conventional plastics amended with additives that are meant to enhance biodegradability, bio-based plastics and natural fiber composites (Tables 2 and 3). The positive and negative controls used for all experiments were cellulose paper (Fisher Scientific, PA, U.S.) and 100% conventional polypropylene (PP), respectively. Materials were tested both after grinding (a preliminary soil experiment only) and as 1 × 1 cm squares (thicknesses shown in Table 3).

2.2. Biodegradation in soil incubation

The extent of long-term biodegradation of polymeric materials in contact with soil was determined based on ASTM D5988-03 [24]. These included PP + 2% additive, polystyrene (PS) + 2% additive, polyethylene terephthalate (PETE) + 1% additive, plastarch, a co-polyester + corn-based plastic, a wheat starch-derived plastic and PHA (Tables 2 and 3). Six natural fiber composite materials were also tested: paper pulp, paper pulp + asphalt, coconut coir, rice hull, composted cow manure and peat fiber. All samples were incubated in triplicate for a period of 660 days.

The soil media used for the experiments was a mixture of 43% certified organic top soil, 43% no-till farm soil collected at coordinates: 40.778633, −81.930873 and 14% sand. Soil was sieved to less than 2 mm particle size and large plant materials, stones, and other inert materials were removed. The chemical properties of the soil mixture are shown in Table 4. The soil media was amended with ammonium phosphate (Fisher Scientific, PA, U.S.) to maintain a C:N ratio of 20:1 based on the carbon content of the test specimen.

The soil mixture (300 g dry) was placed in the bottom of a 2-L (working volume) wide mouth jar (Ball® Corporation, item # 383178). Distilled water was added to bring the moisture content of the mixture to 60% of the moisture holding capacity. The test specimens (1 g of sample carbon) were then mixed thoroughly into the soil. A solution containing 20 ml of potassium hydroxide (KOH) 0.5 N (Fisher Scientific, PA, U.S.) was placed in a cup suspended from the lid of each vessel to trap evolved CO_2. All vessels were sealed and incubated at room temperature (20 ± 2 °C).

Carbon dioxide produced in each vessel reacted with the KOH in the cup to form potassium bicarbonate. The amount of CO_2 produced was determined by titrating the KOH solution with 0.25 N hydrochloric acid (Fisher Scientific, PA, U.S.) to a phenolphthalein end-point. The experiment was designed so that the headspace volume was sufficient to prevent the oxygen concentration in the vessel from falling below 18%. The KOH traps were removed and titrated at time intervals that assured that their absorption capacity was not exceeded. The KOH traps were refilled at a rate dependent on the rate of CO_2 generation in each flask. At the time of removal of the traps, the vessel was flushed and allowed to sit open to allow fresh air to fill the headspace. In addition, distilled water was added to the soil to the original weight to maintain adequate moisture.

The effect of particle size on biodegradation rate was determined by comparing the biodegradability of 1 cm squares to ground samples. Samples were ground in liquid nitrogen using a IKA® A11 basic Analytical mill (IKA® Works Inc., NC, U.S.) for 10 s. Test specimens included PP + 2% additive, co-polyester + corn-based plastic, wheat starch-derived plastic, paper pulp, paper pulp + asphalt, coconut coir and rice hull (Tables 2 and 3). Samples were incubated in triplicate for 660 days.

Table 2
Material information for commercially available bio-based plastics, plastics amended with additives and natural fiber composites.

Material	Material description	Formation process[a]
PP + 2% additive	Blend of polypropylene (PP) with 2% ECM MasterBatch Pellets™ additive (ECM BioFilms Inc., OH, U.S.)	1
PS + 2% additive	Blend of polystyrene (PS) with 2% ECM MasterBatch Pellets™ additive (ECM BioFilms Inc., OH, U.S.)	1
PETE + 1% additive	Blend of polyethylene terephthalate (PETE) with 1% EcoPure® additive (Bio-Tec Environmental LLC., NM, U.S.).	2
Plastarch	A blend of polypropylene with corn starch.	3
Co-polyester + corn-based plastic	Blend of an aliphatic aromatic co-polyester with a corn starch-derived polymer (Ecobras™, BASF).	1
Wheat starch-derived plastic	Made from a wheat starch-derived resin (OP-47 Bio®, Summit Plastic Company, OH, U.S.).	3
PHA	Made from polyhydroxyalkanoates-based resin (Metabolix, MA, U.S.).	1
Paper pulp + soy wax	Paper pulp pot permeated with soy wax.	4
Paper pulp	Recycled (74% minimum) paper pulp.	4
Paper pulp + asphalt	Blend of recycled (74% minimum) paper pulp + asphalt.	4
Coconut coir	Made from coconut husk.	7
Rice hull	Made from rice hull.	5
Composted cow manure	Made from composted cow manure.	6
Peat fiber	Made from Canadian sphagnum peat moss + wood pulp.	6

[a] 1 = injection molding; 2 = blow molding; 3 = thermoforming; 4 = vacuum forming; 5 = compression forming; 6 = pressure forming; 7 = other.

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Table 3
Chemical and physical properties of the test specimens.

Material	Chemical and physical properties[a]				
	Total solids (%)	Volatile solids (%dw)	Total carbon (%dw)	Total nitrogen (%dw)	Film thickness (mm)
Positive	90.3 ± 5	57.4 ± 1.1	41.8 ± 0.1	0.03 ± 0.01	0.35 ± 0.01
Negative	99.8 ± 0.1	96.3 ± 2	82.9 ± 0.1	0.06 ± 0.003	0.37 ± 0.01
PP + 2% additive	99.8 ± 0.1	97.7 ± 0.1	82.9 ± 0.3	0.04 ± 0.01	0.37 ± 0.03
PS + 2% additive	99.9 ± 0.1	97.0 ± 1.5	88.8 ± 1	0.05 ± 0.01	0.23 ± 0.01
PETE + 1% additive	99.4 ± 0.5	99.9 ± 0.1	64.6 ± 0.1	0.01 ± 0.002	0.36 ± 0.01
Plastarch	90.9 ± 2.1	57.5 ± 3	60.9 ± 0.2	0.07 ± 0.01	0.48 ± 0.03
Co-polyester + corn-based plastic	95.2 ± 0.1	99.8 ± 0.1	51.9 ± 0.3	0.10 ± 0.01	0.72 ± 0.02
Wheat starch-derived plastic	97.8 ± 0.4	98.5 ± 0.5	49.4 ± 0.1	0.74 ± 0.004	0.50 ± 0.01
PHA	99.4 ± 0.4	90.4 ± 0.5	50.7 ± 0.3	0.45 ± 0.01	0.62 ± 0.01
Paper pulp + soy wax	94.3 ± 1	91.0 ± 0.4	46.9 ± 0.3	0.06 ± 0.01	2.14 ± 0.03
Paper pulp	92.0 ± 0.1	92.0 ± 0.1	42.1 ± 0.1	0.10 ± 0.01	2.74 ± 0.01
Paper pulp + asphalt	93.4 ± 0.5	90.6 ± 0.3	46.9 ± 0.03	0.22 ± 0.02	2.61 ± 0.1
Coconut coir	96.8 ± 0.3	98.5 ± 0.5	46.7 ± 0.3	0.26 ± 0.002	1.09 ± 0.02
Rice hull	94.0 ± 0.4	89.6 ± 0.4	38.3 ± 0.1	14.1 ± 0.06	1.24 ± 0.02
Composted cow manure	92.5 ± 0.1	89.4 ± 1.0	40.5 ± 0.01	1.12 ± 0.05	2.40 ± 0.1
Peat fiber	92.1 ± 0.3	97.8 ± 0.5	45.4 ± 0.3	0.49 ± 0.07	1.74 ± 0.05

[a] Values are means ± SD of three replicates.

2.3. Biodegradation during composting

Three materials were tested under simulated composting conditions. These included PETE + 1% additive, plastarch and paper pulp + soy wax (Tables 2 and 3). The experiments were conducted in triplicate for a period of 115 days.

The test conditions used were based on a protocol described in ASTM D5338-98 (2003) [25]. This test is a measure of the degree and rate of carbon conversion to CO_2 under conditions that mimic a commercial scale industrial composting facility.

An 80 g sample of each test specimen was mixed with 350 g dry of mature compost inoculum (Table 4). The compost inoculum was obtained from a full-scale windrow composting facility featuring a concrete surface and controlled aeration system at OARDC. The compost contained a mixture of dairy manure and hardwood sawdust as described elsewhere [26].

The compost was collected at various locations on the windrow and screened to less than 10 mm and large inert items were discarded. The screened compost was amended with ammonium phosphate (Fisher Scientific, PA, U.S.) to give a C:N ratio of 20:1 including the carbon content of the test specimen. The initial moisture content of the mixture was adjusted to 60% (wet-weight basis).

The compost and test specimens were incubated in 4-L (working volume) vessels (length 30 cm and diameter 15 cm), made of PVC pipe placed in a 55 °C incubator (BioCold Environmental Inc., MO, U.S.). Each vessel contained approximately 1100 g of material on a wet-weight basis. The reactors were aerated from below at 100 ± 1 ml/min to maintain aerobic conditions. To avoid drying during the experiment, air was saturated by bubbling through bottles containing water at the incubator temperature. The air exiting the vessels was passed through flasks in a separate water bath set at 9 °C to condense moisture from the off-gas. The off-gas was then analyzed for percent CO_2 using an infrared gas analyzer (Vaisala model GMT 220, range 0–20%). CO_2 data was automatically recorded using a Campbell Scientific model 23XL data logger for each vessel every hour. Each vessel was also equipped with a K-type thermocouple to measure the temperatures of the composts mix near the center of the compost vessel, and was recorded automatically every 12 min. A more complete description of the laboratory-scale composting system can be found elsewhere [27].

2.4. Biodegradation during anaerobic digestion

The biodegradation of four materials was compared during high solids batch anaerobic digestion. These included PP + 2% additive, PETE + 1% additive, plastarch and a co-polyester + corn-based plastic (Tables 2 and 3). The experiments were conducted in triplicate for a period of 50 days.

The anaerobic degradation of the polymeric materials was compared under high-solids AD conditions based on a protocol described in ASTM D5511-02 [23] international standard. The test measured the conversion of samples to CO_2 and CH_4 during incubation under controlled anaerobic conditions. For this study test specimens were exposed to an active methanogenic inoculum derived from a full-scale anaerobic digester treating municipal sewage sludge. These conditions resemble those found in high-solids AD digestors and in biologically active landfills, but not in typical landfills where water is excluded and removed.

Table 4
Initial mean characteristics of the aerobic and anaerobic organic substrates.

Organic substrate	Chemical and physical properties[a]				
	Total solids (% ww)	Volatile solids (% dw)	Total carbon (% dw)	Total nitrogen (% dw)	pH
Compost[b] inoculum	24.3 ± 2.0	88.9 ± 1.0	48.7 ± 5.5	2.37 ± 0.2	7.95 ± 0.04
Soil mixture[c]	87.4 ± 0.1	2.96 ± 0.1	1.19 ± 0.2	0.13 ± 0.02	7.43 ± 0.4
Anaerobic seed[d] sludge	8.92 ± 0.5	59.5 ± 2.0	36.8 ± 1.0	7.21 ± 0.2	8.30 ± 0.01
Medina County[e] OFMSW	47.2 ± 7.2	60.3 ± 1.2	89.6 ± 1.3	0.92 ± 0.2	7.50 ± 0.4

[a] Values are means ± SD of three replicates.
[b] Dairy manure and hardwood sawdust mature compost.
[c] This is the value before adding water to reach 60% of the water holding capacity.
[d] Methanogenically active municipal sewage sludge.
[e] OFMSW = the organic fraction of municipal solid waste.

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The AD assays were conducted in 2-L (working volume) laboratory-scale batch reactors. Temperatures were maintained at a mesophilic (37 ± 1 °C) range by means of incubators. Test specimens (25 g of sample carbon) were mixed with 750 g wet of methanogenically active sludge obtained in October of 2010 from a full-scale (3000 m^3) anaerobic digester located at the City of Akron wastewater treatment plant and operated by KB Compost Services, Akron, Ohio [28]. This was mixed with 187.5 g wet of the organic fraction of municipal solid waste (OFMSW) of the Medina County, Ohio Solid Waste District to achieve the desired solids content for the test and to provide supplemental nutrients for the anaerobic microbial consortia. The chemical properties of the seed sludge and OFMSW substrate are shown in Table 4. Ammonium phosphate (Fisher Scientific, PA, U.S.) was added to the mixture to adjust the C:N ratio to a value of 20:1 considering the carbon content of the test specimen.

The volumetric production and CO_2 and CH_4 content of the biogas produced in the AD experiments were analyzed by volume displacement and gas chromatography as described by Gómez et al. [28], respectively. This information was used to calculate the moles of carbon emitted from each reactor.

2.5. Analytical methods

Solids content in soil, organic substrates and test specimens was determined by drying samples to a constant weight at 80 °C. The volatile solids content was determined using an ashing oven set at 500 °C for 4 h. pH was determined using a pH electrode (TMECC 04.11-A 1:5 slurry method, mass basis). Carbon (TMECC 04.01-A combustion with CO_2 detection) and nitrogen content (TMECC 04.02-D oxidation, Dumas method) were determined by the Service Testing and Research laboratory at the OARDC.

Selected test specimens were also analyzed before and after soil incubation using scanning electron microscopy (SEM) (Hitachi S-3500N, Hitachi High Technologies America, Inc., CA, U.S.). Samples were coated with platinum to a thickness of 0.2 kA° using a Hummer® 6.2 sputtering system (Anatech USA, CA, U.S.). A 15 Kv electron beam was applied.

2.6. Statistical analysis

Three independent replicates were used for each treatment. Analysis of variance (ANOVA) was calculated for the average final cumulative percent of carbon loss for each of the studies. Comparisons for all pairs of final cumulative biodegradation means were performed using Tukey–Kramer HSD analysis. All conclusions were based on a significant difference level of $\alpha = 0.05$. The statistical analyses were performed using JMP statistical program version 9 (SAS Institute Inc., SAS Campus Drive, NC, U.S.).

3. Results and discussion

3.1. Biodegradation during soil incubation

The importance of understanding the biodegradability of plastics in soil has increased since these are released inadvertently into the environment where they may persist. Plastics comprise a relatively large fraction of the ubiquitous pollution found worldwide in both land and ocean environments [29]. In addition, intensive and semi-intensive agriculture utilizes large quantities of these materials annually in the form of mulches, as plantable pots, nursery containers [30].This has resulted in the recent development of biodegradable agricultural plastics for these applications [31,32]. One example of this is biodegradable plant nursery pots. Some containers are designed to be plantable pots (e.g. rice hull and coconut coir) allowing them to degrade in the soil after planting, or to be composted at plant nurseries rather than being landfilled.

An initial experiment was conducted to assess the effect of particle size on biodegradation during soil incubation. Seven materials were tested and the amount of carbon converted to CO_2 was compared using student's t method for particle size effect. Student's t method revealed that out of the seven materials studied in this experiment, only one, a co-polyester + corn-based plastic, showed a significant effect of particle size on biodegradability. A significantly greater extent of biodegradation was observed for co-polyester + corn-based plastic in 1 × 1 cm square film form (55.1 ± 2.1%) after 660 days as compared to a ground sample of the same material (39.71 ± 2.4%). For the rest of the materials, there was not a significant effect of particle size on biodegradation. Results from this study suggested that for most of the materials studied, biodegradability in soil was not greatly affected by particle size under the experimental conditions used in the study.

A second soil experiment was conducted to evaluate the relative biodegradability of thirteen different test specimens in 1 × 1 cm square film form. These included bio-based plastics, plastics amended with additives that are meant to enhance biodegradability and natural fiber composites. The experiment was conducted for a period of 660 days. The initial moisture content of the mixes was 16.6 ± 2.1% and the final mean soil moisture content on a wet-weight basis across all treatments was 14.3 ± 3.3% (wet-weight basis) which is 84.9 ± 2.4% of the 60% moisture holding capacity of the soil mixture. The positive control (cellulose paper) exhibited 74.2 ± 4.5% conversion during the period of incubation.

For some bio-based plastics and the positive controls (cellulose paper), the initial rate of mineralization was rapid (Fig. 1). Most of the mineralization took place during the first 300 days of incubation (Fig. 1). The most rapid initial rate of conversion was observed for co-polyester + corn-based plastic with almost 34.6 ± 2.4% mineralized during the first 55 days of the experiment. The extent of PHA biodegradation was initially lower, but its extent surpassed that of co-polyester + corn-based plastic after approximately 280 days reaching a value of 48.5 ± 4.6%. For the wheat starch-derived plastic and plastarch conversion rates were 14.2 ± 0.8 and 24.6 ± 1.4% after 110 and 280 days of experiment, respectively.

Final (660 days) cumulative biodegradation values during soil incubation for the positive control, PHA and co-polyester + corn-based plastic were 74.2 ± 4.5, 69.2 ± 6.4 and 55.1 ± 6.1%, respectively. For the wheat starch-derived plastic and plastarch the final conversion reached 19.7 ± 1.1 and 31.3 ± 1.7%, respectively.

SEM images of PHA and co-polyester + corn-based plastic before and after mineralization showed substantial changes in the

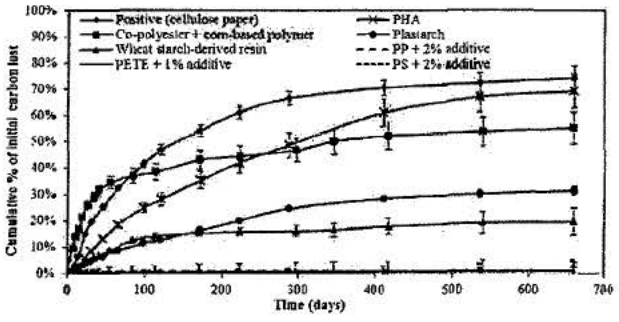

Fig. 1. Cumulative carbon loss (CO_2–C) as percentage of initial carbon (±cumulative standard error) for bio-based plastics and for conventional plastics amended with additives during 660 days of soil incubation. For some data points standard error bars are smaller than markers.

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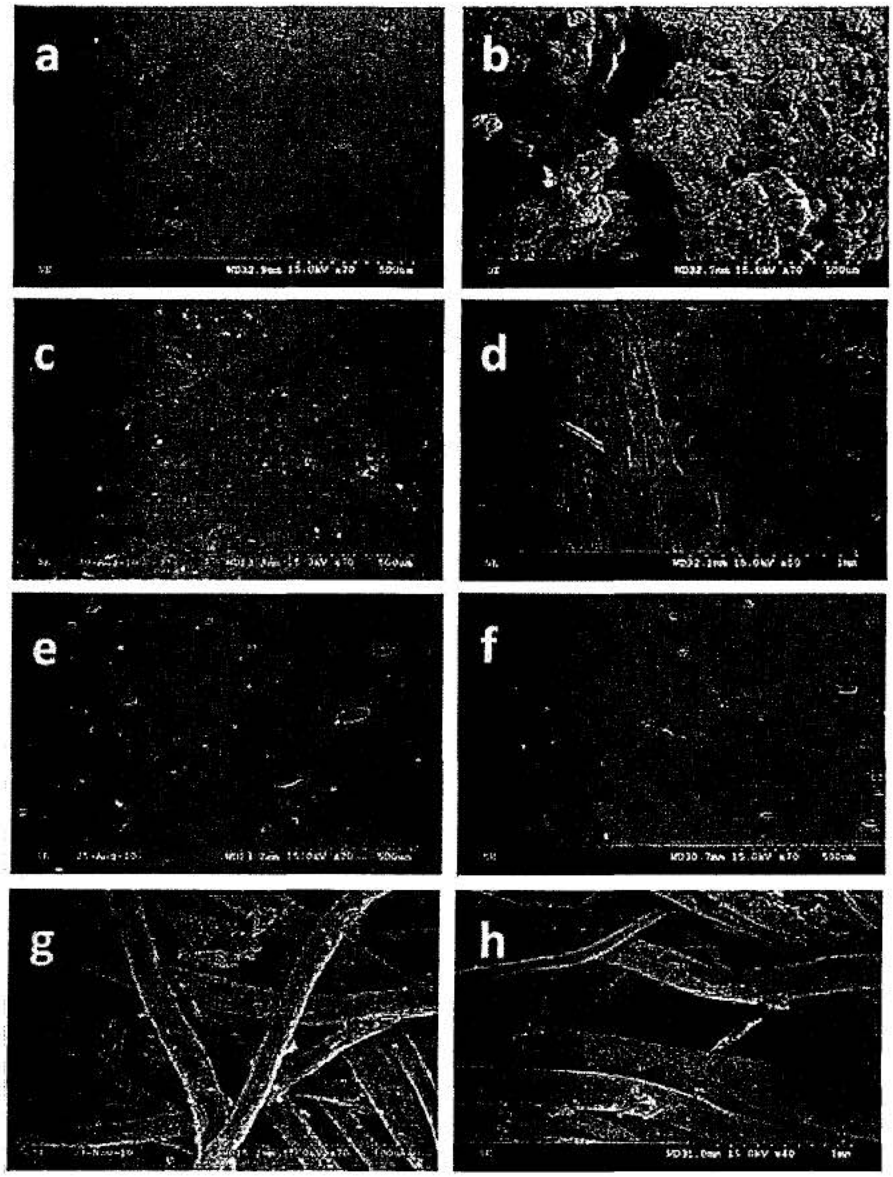

Fig. 2. Scanning electron micrographs of plastics during 2 years of soil incubation. From top to bottom: PHA (a: initial, b: final), co-polyester + corn-based plastic (c: initial, d: final), polypropylene + 2% additive (e: initial, f: final) and coconut coir (g: initial, h: final).

surface of the PHA material (Fig. 2A and B) and some degradation of the co-polyester + corn-based plastic (Fig. 2C and D).

For conventional plastics and the same plastics amended with additives that were supposed to enhance biodegradability, almost no biodegradation was observed after nearly two years of incubation in soil (Fig. 1). The highest observed conversion during soil incubation was 1.0 ± 0.1% (PP + 2% additive). For all other plastics amended with additives, the final cumulative biodegradation ranged between 0.9 and 1%. These values were less than that measured for the negative control (PP) which reached a final cumulative conversion of 1.3 + 0.7%. Although they were not significantly different. SEM images did not reveal qualitative changes in the appearance of PP or PP + 2% additive after the 2 year incubation period (Fig. 2E and F).

The mineralization in soil of the natural fiber composite materials was most rapid during the first 65 days of the experiment

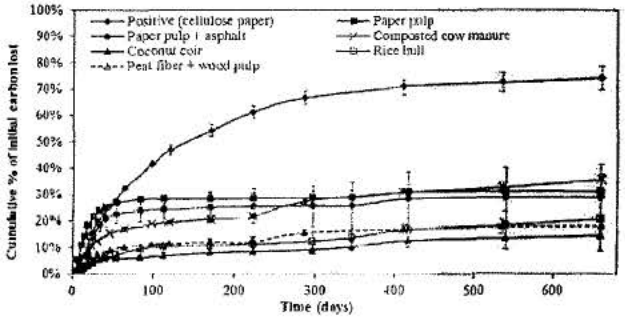

Fig. 3. Cumulative carbon loss (CO_2–C) as percentage of initial carbon (±cumulative standard error) for natural fiber composites during 660 days of soil incubation. For some data points standard error bars are smaller than markers.

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(Fig. 3). This was followed by a period of slow mineralization until the termination of the experiment (Fig. 3). After 660 days, the mineralization percent of the composted cow manure, paper pulp and paper pup + asphalt were 35.5 ± 2.3, 31.3 ± 3.6, 29.4 ± 2.1%, respectively. Lower final conversion values were observed for rice hull, peat fiber and coconut coir with values of 21.1 ± 2.6, 18.3 ± 0.7 and 14.4 ± 2.5%, respectively. SEM images of coconut coir revealed some surface changes indicative of biodegradation (Fig. 2G and H).

Approximately 74.2% of cellulose added to soil was converted to CO_2 after 660 days. This is similar to the conversion of cellulose of 80% reported in a 800 day soil incubation conducted to evaluate how carbon substrates affect microbial biomass yield in soil biodegradation tests [33].

The highest biodegradability observed during soil incubation was reported for PHA (70%); a polyhydroxyalkanoate-based plastic. This was similar in magnitude to the extent of mineralization of the cellulose positive control (cellulose paper). Bacterial polyhydroxyalkanoates are intracellular aliphatic polyesters of various chain lengths [34]. Several studies have been conducted to study the biodegradability of aliphatic polyesters under different conditions [35–38]. Mineralization of these polymers is mainly achieved by cleavage of the ester bonds which occurs due to both enzymatic and chemical hydrolysis [39].

Statistically analysis revealed that significant differences in the extent of biodegradation ($F_{15,32} = 822.2$, $P < 0.0001$) existed between group means. Tukey–Kramer HSD analysis revealed that among bio-based plastics, the difference between PHA and the positive control (cellulose paper) was not significant. Analyses also revealed that differences were not significant between plastics amended with additives that are meant to enhance biodegradability and the negative control (PP). For natural fiber composites all test specimens differed significantly from both the positive and negative controls (Fig. 3).

The results of this study indicate that conventional plastics containing additives do not biodegrade any faster than non-additive containing plastics in soil. Manufacturers of these additives claim that if at least 1–5% (by weight) of their additive is added to plastics products, these will fully biodegrade when disposed of in microbe-rich environments. These claims are not supported by the findings of this study.

The greatest extent of biodegradation among the fiber composite materials tested was the composted cow manure (35%). This was unexpected since low carbon conversion rates were anticipated for the composted cow manure since it had previously been biologically degraded. After undergoing a composting cycle, much of the carbon contained in the cow manure was expected to be stable and humified [26,40]. However, much less extents of degradation were observed for uncomposted composites produced from rice hulls, from peat fiber pot and coconut coir. For these materials, the extent of degradation in soil ranged from 14 to 21% (Fig. 3). These materials have been used as natural composites due to their low price and structural strength [41,42]. Approximately 46% of coconut coir is lignin [43] as is 21–40% of rice hulls [44] which may have limited their biodegradation.

3.2. Biodegradation during composting

Three different materials were evaluated for their relative rate of degradation during composting. The materials were composted at 55 °C under aerobic conditions for a period of 115 days. The tested materials included plastarch, paper pulp + soy wax and PETE + 1% additive (Tables 2 and 3).

The initial moisture content was adjusted to 60% and the final mean compost moisture content across all treatments was 64.2 ± 3.3% (wet-weight basis).

Mineralization under composting conditions occurred at a rapid initial rate for both the positive control and the plastarch material during the first 80 days (Fig. 4). Overall, the positive control (cellulose paper) exhibited 78.4 ± 3.5% conversion during composting.

For paper + soy wax, a majority of the mineralization took place during the first 15 days. For PETE + 1% additive no significant conversion was observed over the entire period of study (Fig. 4). The final cumulative biodegradation during composting for plastarch, paper + soy wax and PETE + 1% additive was 51.3 ± 4.9, 12.4 ± 2.7 and 0.6 ± 3.7%, respectively. The ANOVA indicated that statistically significant differences in the extent of biodegradation ($F_{4,7} = 496.6$, $P < 0.0001$) existed between group means. Tukey–Kramer HSD analysis revealed that all test specimens differed from the positive control. However, PETE + 1% additive did not differ significantly from the negative control.

None of the tested materials mineralized at rates comparable to the positive control material. The highest cumulative biodegradation during composting was observed for the plastarch containing material (51.3%). Starch is made of repeating glucose units linked by glucosidic bonds that are susceptible to enzymatic attack. Uses and applications of starch in its native form or blended with other materials have been discussed [45,46]. Biodegradation of the starch containing portion of the material has been reported [47,48]. However the reason that the plastarch degraded more slowly than cellulose is not known.

After 20 days, only 12% of the paper pulp composite was converted to CO_2 during composting. The low level of cumulative degradation could be related to inhibitory properties of the soy derived wax on the microbial consortia or limiting water accessibility. For plastics containing additives, no degradation was observed. Additives did not improve the biodegradability of PETE during composting.

3.3. Biodegradation during anaerobic digestion

Understanding the biodegradation of different materials in anaerobic conditions such as in industrial sewage sludge AD systems, landfills and anoxic environments is important since under these conditions, microorganisms mineralize organic substrates to both CO_2 and methane. Methane itself can be used as a fuel source but if not captured it has a global warming potential 21 times stronger than CO_2. Since in the U.S. only 30% of the landfills capture methane and among those that do capture, only a small percentage of the methane produced is recovered, then biodegradable plastics in landfills have a greater potential than composted biodegradable plastics to contribute to global warming.

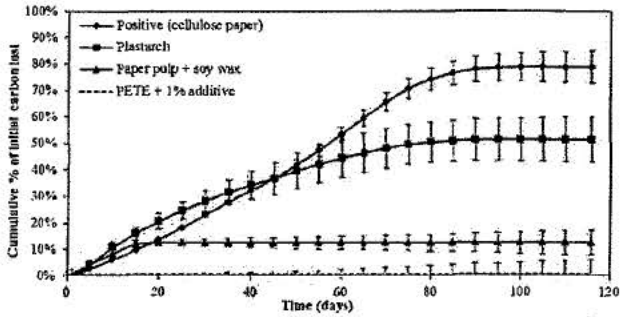

Fig. 4. Cumulative carbon loss (CO_2–C) as percentage of initial carbon (±cumulative standard error) for bio-based plastics, conventional plastics amended with additives and natural fiber composites during 115 days of thermophilic composting. For some data points standard error bars are smaller than markers.

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The biodegradability of polymeric materials exposed to an active methanogenic inoculum was studied under controlled laboratory conditions that resemble those found during active AD for a period of 50 days. They likely differ somewhat from the conditions within a landfill where moisture is usually removed and a greater diversity of materials is present. Yet the extent of biodegradation is likely similar to what would ultimately occur over many years in a landfill environment.

Materials tested included plastarch, co-polyester + corn-based plastics, PP + 2% additive and PETE + 1% additive (Tables 2 and 3). The mean methane content in the biogas across treatments during the entire period of study was 54.1 ± 6.1%.

During the AD incubation, the positive control (cellulose paper) exhibited 74.1 ± 4.8% conversion. For plastarch, the carbon conversion rate to biogas was similar to the positive control (cellulose paper) for the first 7 days (Fig. 5). However, after this period, the rate of conversion slowed as compared to the positive control through day 28. In contrast, no significant mineralization was observed for the plastics containing additive samples over the entire period of the study.

The final cumulative carbon conversion during AD for plastarch and co-polyester + corn-based plastic were 26.4 ± 3.5 and 20.2 ± 4.4%, respectively. The final conversion values for PP + 2% additive and PETE + 1% additive were 3.1 ± 3.7 and 2.2 ± 1.6%, respectively. The ANOVA indicated that statistically significant differences in the extent of biodegradation ($F_{5,12} = 50.7$, $P < 0.0001$) existed between group means. The Tukey–Kramer HSD analysis revealed that the bio-based plastics were significantly different than the positive control but not different from each other. There was no significant difference in the carbon conversion of the negative control (PP) and the plastic containing the additive.

The biodegradability of different bio-based materials including cellulose and starch [49,50] has been investigated previously under anaerobic conditions [51,52]. Yagi et al. [53] studied the biodegradability of cellulose powder under mesophilic (35 °C) and thermophilic (55 °C) AD conditions. Cellulose powder reached a cumulative conversion of 80% under both temperature conditions. Other authors have also studied the anaerobic mineralization of aliphatic polyesters. Abou-Zeid et al. [54] conducted a study to determine the biodegradability of the natural polyesters poly(b-hydroxybutyrate) (PHB), poly(b-hydroxybutyrate-co-11.6%-b-hydroxyvalerate) (PHBV) and the synthetic polyester poly(o-caprolactone) (PCL) using different anaerobic sludges and individual strains. Biodegradability of the powdered materials was measured as the percent of weight loss. They found that almost all the PHB was converted in 9 days, but only 60 and 30% weight loss was observed for the PHBV and PCL, respectively. Similar results were reported by Shin et al. [55] in which nearly complete conversion was observed for the natural bacterial polyester but no biodegradability for synthetic analogs was observed under simulated landfill conditions.

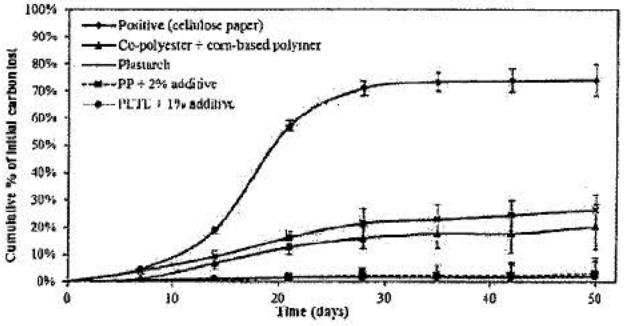

Fig. 5. Cumulative carbon loss (CO_2–C) as percentage of initial carbon (±cumulative standard error) for bio-based plastics, conventional plastics amended with additives and natural fiber composites during 50 days of anaerobic digestion. For some data points standard error bars are smaller than markers.

The results of this study indicate that materials have different rates of mineralization under different end of life scenarios. For example, the positive control reached 70% conversion in 25 days during AD while 75 and 400 days were needed to reach the same extent of conversion under composting and soil incubation conditions, respectively. The plastarch material degraded faster under composting conditions reaching 50% conversion in 85 days than under AD and soil incubation conditions where only 26 and 30% was converted after 50 and 660 days, respectively. For co-polyester + corn-based plastic 20% of the material was converted during 20 days of soil incubation while 50 days were needed to reach the same value during AD. Ultimately, co-polyester + corn-based plastic reached 55% conversion after 660 days of soil incubation. Conventional plastics and those containing additives did not degrade at all under any of the three conditions.

Biodegradable plastics are potential alternatives to petroleum-based materials that can be incorporated into organic recycling schemes based on anaerobic digestion or composting. They also could potentially reduce the pollution associated with conventional plastics and therefore lead to the development of products that are more environmentally friendly. Ideally, biodegradable materials must be useful for a predetermined service life and then biodegrade in a short period of time, leaving no visible fragments and no toxic residues when composted or anaerobically digested. Disposal of these materials in landfills as opposed to anaerobic digestions is not recommended since under anaerobic conditions they biodegrade to form methane and most landfills capture only a small fraction of the methane created [56].

4. Conclusion

In this study, the relative biodegradability of a range of polymeric materials and natural fiber composites used for various commercial applications was investigated under composting, soil incubation and anaerobic digestion conditions. The validity of the tests was confirmed in that positive controls (cellulose paper) biodegraded by more than 70% in all three systems in a reproducible manner.

While some of the bio-based plastics and natural fibers biodegraded to an appreciable extent, plastics containing additives that supposedly confer biodegradability to polymers such as polyethylene and polypropylene did not improve the biodegradability of these recalcitrant polymers. SEM analysis confirmed that substantial biodegradation of polyhydroxyalkanoate-based plastics occurred and that some surface changes occurred in co-polyester + corn-based plastic and coconut coir materials. However, SEM confirmed that no degradation of polypropylene and polyethylene occurred, even after amendment with additives meant to confer biodegradability.

The relative biodegradability of the materials during long-term soil incubation was PHA > co-polyester + corn-based plastic > composted cow manure > plastarch > paper pulps > natural fibers > conventional plastics containing additives to enhance biodegradability = conventional plastics. For anaerobic digestion and composting the relative biodegradability was plastarch > co-polyester + corn-based plastic > conventional plastics with additives and plastarch > paper pulp + soy wax > conventional plastic with additives, respectively.

Over the time scale of organic recycling processes (composting and anaerobic digestion) most of the bioplastics biodegraded to

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only a limited extent. Furthermore, under anaerobic incubation, some of the bio-based plastics biodegraded to generate methane, a potent greenhouse gas that unless captured may negate the perceived environmental benefits of using these materials. Biodegradable plastics made from petroleum (Class II), may have more adverse environmental impacts than conventional plastics (Class I) if their ultimate fate is landfilling and anaerobic conversion to methane.

Acknowledgments

The authors thank the Ohio State University Department of Food, Agricultural and Biological Engineering for financial support to the main author during this project. We would also like to thank the OSU Molecular and Cellular Imaging Center at OARDC for assistance with scanning electron micrographs.

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EXHIBIT RX-D

UNITED STATES OF AMERICA
BEFORE THE FEDERAL TRADE COMMISSION

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

COMPLAINT COUNSEL'S RESPONSE TO RESPONDENT ECM BIOFILMS, INC.'S FIRST SET OF REQUESTS FOR PRODUCTION OF DOCUMENTS AND THINGS

Pursuant to Rule 3.37 of the Federal Trade Commission's Rules of Practice for Adjudicative Proceedings, Complaint Counsel hereby submits the following objections and responses to Respondent ECM Biofilms, Inc.'s ("ECM's") First Set of Requests for Production of Documents and Things.

GENERAL OBJECTIONS

1. Complaint Counsel reserves the right to assert additional objections to production of information or documents as appropriate and to supplement these objections and responses. As to each request where Complaint Counsel has stated that it will produce or make responsive documents available for inspection, such a statement does not imply or represent that responsive documents are known to exist or do, in fact, exist. Complaint Counsel objects to the Document Requests to the extent they seek information that is not relevant to the subject matter of the litigation and/or not reasonably calculated to lead to the discovery of relevant information.

2. Complaint Counsel's willingness to provide information or documents notwithstanding the objectionable nature of the Document Request shall not be construed as (a) an acknowledgment or admission that the material is relevant; (b) a waiver of the General

Objections or the Objections asserted in response to specific document requests; or (c) an agreement that requests for similar information will be treated in a similar manner.

3. Complaint Counsel objects to each document request to the extent that it calls for information or the production of any document that is protected from disclosure by the attorney-client privilege, the attorney work-product privilege, the deliberative process privilege, the law enforcement privilege, the investigative privilege, the government informant privilege, the non-testifying expert privilege, the joint prosecution privilege, the common interest doctrine, that is exempt from disclosure pursuant to confidentiality provisions set forth in the FTC Act, that is protected from disclosure by the privilege for information given to the FTC on a Pledge of Confidentiality, that is protected from disclosure under principles of financial privacy, that is subject to a protective order from another litigation, or that is subject to any other applicable legal protection or privilege. The inadvertent production of any privileged documents shall not be deemed a waiver of any applicable privilege with respect to that document or any other document or information.

4. Complaint Counsel objects to each document request to the extent that it calls for materials generated and transmitted between Complaint Counsel and non-testifying Federal Trade Commission employees, as outside the scope of discovery pursuant to Rule 3.31(c)(2).

5. Complaint Counsel objects to each document request to the extent it seeks information that is not relevant to the subject matter of the litigation and/or not reasonably calculated to lead to the discovery of information relevant to the allegations of the complaint, to the proposed relief, or to Respondent's defenses.

6. Complaint Counsel objects to each document request to the extent that it is overly broad, unduly burdensome, vague, and ambiguous.

7. Complaint Counsel objects to each document request to the extent that it seeks documents that are not in the possession, custody, or control of Complaint Counsel.

8. Complaint Counsel will not produce documents responsive to this request that Respondent previously has produced to Complaint Counsel at any point during the investigation or litigation in this matter.

9. Complaint Counsel will not produce documents responsive to this request that have been provided to Respondent previously.

10. This response addresses only documents collected or reviewed in the course of the investigation and prosecution of this case and that are in the possession, custody or control of the FTC Bureau of Consumer Protection. *See* FTC Rule 3.31(c)(2). Complaint Counsel objects to the Requests to the extent they seek documents outside this scope, and such documents will not be produced.

11. Each of the foregoing General Objections is incorporated in each of the Responses hereinafter set forth. Subject to and without waiving any of such objections, Complaint Counsel responds as follows:

OBJECTIONS AND RESPONSES TO REQUESTS

Request for Production 1: Provide all documents that concern whether plastics in general and ECM Plastics in particular will break down and decompose into elements found in nature after customary disposal or in a landfill.

Response: Complaint Counsel objects to Request for Production 1 on the grounds that a request for documents concerning plastics in general is overly broad, vague, and ambiguous. Subject to and without waiving the foregoing objections, Complaint Counsel will produce responsive, non-privileged documents.

Request for Production 2: Provide all documents, whether prepared by or for the Commission or any other entity, concerning consumer perception, comprehension, or recall (including, but not limited to, copy tests, marketing or consumer surveys and reports, penetration tests, recall tests, audience reaction tests, and communication tests) of plastics biodegradability; biodegradability in general; landfill composition; or conditions of customary waste disposal.

Response: Complaint Counsel objects to Request for Production 2 on the grounds that it is overly broad, vague, and ambiguous. Subject to and without waiving the foregoing objections, Complaint Counsel will produce responsive, non-privileged documents.

Request for Production 3: Provide all documents that support or call into question your conclusion that ECM's biodegradable claims for degradation are false.

Response: Complaint Counsel objects to Request for Production 3 on the grounds that the request is overly broad, vague, and ambiguous. Subject to and without waiving the foregoing objections, Complaint Counsel will produce responsive, non-privileged documents.

Request for Production 4: Provide all documents that support or call into question your conclusion that consumers likely interpret unqualified degradable claims to mean that the entire product or package will completely decompose into elements found in nature within one year after customary disposal.

Response: Subject to and without waiving the foregoing objections, Complaint Counsel will produce responsive, non-privileged documents.

Request for Production 5: Provide all documents relating to your contention that express or implied representations made in or implied by ECM BioFilm's written advertising or promotional materials are false or misleading.

Response: Subject to and without waiving the foregoing objections, Complaint Counsel will produce responsive, non-privileged documents.

Request for Production 6: Provide all correspondence between FTC and ASTM and ASTM present and past members, officers, directors, or agents.

Response: Subject to and without waiving the foregoing objections, Complaint Counsel will produce responsive, non-privileged documents.

Request for Production 7: Provide all documents pertaining to the ASTM standards which concern plastics biodegradability, or concern ASTM policies, membership, or revisions to standards.

Response: Subject to and without waiving the foregoing objections, Complaint Counsel will produce responsive, non-privileged documents.

Request for Production 8: Provide all documents that relate to your contention that end-consumers (as opposed to ECM's trade customers) view, understand, or rely on ECM's written advertising materials.

Response: Subject to and without waiving the foregoing objections, Complaint Counsel will produce responsive, non-privileged documents.

Request for Production 9: Provide all documents relating to any investigation conducted by you or on your behalf relating to any advertising claims or representations concerning the ECM MasterBatch Pellets, or any other ECM plastics additive.

Response: Subject to and without waiving the foregoing objections, Complaint Counsel will produce responsive, non-privileged documents.

Request for Production 10: Produce all documents concerning your contention that landfills are generally anaerobic environments that lack oxygen and that restrict the amount of liquid infiltration or moisture content.

Response: Subject to and without waiving the foregoing objections, Complaint Counsel will produce responsive, non-privileged documents.

Request for Production 11: Provide all documents concerning plastics chemistry, formation, polymerization, formulation, mineralization, enzymatic degradation, or depolymerization in biodegradable and non-biodegradable polymers.

Response: Complaint Counsel objects to Request for Production 11 on the grounds that it is overly broad, vague, and ambiguous. Subject to and without waiving the foregoing objections, Complaint Counsel will produce responsive, non-privileged documents.

Request for Production 12: Provide all documents relating to your contention that ECM's tests were not designed to support its claims, and that the data from ECM's testing is invalid or cannot support reliable conclusions.

Response: Subject to and without waiving the foregoing objections, Complaint Counsel will produce responsive, non-privileged documents.

Request for Production 13: Produce all documents concerning the period of time under which conventional plastics generally biodegrade, including documents supporting your contention that plastics will normally require hundreds of thousands of years to biodegrade.

Response: Subject to and without waiving the foregoing objections, Complaint Counsel will produce responsive, non-privileged documents.

Request for Production 14: Produce all documents concerning your definition of "competent and reliable" scientific evidence as that definition concerns biodegradation claims for plastics in general and ECM's express and/or implied claims challenged by the FTC.

Response: Complaint Counsel objects to Request for Production 14 on the grounds that it is overly broad, vague, and ambiguous. Subject to and without waiving the foregoing objections, Complaint Counsel will produce responsive, non-privileged documents.

Request for Production 15: Provide all documents relating to any advertisement or promotional material for the ECM MasterBatch pellets, other than documents produced by Respondents in pre-complaint disclosures or discovery.

Response: Subject to and without waiving the foregoing objections, Complaint Counsel will produce responsive, non-privileged documents.

Request for Production 16: Produce all documents identified in any answer to an Interrogatory propounded by ECM or on which you rely in answering any Interrogatory propounded by ECM.

Response: Subject to and without waiving the foregoing objections, Complaint Counsel will produce responsive, non-privileged documents.

Dated: January 2, 2014

Respectfully submitted,

Katherine Johnson (202) 326-2185
Jonathan Cohen (202) 326-2551
Elisa K. Jillson (202) 326-3001
Division of Enforcement
Bureau of Consumer Protection
Federal Trade Commission
600 Pennsylvania Avenue, NW
Mailstop M-8102B
Washington, DC 20580

CERTIFICATE OF SERVICE

I hereby certify that on January 2, 2014, I caused a true and correct copy of the paper original of the foregoing *Complaint Counsel's Response to Respondent ECM Biofilms, Inc.'s First Set of Requests for Production of Documents or Things* to be served as follows:

One electronic copy to **Counsel for the Respondent**:

Jonathan W. Emord
Emord & Associates, P.C.
11808 Wolf Run Lane
Clifton, VA 20124
Email: jemord@emord.com

Peter Arhangelsky
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Chandler, AZ 85286
Email: lcaputo@emord.com

I further certify that I possess a paper copy of the signed original of the foregoing document that is available for review by the parties and the adjudicator.

Katherine Johnson
Division of Enforcement
Bureau of Consumer Protection
Federal Trade Commission
600 Pennsylvania Ave., NW, M-8102B
Washington, DC 20580
Telephone: (202) 326-2185
Facsimile: (202) 326-2558
Email: kjohnson3@ftc.gov

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EXHIBIT RX-E

Peter Arhangelsky

From: Johnson, Katherine <kjohnson3@ftc.gov>
Sent: Friday, February 14, 2014 6:36 PM
To: Peter Arhangelsky
Cc: Jonathan Emord; Lou Caputo; Jillson, Elisa; Cohen, Jonathan
Subject: Re: File Request - Data for Katherine Johnson: ECM Biofilm

Thanks, Peter.

From: Peter Arhangelsky [mailto:PArhangelsky@emord.com]
Sent: Friday, February 14, 2014 08:31 PM
To: Johnson, Katherine
Cc: Jonathan Emord <JEmord@emord.com>; Lou Caputo <LCaputo@emord.com>; Jillson, Elisa; Cohen, Jonathan
Subject: FW: File Request - Data for Katherine Johnson: ECM Biofilm

Katherine,

I am having some trouble working with the larger files. I hope to resolve all issues so I can transmit, but that may not happen tonight after all. Because the link below is valid for four days, I still intend to use the transfer protocol. I will work to complete the supplemental production shortly, likely by Monday.

Best,

Peter

Peter A. Arhangelsky, Esq. | **EMORD & ASSOCIATES, P.C.** | 3210 S. Gilbert Rd., Ste 4 | Chandler, AZ 85286
Firm: (602) 388-8899 | Direct: (602) 334-4416 | Facsimile: (602) 393-4361 | www.emord.com

NOTICE: This is a confidential communication intended for the recipient listed above. The content of this communication is protected from disclosure by the attorney-client privilege and the work product doctrine. If you are not the intended recipient, you should treat this communication as strictly confidential and provide it to the person intended. Duplication or distribution of this communication is prohibited by the sender. If this communication has been sent to you in error, please notify the sender and then immediately destroy the document.

From: pclarke@ftc.gov [mailto:pclarke@ftc.gov]
Sent: Friday, February 14, 2014 2:44 PM
To: Peter Arhangelsky
Subject: File Request - Data for Katherine Johnson: ECM Biofilm

---

pclarke@ftc.gov has requested a file from you.
Use the link below to send securely.

Please use the attached link to upload data to the FTC for Katherine Johnson. Thanks.

pclarke@ftc.gov has requested a file from you.

Please click on the link below to send files back:
https://securemail.ftc.gov/a/wreq/SVykJcIt5t08888

In order to send a file securely, please do not use your email reader's reply function. Rather click the above-enclosed link, and

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upload through the secure web interface for an encrypted file transfer

The request file is only valid for 4 day(s) or up to 1 transaction(s) only.
(If clicking the link in this message does not work, copy and paste the link into the address bar of your browser.)

Secured by Accellion

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EXHIBIT RX-F

UNITED STATES OF AMERICA
BEFORE THE FEDERAL TRADE COMMISSION

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

COMPLAINT COUNSEL'S NOTICE OF RULE 3.33(c)(1) DEPOSITION

To: ECM Biofilms, Inc.
Victoria Place, Suite 225
100 South Park Place
Painesville, OH 44077

PLEASE TAKE NOTICE that Complaint Counsel will depose ECM Biofilms, Inc. ("ECM"), upon oral examination, pursuant to Rule 3.33(c)(1) of the Federal Trade Commission's Rules of Practice for Adjudicative Proceedings, as to the matters set forth below. ECM is required to designate one or more officers, directors, managing agents, or other persons to testify on its behalf who have knowledge of the matters specified below. Pursuant to Rule 3.33(c)(1) and other applicable authority, ECM's designee must testify regarding all information known or reasonably available to ECM.

1. The allegations in the Complaint.

2. The bases for ECM's refusal to unequivocally admit every allegation in the Complaint that ECM did not unequivocally admit.

3. ECM's affirmative defenses.

4. Any and all objections to the conduct relief Complaint Counsel seeks to obtain.

5. ECM's basis for its refusal to unequivocally admit each Request for Admission that ECM did not unequivocally admit.

6. ECM's claims that plastic products made with ECM's additive are (a) biodegradable, (b) biodegradable in a landfill, (c) biodegradable in approximately nine months to five years, and (d) biodegradable in some period greater than a year.

7. ECM's sales and marketing strategies related to the advertising claims identified in Topic 6.

8. ECM's communications with current, former, and potential customers and distributors related to the advertising claims identified in Topic 6.

9. ECM's substantiation, including, without limitation, various scientific tests such as ASTM D5511, for the advertising claims identified in Topic 6.

10. Other scientific tests relevant or potentially relevant to the biodegradability of plastic including, without limitation, ASTM 5209, ASTM D5511, ASTM D5526, ASTM D5338, ASTM D6400, SEM imaging, GPC, ISO 14855, and C-14 tagging, regardless of whether ECM relies upon the test for substantiation.

11. Every scientific test, report, or article related to biodegradability that ECM conducted, caused to be conducted, created, caused to be created, reviewed, or relied upon for any purpose, regardless of whether ECM relies upon it for substantiation.

12. All certificates of biodegradability (or other similar documents) that ECM issued, or considered issuing, to customers or potential customers.

13. All logos (or other similar marks) concerning or indicating biodegradability that ECM issued, or considered issuing, to customers or potential customers.

14. ECM's position with respect to consumer perception of claims that a product is (a) biodegradable, (b) biodegradable in a landfill, (c) biodegradable in approximately nine months to five years, and (d) biodegradable in some period greater than a year, including all facts, studies, or other evidence supporting ECM's position.

15. All facts, studies, surveys, or other evidence that ECM has ever received, reviewed, or relied upon regarding consumer perception of claims that a product is (a) biodegradable, (b) biodegradable in a landfill, (c) biodegradable in approximately nine months to five years, and (d) biodegradable in some period greater than a year, including all facts, studies, or other evidence supporting ECM's position.

16. ECM's position with respect to its customers' perception of claims that plastic products made with ECM's additive are (a) biodegradable, (b) biodegradable in a landfill, (c) biodegradable in approximately nine months to five years, and (d) biodegradable in some period greater than a year, including all facts, studies, or other evidence supporting ECM's position.

17. All facts, studies, surveys, or other evidence that ECM has ever received, reviewed, or relied upon regarding its customers' perception of claims that plastic products made with ECM's additive are (a) biodegradable, (b) biodegradable in a landfill, (c) biodegradable in approximately nine months to five years, and (d) biodegradable in some period greater than a year, including all facts, studies, or other evidence supporting ECM's position.

18. The representations made in the Declaration of Robert Sinclair executed December 12, 2013.

19. ECM's communications with the media.

20. ECM's communications with current, former, and potential customers and distributors regarding this action, or any other litigation or enforcement proceeding of any sort related in any way to biodegradability claims.

21. ECM's communications with any person or institution that has, or purports to have, any expertise regarding chemistry, biodegradability, or materials science.

22. ECM's communications with the FTC, NAD, or any other organization or public agency in any way responsible for or with jurisdiction over marketing claims.

23. ECM's contractual arrangements with its current and past customers and distributors.

24. The contents and usage of ECM's Website.

25. ECM's document retention policies and practices, and its compliance with document preservation obligations.

26. ECM's practices for archiving and maintaining records of customer-related communications and other customer-related documents.

The deposition will be held on Friday, January 24, 2014 at 9:00 A.M. at the offices of the Federal Trade Commission's Division of Enforcement, 1800 M St. NW, 8th floor, Washington, DC, before an officer authorized to take depositions.

/s/ Elisa Jillson
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CERTIFICATE OF SERVICE

I hereby certify that on January 10, 2014, I caused a true and correct copy of the paper original of the foregoing *Complaint Counsel's Notice of Rule 3.33(c)(1) Deposition* to be served as follows:

One electronic copy to **Counsel for the Respondent**:

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I further certify that I possess a paper copy of the signed original of the foregoing document that is available for review by the parties and the adjudicator.

/s/ Elisa Jillson
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