

UNITED STATES OF AMERICA  
BEFORE THE FEDERAL TRADE COMMISSION



\_\_\_\_\_)  
In the Matter of )  
 )  
ECM BioFilms, Inc., )  
a corporation, also d/b/a )  
Envioplastics International )  
\_\_\_\_\_)

Docket No. 9358  
PUBLIC DOCUMENT  
ORAL ARGUMENT REQUESTED

COMPLAINT COUNSEL’S OPPOSITION  
TO RESPONDENT’S SECOND AND THIRD MOTIONS TO EXCLUDE THE  
OHIO STATE STUDY

In a continuing effort to exclude a damaging, peer-reviewed study performed by two Ohio State researchers (“the Ohio State Study”), Respondent ECM filed two frivolous motions (and a supplemental memorandum) alleging discovery misconduct. Because none of these filings is grounded in the law or supported by fact, the Court should deny both motions.

**I. ECM’s Motion to Exclude the Ohio State Study Based on “Intentional Dissuasion” Lacks Merit.**

First, Respondent erroneously argues that a letter sent by an FTC attorney pursuant to FTC confidentiality regulations constitutes a discovery abuse. *See* Second Motion To Exclude (Mar. 20, 2014). Specifically, the FTC Act and FTC regulations require that, in certain circumstances, parties who submit materials to the FTC be provided “an opportunity to seek an appropriate protective or *in camera* order.” 16 C.F.R. § 4.10(g); *see also* 15 U.S.C. §§ 57b-2(b), 57b-2(c), 57b-2(f). The FTC’s correspondence with Dr. Michel, which forms the basis for ECM’s motion, was sent by an FTC attorney to **allow production** of the subpoenaed materials in compliance with these requirements – a fact that ECM conveniently ignores.<sup>1</sup> ECM also fails to mention that the FTC’s letter **allowed** immediate production of materials not subject to these

<sup>1</sup> Indeed, despite block-quoting nearly half the FTC’s letter, ECM omits – with ellipses – that the FTC sent the submitter notice because the third-party materials requested by the subpoena “may be entitled to confidential treatment under the FTC Rules of Practice . . . .” *Compare* Second Motion to Exclude at 6 *with* Second Motion to Exclude at RX-B.

protections and, indeed, Dr. Michel produced such documents by the subpoena return date.<sup>2</sup> Likewise, ECM fails to inform the Court that the materials in question were collected by the FTC (and provided to Dr. Michel) in the context of two entirely different matters and that the correspondence ECM complains of was sent by the lead attorney for those matters, who is not Complaint Counsel.<sup>3</sup>

Moreover, contrary to ECM's unfounded allegations, FTC staff did not delay sending the submitter notices. Rather, Dr. Michel contacted the FTC about the discovery request for the first time on March 12, 2014, and the attorney he contacted immediately contacted Complaint Counsel. CX-A (M. Wilshire Dec.) ¶ 6. It was at this time that Complaint Counsel first learned that anyone at the FTC had contact with Dr. Michel. CX-B (K. Johnson Dec.) ¶ 4; CX-C (K. Pessolano Dec.) ¶¶ 2-3; Clarification (Mar. 13, 2014) at 1. Two days later, the FTC sent the submitter notices, informed Dr. Michel that it did not object to the production of materials not covered under the FTC's confidentiality regulations, and instructed Dr. Michel to wait to produce potentially confidential third-party materials in compliance with FTC regulations and his non-disclosure agreement. CX-A:1; CX-A ¶ 7.

Significantly, ECM has cited to no authority for imposing sanctions on these facts, relying instead on cases involving private parties – with no statutory obligations – who dissuaded third parties to withhold subpoenaed materials entirely. *See* Second Motion at 8.<sup>4</sup> In contrast,

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<sup>2</sup> ECM erroneously states that the FTC's direction that Dr. Michel produce materials he received from the FTC consistent with the FTC's confidentiality regulations "applied to all but one ECM subpoena request (item 20)." Second Motion to Exclude at 6. However, of the 21 document requests propounded, the only subpoena request implicated by the FTC's confidentiality regulations was Request 20. *See* Second Motion to Exclude at RX-A:3 (explaining that all documents related to item 20 were produced, with the exception of documents containing information submitted to the FTC by third parties and noting that Ohio State would answer the other 20 requests).

<sup>3</sup> When the Commission issued the Complaint, two attorneys represented Complaint Counsel: Katherine Johnson and Elisa Jillson. *See* Notice of Appearance (Nov. 15, 2013). Subsequently, Jonathan Cohen filed an appearance on Complaint Counsel's behalf. *See* Notice of Appearance (Dec. 12, 2013). With respect to this matter, no other attorneys represent Complaint Counsel currently, or have ever represented Complaint Counsel.

<sup>4</sup> ECM's assertion that Complaint Counsel has violated the Rules of Professional Responsibility is equally baseless. Specifically, as discussed in Section I, *supra*, Complaint

the FTC directed Dr. Michel – who holds these materials as an agent – **to produce** materials not covered by its confidentiality regulations and **to produce** confidential third-party materials consistent with its confidentiality regulations. *See* CX-A; 16 C.F.R. § 4.10(d).<sup>5</sup> Indeed, the non-disclosure agreement – which incorporates the FTC’s confidentiality regulations – requires FTC staff or the FTC General Counsel to consent to disclosure of FTC materials. *Id.* Thus, far from thwarting discovery, the FTC’s letter is the mechanism by which discovery may proceed.<sup>6</sup>

Accordingly, it does not constitute a failure to comply with discovery obligations – let alone an “unjustified” one, as Rule 3.38 requires. *See* Order (Mar. 11, 2014) at 3 (citing *In re IT&T*, 104

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Counsel has instructed Dr. Michel **to produce** documents responsive to ECM’s request and, accordingly has not obstructed ECM’s access to discovery in violation of D.C. Rule of Professional Conduct § 3.4(a). Further, Rule 3.4(f) involves requests of non-parties to refrain from “voluntarily” providing adverse parties relevant information and, thus, does not implicate formal discovery. D.C. R. Prof’l Conduct §3.4(f). Moreover, it specifically exempts agents like Dr. Michel from the rule. *Id.* Indeed, the cases ECM cites as support for its outlandish accusations are inapposite. *Harlan v. Lewis* 141 F.R.D. 107, 113 (E.D. Ark. 1992), involved a defense attorney’s attempt to influence third-party testimony, and *In re Minniti*, 2000 WL 275852, at \*1-2 (Jan. 4, 2000) involved an attorney who threatened sanctions if the third party produced the subpoenaed materials and later misrepresented that the case had been dismissed. Ironically, Mr. Emord’s groundless accusations of unethical conduct and requests for bar referral may themselves violate the Virginia Bar’s ethics rules. *See* Va. R. Prof’l Conduct § 3.4(i) (prohibiting an attorney from “[p]resent[ing] or threaten[ing] to present criminal or disciplinary charges solely to obtain an advantage in a civil matter”); Va. R. Prof’l Conduct § 3.4(j) (a lawyer may not “[f]ile a suit, initiate criminal charges, assert a position, conduct a defense, delay a trial, or take other action on behalf of the client when the lawyer knows or when it is obvious that such action would serve merely to harass or maliciously injure another.”).

<sup>5</sup> 16 C.F.R § 4.10(d) expressly applies to information in the custody of a consultant or contractor retained by the FTC who has agreed in writing not to disclose third-party materials marked confidential by the FTC. The non-disclosure agreement provides that a recipient of FTC materials may not: (1) divulge materials and information to anyone other than an FTC employee or contractor who has signed a non-disclosure agreement or (2) “directly or indirectly use . . . FTC materials and information for any purpose other than that directly associated with . . . officially assigned duties.” *See* CX-A:1. It further provides that disclosures may be made “at and consistent with **directions of FTC staff** during an adjudicative or judicial proceeding to which the FTC is a party.” *Id.* (emphasis added). By signing the non-disclosure agreement – which makes clear that the FTC retains control of the use of the documents it provides – Dr. Michel is an agent for purposes of using FTC-provided documents. *See* RESTATEMENT (THIRD) OF AGENCY § 1.01 (2006) (“Agency is the fiduciary relationship that arises when one person (a ‘principal’) manifests assent to another person (an ‘agent’) that the agent shall act on the principal’s behalf and subject to the principal’s control, and the agent manifests assent or otherwise consents so to act.”).

<sup>6</sup> This effort to facilitate discovery stands in marked contrast to the months of delay caused by ECM’s refusal to disclose its customer list and subsequent frivolous motions to prevent Complaint Counsel from obtaining basic discovery from its customers.

F.T.C. 280, 1984 WL 565367 at \*127 (July 25, 1984)) (sanctions may be appropriate for failure to comply with discovery obligations where the failure was unjustified).

Further, ECM's suggestion that a protective order somehow vitiates the FTC's obligation to provide submitter notice pursuant to § 4.10(g) flies in the face of the regulation's plain language, which provides that a submitter "**will** be afforded an opportunity to seek an appropriate protective order or in camera order." 16 C.F.R. § 4.10(g) (emphasis added); *accord* 46 Fed. Reg. 26284, 26287 (May 12, 1981) (Final Rule) (explaining that "rule 4.10(g) information **will not be disclosed** in administrative or adjudicatory proceedings without affording the submitter an opportunity to obtain a protective or *in camera* order") (emphasis added). Indeed, the protective order provides identical protections for confidential materials submitted by third parties, requiring that "any party receiv[ing] a discovery request . . . that **may** require the disclosure of confidential material . . . shall promptly notify the submitter" and that "such notification shall be in writing and be received by the submitter at least 10 business days before production." Protective Order (Oct. 22, 2013) ¶ 11 (emphasis added). It makes no sense that potentially confidential third-party materials should receive less protection simply because ECM propounded their request on an FTC expert in an unrelated matter who may not disclose the potentially confidential documents at all.<sup>7</sup> *See* 16 C.F.R § 4.10(d).

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<sup>7</sup> Notwithstanding its flowery language and citations to *The Federalist*, the quasi-Constitutional "separation of functions" argument that ECM's March 25 Supplement asserts is flat-out wrong because it is based entirely on the erroneous assumption that Mr. Wilshire is "one of Complaint Counsel." *See* Supplement at 1. Mr. Wilshire is not Complaint Counsel in this action, he has never been Complaint Counsel, he had no "involvement in the investigation of ECM," CX-A ¶ 5, and his "only participation in the litigation with ECM has been related to the sanctions motions ECM filed regarding [his] contact with Dr. Michel," *see id.* ECM cites nothing in support of its mistaken claim that Mr. Wilshire is "one of Complaint Counsel"—which is *ipse dixit* reflecting either misguided speculation or a gross misunderstanding of Complaint Counsel's role vis-à-vis the rest of the FTC. Notably, Mr. Wilshire's March 24 letter instructed Dr. Michel "to produce, as soon as reasonably possible, responsive documents" belonging to third party Down to Earth Designs, Inc., because Down to Earth waived any objection under 16 C.F.R. § 4.10(g). *See* Supp. at RX-J. How Mr. Wilshire's instruction to produce documents could have possibly violated the Administrative Procedure Act and the "separation of functions" doctrine is unclear, especially given that he is not Complaint Counsel. Furthermore, even if Mr. Wilshire served as Complaint Counsel – and he does not – there is no conceivable reason that informing a document custodian to disclose documents to ECM more quickly than regulations require would violate any law or doctrine.

**II. ECM's Motion to Exclude the Ohio State Study Based on Inadvertent Late Disclosure Lacks Merit.**

Second, ECM argues that Complaint Counsel improperly withheld the Ohio State Study for more than a year.<sup>8</sup> In doing so, ECM ignores the fact that Dr. Michel provided the study to the FTC in the course of an entirely different matter. It also misstates the law, erroneously suggesting that Complaint Counsel has an obligation “to distribute discovery requests to all employees and agents of . . . the FTC.” See Third Motion to Exclude (Mar. 20, 2014) at 5 (citing *Nat'l Assoc. of Radiation Survivors v. Turnage*, 115 F.R.D. 543, 556 (N.D. Cal. 1987)). Significantly, the case ECM relies on involved federal court litigation rather than administrative litigation under the FTC's Rules. Indeed, Rule 3.31 makes clear that “[c]omplaint counsel need only search for materials that were collected or reviewed in the course of the investigation of the matter or prosecution of the case and that are in the possession, custody or control of the Bureaus or Offices of the Commission that investigated the matter, including the Bureau of Economics.” 16 C.F.R § 3.31(c)(2).

Here, although a draft of the study was received by an FTC attorney on November 2, 2012, it was received in conjunction with a search for experts in two entirely unrelated investigations, see CX-A ¶¶ 3-4, it was not known to Complaint Counsel prior to February 14, 2014, CX-B ¶ 3, and it was not used in the investigation or prosecution of the ECM matter prior to that time, *id.* at ¶ 4. Furthermore, Complaint Counsel's lack of knowledge about the existence of this document was entirely justified. Specifically, because Mr. Wilshire – who received the document from Dr. Michel – had no involvement in the investigation or prosecution of ECM, his files were not searched. CX-A ¶ 5; CX-B ¶ 8.<sup>9</sup> Ms. Pessolano, who left the agency ten months

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<sup>8</sup> ECM's argument is wrong, but ECM asserts it anyway at least partly to divert attention from its obstructionist approach to discovery that caused months of delay with respect to core issues – including ECM's belated document production, ECM's refusal to disclose a customer list, and ECM's two failed motions to limit Complaint Counsel's ability to contact its customers.

<sup>9</sup> One of these matters, *In re gDiapers*, resulted in a public complaint. As is evident from the complaint in that matter, the issue in *gDiapers* involved primarily claims of biodegradability in a composting (aerobic) environment – as opposed to biodegradability in a landfill (which is an anaerobic environment). The other matter, *In re Biobags*, also involved primarily composting (aerobic) claims.

before the Complaint, received the Ohio State Study in connection with her duties on these unrelated matters.<sup>10</sup> CX-C ¶ 2. Furthermore, when Ms. Pessolano left the agency, she archived all of her e-mails and electronic files from the ECM investigation and turned over paper files to Ms. Johnson. CX-B ¶ 6; CX-C ¶ 4. These files were searched upon receipt of ECM's First Document Request. CX-B ¶ 7. Because Ms. Pessolano did not realize the relevance of the study to the ECM investigation,<sup>11</sup> she did not show it to Ms. Johnson or copy it to the ECM investigative file,<sup>12</sup> CX-C ¶ 3, which is why Complaint Counsel did not identify it.

Further, once we discovered that attorneys at the FTC had previous contact with Dr. Michel, Complaint Counsel immediately informed Respondent's counsel and the Court. Complaint Counsel then searched the files of the unrelated matters and produced documents responsive to ECM's First Document Request. CX-B ¶ 7. We also began producing documents responsive to Requests 1 and 3 of ECM's Second RFPD on March 18, 2014 – almost two weeks before our response is due. Simply put, Respondent has put forth no evidence to support its allegations that Complaint Counsel disregarded its discovery obligations. The evidence shows that, at most, the late production of the article was inadvertent. In such circumstances, this Court has declined to impose sanctions. *In re OSF Healthcare Sys.*, No. 9349, 2012 WL 861973, at \*3-4 (Mar. 2, 2012).

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<sup>10</sup> Notwithstanding the fact that it involved a separate investigation, we disclose Mr. Wilshire's email forwarding the draft study to Ms. Pessalano solely to end ECM's speculation that Ms. Pessalano somehow received it in connection with this case – she did not. We reserve our right to limit our search for responsive materials in accordance with 16 C.F.R § 3.31(c)(2). *See supra* at 5.

<sup>11</sup> Significantly, Ms. Pessolano received a draft journal article that did not reference ECM in the "Executive Summary," or otherwise until page four. *See* RX-A. Ms. Pessolano does not recall reviewing the document. CX-C ¶ 3. Had she realized it concerned ECM, consistent with her standard practice, she would have forwarded it to Ms. Johnson. *See id.*

<sup>12</sup> Assuming, *arguendo*, that Ms. Pessolano should have recognized its relevance and forwarded it to Ms. Johnson, the oversight was entirely inadvertent and *de minimis*. In contrast, ECM has conducted a calculated, months-long stonewalling campaign involving, among other things, the delay of its entire document production and its refusal to disclose a customer list.

**III. The Sanctions ECM Seeks are Unwarranted.**

As this Court has recognized, sanctions must be “reasonable in light of the material withheld.” Order (Mar. 11, 2014) at 3 (citations omitted). The chief sanction ECM seeks – the exclusion of the Ohio State Study – is extraordinary and unwarranted on these facts. To begin, unlike most discovery disputes, the Ohio State Study is a published study that is publicly available – a fact that mitigates harm from a late production. Furthermore, as the Court is aware, Complaint Counsel already proposed a mutual extension of the fact discovery deadline.<sup>13</sup> See Motion (Mar. 18, 2014).

Moreover, even if ECM could articulate some theory of harm (which it cannot), courts have refused to exclude evidence where a failure to produce was inadvertent. See *In re OSF Healthcare Sys.*, No. 9349, 2012 WL 861973, at \*3-4 (Mar. 2, 2012); accord Order (Feb. 4, 2014) at 5 (declining to bar respondents from pursuing certain defenses as a sanction for refusal to answer an interrogatory for five weeks and holding that a full answer to the interrogatory constituted a “just” remedy); Order (Mar. 11, 2014) at 2 (denying sanctions where most of the requested discovery was provided and Respondents committed to complete production). ECM has cited to no cases indicating otherwise and, indeed, the cases it does cite are inapposite.<sup>14</sup>

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<sup>13</sup> In contrast, ECM proposes only a unilateral extension.

<sup>14</sup> As discussed below, *Benitz-Garcia*, *Bonds*, and *Batson* involved whether dismissal of a case was proper for discovery violations and concluded that it was not. In *Moore v. Chicago*, 2006 WL 1710234, at \*11-12 (N.D. Ill. June 14, 2006), the court imposed fees as a sanction rather than dismissal. Similarly, *Turnage* involved the imposition of fees, additional discovery, and a special master to oversee discovery as a sanction. 115 F.R.D. at 558-61. In *Republic of China v. Nat’l Union Fire Ins. Co.*, 142 F. Supp. 551, 556-57 (D. Md. 1956), the court refused to impose sanctions where the government’s refusal to answer an interrogatory would have been prejudicial to foreign relations. Further, *HUD v. First Source Financial*, 2007 WL 3173360, at \*3, \*5, \*7 (H.U.D. Oct. 12, 2007), involved a default judgment against the respondent for failure to participate in discovery or defend the action at all and *In re Somerson*, 2003 WL 22855212, at \*1-2, \*5 (D.O.L. Nov. 25, 2003), involved dismissal of a complaint alleging wrongful termination where the complainant, among other things, sent harassing and threatening e-mails to witnesses. Finally, ECM cites *In the Matter of Basic Research*, 2005 WL 3524918, \*2-3 (F.T.C. Nov. 22, 2005) for the assertion that “[s]anctions for the discovery violations present here are warranted.” See Third Motion To Exclude at 4. However, *Basic Research* involved a very different situation involving Complaint Counsel’s alleged failure to comply with expert disclosure requirements – and, in any event, the Court denied the sanctions motion. See *Basic Research*, 2005 WL 3524918, at \*3 (denying sanctions based on Complaint Counsel’s “sworn declaration certifying that Complaint Counsel was not aware that Heymsfield was listed as a co-

Likewise, ECM's attempt to exclude the Ohio State Study based on the short delay the FTC's confidentiality regulations require should fail. ECM has not established any nexus between the third-party confidential documents and the Ohio State Study. Indeed, although ECM repeatedly has alleged conspiracy and bias, *see e.g.*, Mot. at 3-4, such accusations are baseless. Moreover, ECM has not articulated how (at most) a 10-day delay – roughly the same amount of time ECM took to subpoena Dr. Michel after learning of his article – warrants exclusion. Nor has it cited a single case that supports its position.

ECM's other requested sanctions – dismissal of the case, removal of counsel, and referral of counsel to the DC Bar and the Inspector General – are even more ridiculous. As the cases ECM relies on make clear, “a case should not be dismissed with prejudice except ‘when a plaintiff’s misconduct is particularly egregious or extreme.’” *Benitz-Garcia v. Gonzalez-Vega*, 468 F.3d 1, 5 (1st Cir. 2006) (reversing dismissal where three discovery deadlines were violated) quoting *Benjamin v. Aroostook Med. Ctr.*, 57 F.3d 101, 107 (1st Cir. 1995); *see also Bonds v. District of Columbia*, 93 F.3d 801, 808-09 (D.D.C. 1996) (reversing dismissal where lesser sanctions not considered); *Batson v. Neal Spelce Assocs., Inc.*, 765 F.2d 511, 516 (5th Cir. 1985) (same); *Moore v. Chicago*, 2006 WL 1710234, at \*15 (N.D. Ill. June 14, 2006) (denying dismissal for discovery violations).<sup>15</sup> Similarly, we are unaware of any authority (and ECM cites none) in which a court disqualified attorneys to sanction them over an unintentional discovery infraction. The facts here – that the FTC allowed a prior expert to expeditiously produce materials consistent with its confidentiality regulations and, at most, inadvertently produced a publicly available document late – do not come close to meeting these standards. Moreover, as

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author on studies that had been published and later withdrawn from publication”), motion for reconsideration denied, 2006 WL 159735 (F.T.C. Jan. 10, 2006). Note that Westlaw erroneously reports two proposed orders filed by a Basic Research respondent as the Court's orders, *see* 2006 WL 159735 (F.T.C. Dec. 6, 2005), although the Court denied both the sanctions motions, *see* 2005 WL 3524918, and the subsequent motions to reconsider that denial, *see* 2005 WL 3524918.

<sup>15</sup> *Arias v. Dyncorp Aerospace Operations*, 677 F. Supp. 2d 330, 333-34 (D.D.C. 2010), in which the court dismissed certain classes of plaintiffs (as opposed to the case as a whole), involved plaintiffs who failed for **two years** to complete questionnaire responses in violation of multiple court orders.

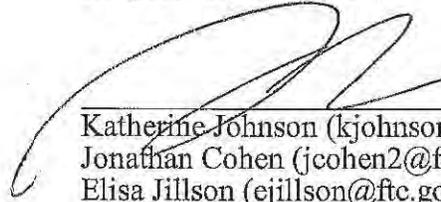
discussed in Section I, *supra*, ECM's allegations regarding unethical conduct are based on misreading of the rules and are not supported in the caselaw.

**IV. Conclusion**

For all of these reasons, the Court should deny ECM's Second and Third Motions to Exclude the Ohio State Study.

Dated: March 27, 2014

Respectfully submitted,



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**STATEMENT REGARDING ORAL ARGUMENT**

Oral argument is appropriate given the disparity between the alleged impropriety (which is either nonexistent or inadvertent) and the drastic relief sought here, including: (1) the referral of Complaint Counsel to the bar; (2) the action's dismissal; (3) the involvement of the Inspector General; (4) the exclusion of highly probative evidence from the Commission's record; (5) injunctive relief to prohibit an FTC attorney not before the Court from communicating with an expert regarding another matter also not before the Court; and (6) the *de facto* elimination or alteration of 16 C.F.R. § 4.10(g) as applied to experts.

CERTIFICATE OF SERVICE

I hereby certify that on March 27, 2014, I caused a true and correct copy of the foregoing to be served as follows:

One electronic copy through the FTC's e-filing system, and one electronic courtesy copy to the **Office of the Secretary:**

Donald S. Clark, Secretary  
Federal Trade Commission  
600 Pennsylvania Ave., NW, Room H-159  
Washington, DC 20580  
Email: [secretary@ftc.gov](mailto:secretary@ftc.gov)

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

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

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

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Date: March 27, 2014

  
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**UNITED STATES OF AMERICA  
BEFORE THE FEDERAL TRADE COMMISSION**

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**In the Matter of** )  
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 )  
**ECM BioFilms, Inc.,** )  
**a corporation, also d/b/a** )  
**Enviroplastics International** )

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**Docket No. 9358**  
**PUBLIC DOCUMENT**  
**ORAL ARGUMENT REQUESTED**

**EXHIBITS IN OPPOSITION TO  
ECM'S SECOND AND THIRD MOTIONS TO EXCLUDE THE OHIO STATE STUDY**

# **Complaint Counsel Exhibit A**

**CX-A**

## DECLARATION OF MATTHEW J. WILSHIRE

Pursuant to 28 U.S.C. § 1746

In accordance with 28 U.S.C. § 1746, I declare under penalty of perjury that the following is true and correct:

1. I reside in Washington, D.C. I am over 18 years of age. I have personal knowledge of the facts set forth below. If called as a witness, I could and would competently testify thereto.
2. I am a staff attorney with the Federal Trade Commission's ("FTC's") Bureau of Consumer Protection. I currently work in the Bureau's Division of Financial Practices. From May 2006 until January 2014, I worked in the Bureau's Division of Enforcement.
3. From approximately September 2012 until January 6, 2014, I was the lead attorney in the matter of Down to Earth Designs, Inc., d/b/a gDiapers ("gDiapers") and another non-public investigation that concerned environmental marketing claims.
4. In December 2012, the FTC retained Dr. Fred Michel of the Ohio State University as a consulting expert in the two environmental marketing matters referenced in Paragraph 3. The manager assigned to oversee my environmental marketing investigations did not oversee the matter of ECM BioFilms, Inc. ("ECM").
5. At no time did I have any involvement in the investigation of ECM. My only participation in the litigation with ECM has been related to the sanctions motions ECM filed regarding my contact with Dr. Michel.
6. On March 12, 2014, I received a phone call from Dr. Michel. He indicated that he had received a subpoena from the Federal Trade Commission related to the ECM matter. Prior to that phone call, I was unaware that Dr. Michel had received a subpoena. Dr. Michel stated that some responsive documents in his possession had been submitted to the FTC by third parties during my environmental marketing investigations.
7. On March 14, 2014, I sent notices to counsel for gDiapers and the other company we investigated. These notices informed gDiapers and the other company of their rights under Commission Rule 4.10(g), 16 C.F.R. § 4.10(g), to protect confidential information.
8. As a condition of acting as an FTC consulting expert, Dr. Michel executed a non-disclosure agreement. A true and correct copy of that non-disclosure agreement is attached hereto as Attachment 1.

Executed this 26th of March 2014 in Washington, D.C.



Matthew J. Wilshire

**Complaint Counsel  
Exhibit A  
Attachment 1**

**CX-A:1**



UNITED STATES OF AMERICA  
FEDERAL TRADE COMMISSION  
WASHINGTON, D.C. 20580

**NONDISCLOSURE AGREEMENT FOR CONTRACTORS**

(1) **Disclosure of FTC materials and information.** I will not divulge FTC materials and information for any purpose to any person other than an authorized person.

- "FTC materials and information" includes both materials and information provided to me by the FTC (whether the FTC received such materials and information from a submitter or generated them internally) and produced by me pursuant to my work for the FTC. It includes materials and information in any form, including, for example, electronic form, and it includes information identifying the existence of a nonpublic FTC investigation.
- An "authorized person" is
  - (1) a member of the FTC staff, or
  - (2) other contractor personnel from whom the Contracting Officer has received a signed FTC "Nondisclosure Agreement for Contractors."

(2) **Use of FTC materials and information.** I will not directly or indirectly use, or allow the use of, FTC materials and information for any purpose other than that directly associated with my officially assigned duties. I will not reveal the nature or content of FTC materials and information to any unauthorized person, either by direct action, counsel, recommendation or suggestion.

(3) **Return of FTC materials and information.** At the conclusion of my work under this contract, I will return to the FTC (or destroy, at the request of the Contracting Officer's Technical Representative) all FTC materials, including copies, and all records containing FTC materials and information.

Consistent with the above, I understand that all reports or data first produced during my contract with the FTC and in connection with that contract shall be the sole property of the government.

None of these provisions shall limit disclosures: (1) at and consistent with directions of FTC staff, during an adjudicative or judicial proceeding to which the FTC is a party; or (2) with the written consent of the FTC General Counsel, or the General Counsel's delegate, which consent can only be given if consistent with the FTC Act, the FTC's Rules of Practice, and any other applicable laws, regulations, or orders.

Sanctions for misuse of FTC materials and information may include a fine of up to \$10,000, imprisonment of up to ten years, or both.

Frederick C. Michel Jr. (typed or printed name)  
*Frederick C. Michel Jr.* (signature) The Ohio State University (company)  
11/8/2012 (date) \_\_\_\_\_ (contract number)

(At the time of contract award, the Contracting Officer is \_\_\_\_\_;  
the Contracting Officer's Technical Representative is \_\_\_\_\_)

# **Complaint Counsel Exhibit B**

**CX-B**

**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**

**PUBLIC DOCUMENT  
ORAL ARGUMENT REQUESTED**

**DECLARATION OF KATHERINE JOHNSON  
IN OPPOSITION TO ECM'S SECOND AND THIRD MOTIONS TO EXCLUDE  
THE OHIO STATE STUDY**

In accordance with 28 U.S.C. § 1746, I declare under penalty of perjury that the following is true and correct:

1. I am over 18 years of age, and I am a citizen of the United States. I am employed by the Federal Trade Commission ("FTC") as an attorney in the Division of Enforcement in the Bureau of Consumer Protection. I am an attorney of record in the above-captioned matter, and I have personal knowledge of the facts set forth herein.

2. I have been lead attorney on the investigation and prosecution of the ECM matter. Until Kathleen Pessolano left the agency in early 2013, she assisted me in the investigation of the ECM matter.

3. Neither I, nor anyone who has appeared in this matter as Complaint Counsel, knew of or was aware of the Ohio State Study, or any version thereof, prior to February 14, 2014.

4. Neither the Ohio State Study, nor any version thereof, was collected or reviewed by anyone who has appeared in this matter as Complaint Counsel during the investigation or prosecution of the ECM matter prior to February 14, 2014.

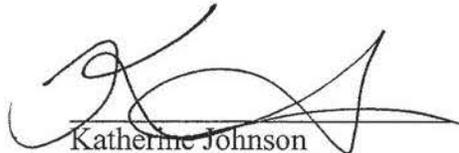
5. On March 12, 2014, Complaint Counsel first learned that the FTC had prior contact with Dr. Michel.

6. When Ms. Pessolano left the agency, she turned over to me archived emails and paper files from the ECM investigation.

7. In accordance with Commission Rule 3.31(b) regarding mandatory initial disclosures, Rule 3.31(c) regarding the scope of discovery, and Respondent's First Set of Requests for Production of Documents, I searched the archived emails and paper files from the ECM investigation that Ms. Pessolano provided to me.

8. Complaint Counsel did not search Matthew Wilshire's files because, other than assisting with the response to ECM's sanctions motions, Mr. Wilshire had no involvement in the investigation or prosecution of the ECM matter.

Executed this 27th of March, 2014 in Washington, D.C.



Katherine Johnson  
Complaint Counsel

# **Complaint Counsel Exhibit C**

**CX-C**

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

NONPUBLIC DOCUMENT

**DECLARATION OF KATHLEEN PESSOLANO IN OPPOSITION  
TO RESPONDENT'S SECOND AND THIRD MOTIONS TO EXCLUDE THE  
OHIO STATE STUDY**

In accordance with 28 U.S.C. § 1746, I declare under penalty of perjury that the following is true and correct:

1. I am over 18 years of age, and I am a citizen of the United States. I was employed by the Federal Trade Commission ("FTC") as an attorney in the Bureau of Consumer Protection from August 2009 to February 2013. I have personal knowledge of the facts set forth herein.

2. On November 16, 2012, I received from Matthew J. Wilshire an e-mail with two attachments, both of which were titled "Biodegradation of Bioplastics and Natural Fibers During Composting, Anaerobic Digestion and in Soil." I received the e-mail and attached document in connection with considering potential experts for two non-public investigations that were unrelated to the investigation of ECM BioFilms, Inc. ("ECM"). **Attachment 1** hereto is a true and correct copy of the e-mail and attachments I received.

3. I do not recall reviewing this document. Had I reviewed this document and realized that it mentioned ECM, I would have forwarded this document to Katherine Johnson, with whom I was working on the ECM investigation, or preserved this document in the investigation file and informed Ms. Johnson of its existence. It is my standard practice to inform colleagues of materials potentially relevant to an investigation.

4. When I resigned the FTC for another position, I made a copy of e-mails I sent and received in connection with the ECM investigation and informed Ms. Johnson of where to locate those files. I also provided Ms. Johnson with paper files from the investigation.

Executed this 25th of March 2014 in Washington, D.C.



Kathleen Pessolano

**Complaint Counsel  
Exhibit C  
Attachment 1**

**CX-A:1**



+++++

# Biodegradation of Bioplastics and Natural Fibers during Composting, Anaerobic Digestion and in Soil

Eddie Gómez<sup>a</sup>, Frederick C. Michel Jr.<sup>a,b</sup>

**Contact:** <sup>a</sup>Department of Food, Agricultural and Biological Engineering, The Ohio State University, OARDC, 1680 Madison Avenue, Wooster, OH 44691, USA. michel.36@osu.edu, gomez.69@osu.edu.  
<sup>b</sup>Corresponding author.

## EXECUTIVE SUMMARY

Plastics are increasingly causing pollution problems in natural environments due to their recalcitrant nature. Various new materials have recently begun to be marketed that claim to biodegrade or compost during waste treatment. These materials include conventional plastics amended with additives that are meant to confer biodegradability or compostability as well as plastics made from biopolymers, and natural fiber based materials. Different industries are particularly interested in these materials as alternatives to conventional plastics that are neither compostable nor biodegradable. In this study, the amount of carbon in various commercially available bioplastics and natural fibers converted to carbon dioxide (CO<sub>2</sub>) and methane was determined during soil incubation, composting and anaerobic digestion (AD). The materials included biopolymers made from corn starch, polylactic acid and polyhydroxyalkanoate, natural fibers such as coconut coir, paper, dry manure and asphalt and soy-wax coated paper as well as polypropylene (PP) and other conventional plastics amended with additives claiming to confer biodegradability. Controls included cellulose paper, pots made from PP. During the 550 day soil incubation experiment, all materials degraded more slowly than the cellulose positive control. However the biopolymers and natural fiber materials showed substantial degradation during this period. No significant degradation was observed for plastics amended with additives. During anaerobic digestion for 50 days, 75% of the cellulose paper, 20-25% of the biopolymers and less than 2% of the additive containing PP and PETE had been converted to biogas. After 110 days of composting, more than 70% of cellulose paper, 0.6% of an additive amended PP, 51% of a corn starch based bioplastic and 12% of a soy-wax coated paper was converted to CO<sub>2</sub>. In conclusion, although certain biopolymers and natural fibers appear to biodegrade to an appreciable extent, none meet ASTM standards for biodegradability or compostability. Conventional plastics containing additives did not biodegrade differently than non-additive containing plastics.

Keywords: bioplastics, composting, soil, anaerobic digestion, biodegradation.

## 1 INTRODUCTION

In 2010, the United States generated almost 14 million tons of plastics as containers and packaging and almost 7 million tons of nondurable goods such as example plates and cups (EPA, 2010). Only 8 percent of the total plastic waste generated was recovered for recycling. A vast majority of the plastics that are commercially available are made from non-renewable petroleum-based resources and are essentially not biodegradable. Thus, until improvements in recycling programs are made, tons of plastics will accumulate in landfills, minimizing the overall landfill (Hopewell et al., 2009). These materials are also increasingly causing pollution problems in natural environments due to their recalcitrant nature and due to energy use and greenhouse gas emissions during their life cycle (Kyrikou & Briassoulis, 2007). Roadsides, parks, beaches and natural areas are inundated with plastic trash.

One reason for limited plastics recycling is that it is often commingled with organic wastes (food scraps, wet paper, yard trimmings, soil and liquids), making it difficult and impractical to recycle without expensive cleaning and sanitizing procedures. Food scraps and wet, non-recyclable paper comprise an additional 50 million tons of municipal solid waste in the U.S. Composting these mixed organics could potentially recover a sizable portion of the waste stream, dramatically increasing community organics recycling and natural resource sustainability. Biodegradable plastics can replace the non-degradable plastics in these waste streams, allowing mixed wastes to be composted and making municipal composting a significant tool to divert large amounts of otherwise unrecoverable waste.

Various plastic and natural materials have recently begun to be marketed that claim to biodegrade or compost during waste treatment (Song et al., 2009). These materials include conventional plastics amended with additives that are meant to confer biodegradability or compostability as well as plastics made from biopolymers, and natural fiber based materials. However, there is limited information about the extent or rate of biodegradation of these materials. There is a need to develop novel materials that are designed to fully or partially degrade under different conditions, including soil, composting and anaerobic digestion (AD); the latter mimics landfilling. Advantages of biodegradable materials include the increase in the economic feasibility of the landfill or anaerobic digestors due to methane gas collection for bioenergy production and volume reduction of the waste due to biodegradation during the active life of the of the system (International, 2011). One of the most pressing questions is whether the “biodegradable” plastics and natural fibers available in the market truly degrade. There is a lack of scientific information supporting the claims made by “novel” materials developers.

Whereas some research has focused on the degradation of specific biopolymers and natural fibers that are used to produce bioplastics (Hanley et al., 2000; Ishigaki et al., 1999; Woolnough et al., 2010) there is lack of information on how the “novel” materials that are available in the market will degrade after incorporation into products or under conditions found during waste management or environmental release. These degradation rates are particularly important to studies quantifying the impact of specific products and processes on different environments. The overall objective of this study was to determine the biodegradability of a wide range of materials and additives claiming to be biodegradable or to confer biodegradability to conventional plastics.

## 2 METHODOLOGY

Laboratory-scale experiments were conducted to study the biodegradability of plastics under soil incubation, composting, AD conditions. The percent biodegradation was calculated by measuring the average carbon dioxide (CO<sub>2</sub>) evolved from each treatment, subtracting this from the average CO<sub>2</sub> evolved from negative controls, and dividing this by the total amount of sample carbon added to each treatment. All materials were cut into 1 cm squares and tested based on ASTM international standard test methods.

### 2.1 Experimental procedure

The compostability of bioplastics samples was determined based on ASTM D5338-98(2003) (International, 2003b). The test determines the percent of carbon in the plastic material that was converted to CO<sub>2</sub> during the course of a composting experiment that mimics the temperature and aeration conditions during full scale commercial composting. Each bioplastic sample (80 g dry) was mixed with a compost inoculum (350 g dry) and the moisture content of the mixture was adjusted to 60% using deionized water. On a wet-weight basis, each vessel contained approximately 1100 g of material.

The compost inoculum was obtained from the Ohio Research and Development Center (OARDC) composting site. This is a full scale windrow composting facility featuring a concrete composting surface and a built in aeration system. The compost contained a mixture of dairy manure and hardwood sawdust (Michel et al., 2004). Compost was then screened to less than 10 mm and large inert items were discarded. Compost was amended with ammonium phosphate to give an overall C:N of 20:1 (by weight), including carbon contained in the test material. Composting was performed using a bench scale reactor system featuring 18, 4-liter capacity reactors placed in an incubator set at 55°C. To maintain aerobic conditions, regulated humidified air at a -40°C dew point entered the vessels at a rate of 100 ml/min (Grewal et al., 2006). Air was exhausted at the top of the vessels through tubes attached to an air outlet and bubbled through flasks in a separate water bath set at 9°C to condense moisture from the off-gas. The off-gas was then analysed for percent CO<sub>2</sub> (Vaisala model GMT 220, range 0 to 20%). Data was automatically recorded on a Campbell Scientific model 23XL data logger for each vessel every hour. Each vessel was also equipped with a K-type thermocouple to measure temperature in the mix near the middle of the compost, and data will be recorded automatically every 12 min. The experiments were conducted over a period of 110 days.

The anaerobic digestion study determined the degree and rate of conversion of plastic materials to CO<sub>2</sub> and CH<sub>4</sub> during incubation under anaerobic conditions based on ASTM D5511-02 (International, 2002). For this study test materials

were exposed to an active methanogenic inoculum derived from a full-scale anaerobic digester treating municipal sewage sludge. The test was designed to measure the percent conversion of carbon in the test materials to biogas, a combination of CH<sub>4</sub>, CO<sub>2</sub> and trace gases. These conditions resemble those found in high-solids anaerobic digestion systems and in biologically active landfills.

The anaerobic digestion assays were performed using laboratory-scale batch reactors, without solids recycling. Temperatures were maintained at mesophilic (36 ± 1) conditions by means of incubators. The volume of gas produced, and biogas composition were quantified on a daily basis (Gomez et al., 2011). All the reactors were inoculated with methanogenically active sludge obtained from the Akron Waste Water treatment plants full-scale (3000 m<sup>3</sup>) anaerobic digester. Once inoculated, reactors were sealed to initiate a 7 day start-up phase. The start-up process involved adapting the digester biomass to the operational conditions of the laboratory-scale reactors. After proper functioning of the reactors was confirmed, sample materials (20 g dry) were added. The experiments were conducted over a period of 50 days.

For the soil incubation experiment the degree and rate of aerobic biodegradability of a plastic material in the environment determines the extent to which and time period over which the plastic may be mineralized according to ASTM D5988-03 (International, 2003a) test method. Agricultural soils were obtained from experimental units at the OARDC. The soil media was a laboratory mixture of 43% certified organic top soil, 43% of no-till farm soil and 14% sand. Soil was sieved to less than 2-mm particle size, plant materials, stones, and other inert materials were removed. The soil was then analysed for moisture holding capacity (MHC) according to ASTM test method D2980. For this experiment, 300 grams of the soil media (dw) were placed in the bottom of the vessels (figure 1). Soil was amended with ammonium phosphate to give a C:N of 20:1 (by weight), including carbon contained in the test specimen. Distilled water was added to bring the moisture content of the mixture to 60% of the MHC. The test samples containing 1000 mg of carbon (~ 2 of sample) were then mixed thoroughly with the soil. A solution containing 20 ml of potassium hydroxide (KOH) 0.5N was placed in each vessel. The experiments were conducted over a period of 550 days.

## 2.2 Chemical parameters

A variety of analytical measurements were used to monitor the biodegradation of sample materials during composting, AD and in soil experiments. These included CO<sub>2</sub> evolution, total carbon content of the media and plastics, total nitrogen and biogas production (CO<sub>2</sub> and CH<sub>4</sub>).

The total carbon and nitrogen contents of the sample materials were measured according to methods developed by the US Composting Council (Composting Council et al., 2002) by the Service Testing and Research laboratory (STAR) at The OARDC in Wooster, OH. A VarioMax Carbon-Nitrogen combustion analyser (Elementar Americas Inc., Mount Laurel, NJ, U.S.) was used to carry out the analyses based on combustion followed by CO<sub>2</sub>. Analyses for the complete suite of elements was performed in the same location by ICP analysis after microwave digestion (EPA Method 3051).

The off-gas from the composting experiment was analysed for percent CO<sub>2</sub> using infrared spectroscopy (Vaisala model GMT 220, range 0 to 20%). A polarographic oxygen system was used to measure percent oxygen (O<sub>2</sub>) (Mine Safety Appliances model "ULTIMA," range 0 to 25%). Data will be automatically recorded on a Campbell Scientific model 23XL data logger for each vessel every hour. Each vessel was equipped with a K-type thermocouple to measure temperatures in the mixes near the middle of the compost, and data was recorded automatically every 12 min.

Volumetric production of biogas from the AD experiments was measured by collecting the off-gas from the reactors in 0.5 L tedlar bags. The gas volume evolved during the experiments was measured by pumping the gas through a drum type wet-test volumetric gas meter (RITTER®, Bochum, Germany), volumes were converted to standard temperature and pressure (STP) conditions based on the building temperature and pressure at the time of the measurement. The methane content in the biogas was determined using a gas chromatograph (GC) HP 6890 (Agilent Technologies, Santa Clara, CA, U.S.) series equipped with a ValcoPlot VP-Alumina (Valco Instruments Co. Inc., Ontario, Canada) column and a thermal conductivity detector (TCD) operated isothermally at 40°C. Helium was the carrier gas at a flow rate of 20 ml/min.

Carbon dioxide produced in each vessel containing soil reacted with KOH to form bicarbonate (KHCO<sub>3</sub>). The amount of CO<sub>2</sub> produced was determined by titrating the remaining KOH solution with 0.25N hydrochloric acid to a phenolphthalein end-point. Vessels were incubated at room temperature. KOH traps were removed and titrated before their capacity was exceeded. In addition O<sub>2</sub> content in the vessel was ensured not to fall below 18%. The time to replace

a trap varied with test materials. Moreover, a frequency of every 3 to 4 days for the first 2 to 3 weeks and every 1 to 3 thereafter was used. At the time of removal of the traps, the vessel was allowed to sit open for a maximum of 15 minutes to allow for fresh air to get into the system. In addition, distilled water was added accordingly to maintain adequate moisture content. The test was terminated when the CO<sub>2</sub> evolution reached a plateau assuming that all accessible carbon was oxidized.

### 2.3 2.3 Data analysis

Three independent replicates will be used for each treatment. Analysis of variance (ANOVA) will be calculated for the average cumulative percent conversion for each of the tests. Comparisons for all pairs of bioconversion means will be performed using Tukey-Kramer HSD method. All conclusions will be based on a significant difference level of  $\alpha = 0.05$ . The statistical analyses will be performed using JMP statistical program version 9 (SAS Institute Inc., SAS Campus Drive, NC, U.S.).

## 3 RESULTS AND DISCUSSION

Three materials were tested under composting conditions; corn starch biopolymer Ecotainer<sup>®</sup>, soy wax coated paper, and polypropylene (PP) with 2% ECM<sup>®</sup> additive. The positive control used was cellulose paper. The initial rate of degradation was similar for the positive control and the Ecotainer<sup>®</sup>, samples (Fig. 1). The Ecotainer material continued to biodegrade steadily until the end of the experiment. Little conversion was observed for the soy wax coated paper or the PP with additive. Soy wax coated paper samples reached a maximum degradation after 15 to 20 days of the experiment. The average final carbon conversion for the coated paper and Ecotainer samples was  $12.4 \pm 0.2$  and  $51.3 \pm 0.2\%$  respectively. Over 70% biodegradation was observed for the positive control. Plastic with ECM additive did not show significant degradation over the period of study (110 days).

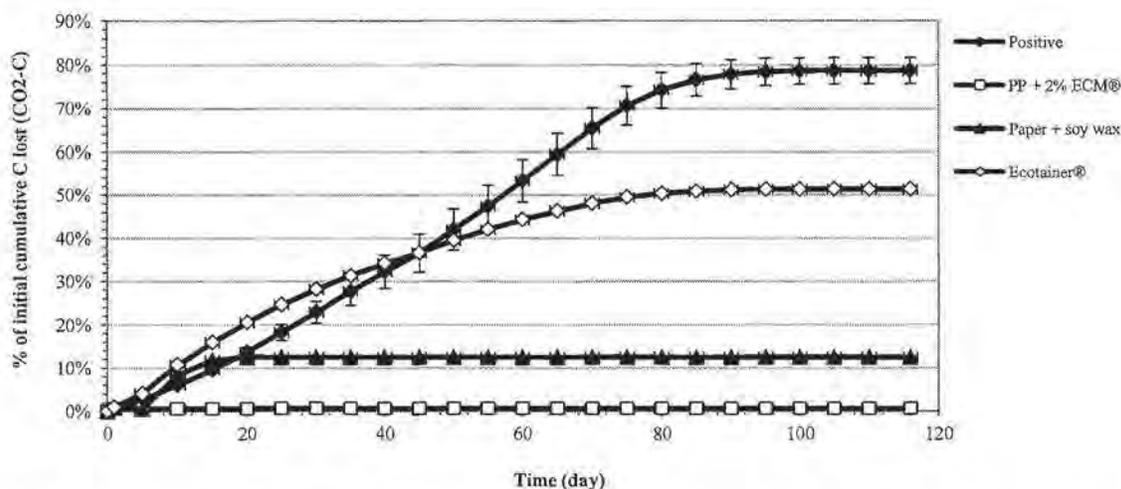


Figure 1. Cumulative carbon loss (CO<sub>2</sub>-C) during composting as the percentage of initial carbon ( $\pm$ SD) over time. For some data points SD bars are smaller than markers.

Eleven different materials were tested in soil incubation experiments. The positive control used was cellulose paper. Bioconversion occurred at faster rate initially for most of the materials tested (Fig. 2). PHA and Ecobras<sup>®</sup>, showed the greatest rate of degradation among the materials tested. This was followed by Cow Pot<sup>®</sup>, paper + asphalt, and Ecotainer. Materials derived from natural fibers (Coconut coir, Rice hull and Peat Pot<sup>®</sup>) showed a slower, but significant rate of degradation. No degradation was observed for PP and PETE with additives over the entire period of study. After 550 days, the PHA and Ecobras<sup>®</sup> sample showed  $56.4 \pm 0.7$  and  $53.0 \pm 0.8\%$  carbon conversion to CO<sub>2</sub>, respectively. Cumulative degradation of the materials made from paper and natural fibers were between 5 and 25%.

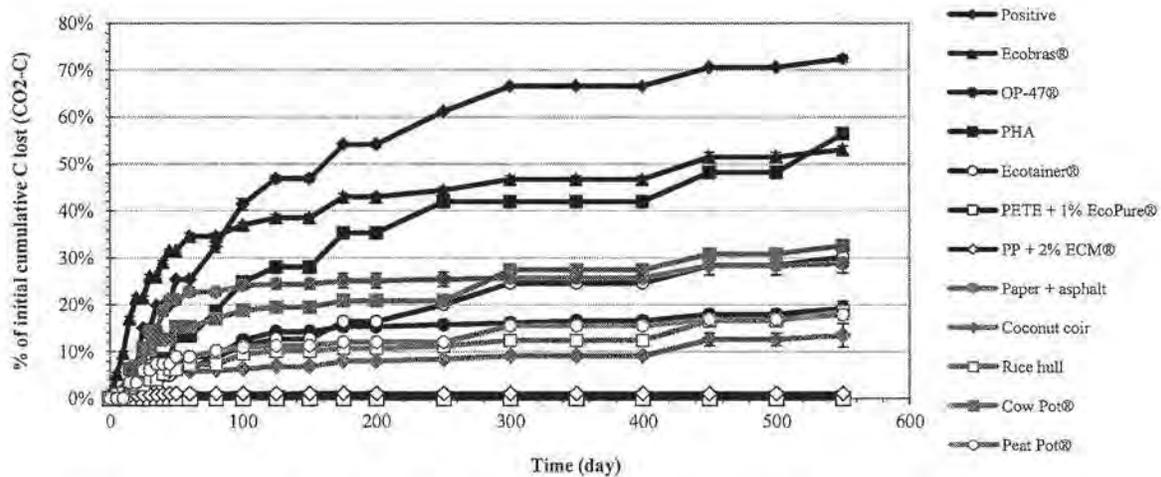


Figure 2. Cumulative carbon loss ( $\text{CO}_2\text{-C}$ ) during soil incubation as the percentage of initial carbon ( $\pm\text{SD}$ ) over time. For some data points SD bars are smaller than markers.

Four materials were tested under anaerobic digestion conditions (Fig. 3). The positive control used was cellulose paper. The initial rate of degradation was highest for Ecotainer<sup>®</sup> and Ecobras<sup>®</sup> samples. The rate of degradation was steady through day 30 for these two samples and appeared to slow somewhat after this period. Final values for Ecotainer<sup>®</sup> and Ecobras<sup>®</sup> were of  $26.4\pm 8.0$  and  $20.2\pm 6.7\%$  over a 50 day period in an anaerobic environment, respectively. For treatments containing PP and PETE amended with additives, no significant degradation was observed over the period of study. Statistical analyses revealed that differences between Ecobras and Ecotainer were not significant.

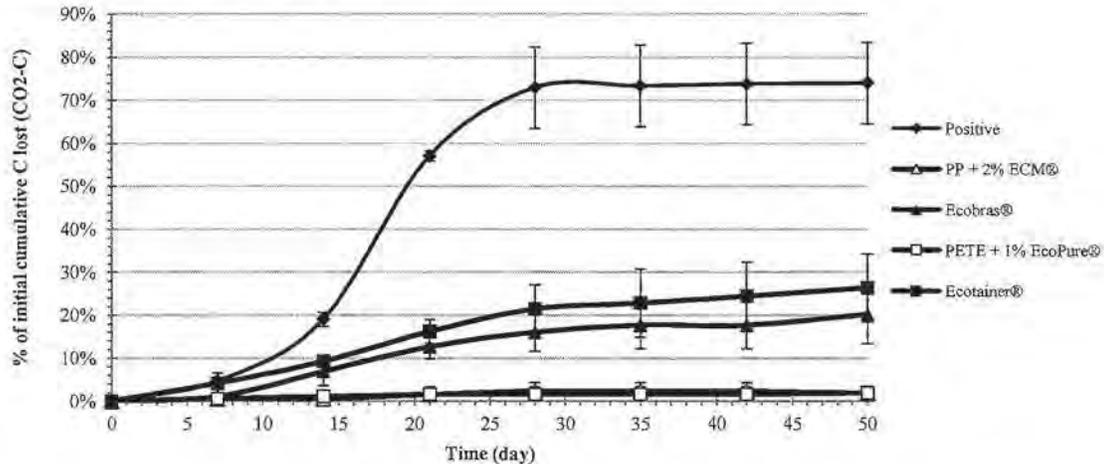


Figure 3. Cumulative carbon loss ( $\text{CO}_2\text{-C}$ ) during anaerobic digestions as the percentage of initial carbon ( $\pm\text{SD}$ ) over time. For some data points SD bars are smaller than markers.

#### 4 CONCLUSION

Although certain biopolymers and natural fibers appear to biodegrade to an appreciable extent during composting, anaerobic digestion and soil incubation, none degrade at the same rate or to the same extent as positive controls. Therefore, none met ASTM standards for biodegradability or compostability. Conventional plastics containing additives that are marketed to improve biodegradability did not biodegrade differently than non-additive containing plastics and neither biodegraded to an appreciable extent.

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# BIODEGRADATION OF BIOPLASTICS AND NATURAL FIBERS DURING COMPOSTING, ANAEROBIC DIGESTION AND IN SOIL

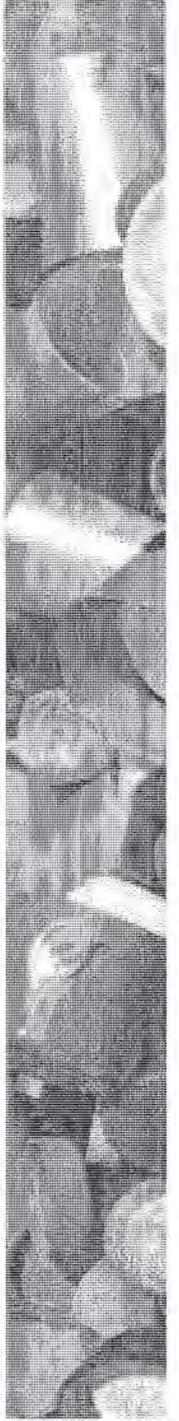
Student: Eddie F. Gómez (gomez.69@osu.edu)

Advisor: Dr. Frederick Michel Jr. (michel.36@osu.edu)

The Ohio State University, OARDC

1680 Madison Avenue

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# Understanding the project

Today's  
talk!

- Study of the biodegradation of materials that are available in the market claiming to be “biodegradable” or “compostable”.



- Development of our own biodegradable material.  
Understanding the factors affecting bioconversion.



- Compare all products by means of a complete Life Cycle Assessment study. Is recycling of plastics better for the environment than biodegradables?

# Presentation Outline

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- Background:
  - Plastic use in the U.S.
  - Production of “green” plastics.
  - Certifications.
- Experimental design
- Results
- Conclusion
- Using the data of this project, what’s next?

# Waste generation in the U.S.

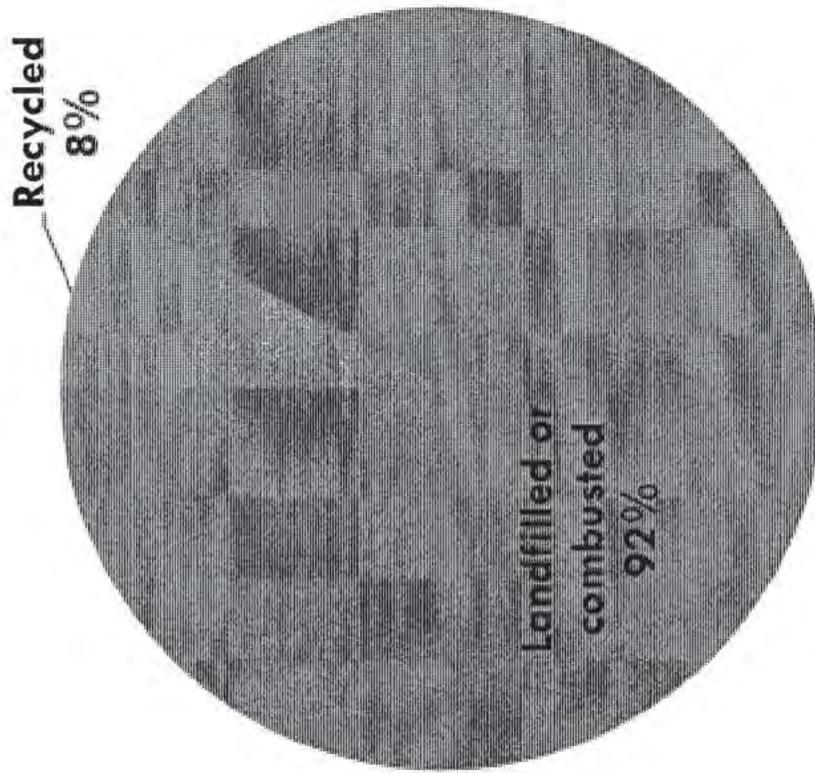


Figure 1. Waste generation in the U.S.

U.S. Environmental Protection Agency (2011) Municipal Solid Waste generation, recycling, and disposal in the United States: Facts and Figures 2010.

# Reasons behind the project

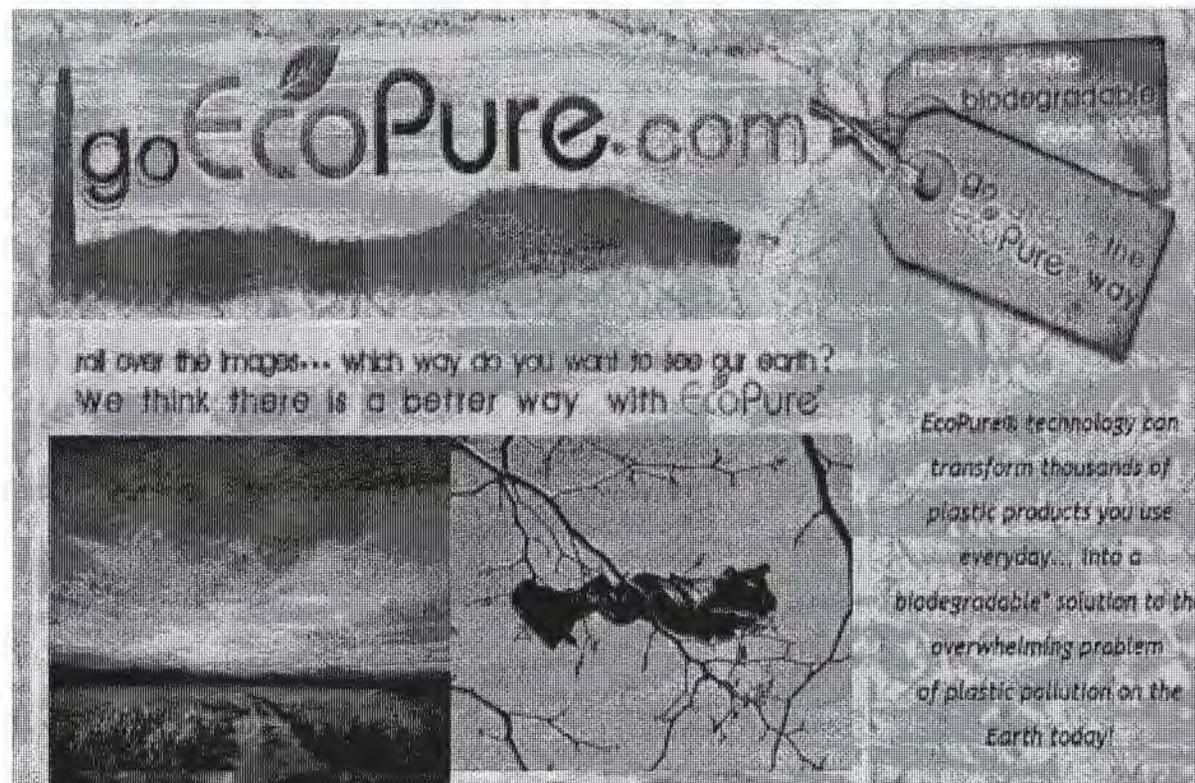


Figure 2. "Green" materials.

# Background



Biodegradable Products institute, NY, US.



## The Science of Biodegradation

There is some confusion and disagreement about the term "biodegradable."

Some unscrupulous manufacturers label products as "biodegradable" or "compostable" when, in fact, they are only partially so.

<http://www.bpiworld.org/science-of-biodegradation>



degradable plastic, *n*—a plastic designed to undergo a significant change in its chemical structure under specific environmental conditions resulting in a loss of some properties that may vary as measured by standard test methods appropriate to the plastic and the application in a period of time that determines its classification. (1991)



3.1.1 *biodegradable plastic*—a degradable plastic in which the degradation results from the action of naturally occurring microorganisms such as bacteria, fungi, and algae.



# Background



3.1.2 *compostable plastic*—a plastic that undergoes degradation by biological processes during composting to yield CO<sup>2</sup>, water, inorganic compounds, and biomass at a rate consistent with other known compostable materials and leave no visible, distinguishable or toxic residue.



- They must biodegrade at a rate comparable to yard trimmings, food scraps and other compostable materials, such as kraft paper bags.
- They must disintegrate, so that no large plastic fragments remain to be screened out.

<http://www.bpiworld.org/BPI-Public>



# Background

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Confused by the terms Biodegradable & Biobased?



A product that contains 100% annually renewable raw materials **MAY** or **MAY NOT** be biodegradable/compostable. It all depends on the molecular structure of the material itself

# Introduction

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The overall objective of this study was to determine the biodegradability of a wide range of materials and additives that are commercially available claiming to be biodegradable or to confer biodegradability to conventional plastics.

# Test materials

		Compostability	Anaerobic digestion	Soil incubation
<b>Additives</b>	PP + 2% ECM®	X	X	X
	PETE + 1% EcoPure®		X	X
<b>Biopolymers</b>	Ecotainer®	X	X	X
	Ecobras®		X	X
	OP-47®			X
	PHA			X
	Paper + soy wax	X		X
<b>Natural fibers</b>	Paper + asphalt			X
	Coconut coir			X
	Rice hull			X
	Cow Pot®			X
	Peat Pot®			X

Table 1. Description of test materials. Note: PP: Polypropylene, PETE: Polyethylene Terephthalate, PHA: Polyhydroxyalkanoate (PHA).

# Methodology

- Three independent replicates were used for each treatment.
- Bench-scale experiments were conducted.
- Positive and negative controls used were cellulose paper and polypropylene, respectively.
- All materials were cut into 1 cm squares and tested based on ASTM international standard test methods.
  
- Methods:
  - Compostability: ASTM D5338-98(2003). 120 days.
  - Soil incubation: ASTM D5988-03. 550 days.
  - Anaerobic digestion: ASTM D5511-02. 50 days.
  
- The percent biodegradation was calculated:

$$\% = \frac{C_{\text{evolved from sample}} - C_{\text{evolved from negative control}}}{\text{total amount of sample carbon added}}$$

# Compostability

- 4-liter bioreactor vessels.
- Incubator set at 55°C.
- 80g of test materials were mixed with 1kg of mature dairy manure compost.
- Regulated humidified air entered the vessels at a rate of 100 ml/min (Grewal et al., 2006).
- The off-gas was analysed for percent CO<sub>2</sub> (Vaisala model GMT 220, range 0 to 20%).

## Bioreactor System

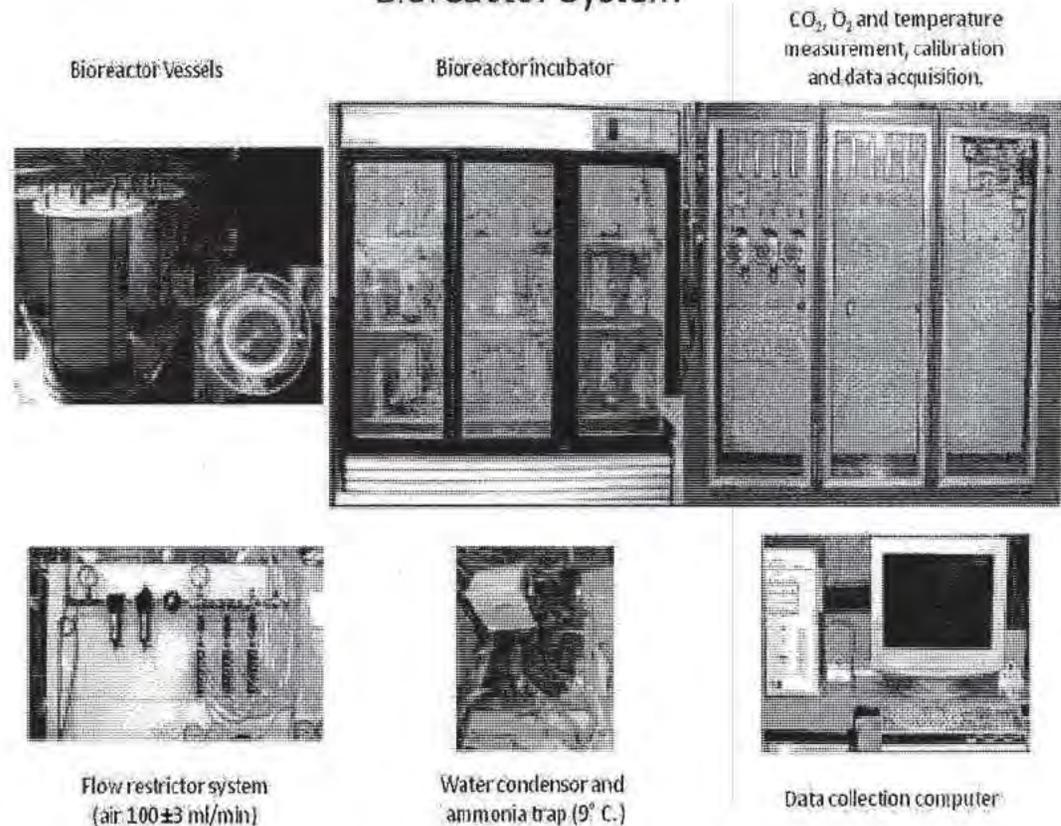


Figure 3. Schematic diagram and photograph of the bench-scale composting reactor system

# Anaerobic digestion

- 2-liter batch reactors.
- Incubator set at 37°C.
- 60g of test materials were mixed with 340g of active sludge from a anaerobic digester.
- The volume of gas produced, and biogas composition were quantified on a daily basis (Gomez et al., 2011).



Figure 4. Photograph of the bench-scale AD reactor system.

# Soil incubation

- The soil media was a mixture of organic top, no-till farm soil and sand.
- 2-liter vessels were used.
- 300 g dry of the soil media were mixed with 2g of the test material.
- Vessels were incubated at room temperature.
- A solution containing KOH (0.5N) was placed in each vessel to react with the CO<sub>2</sub>.
- The amount of CO<sub>2</sub> produced was determined by titrating with HCl (0.25N) to a phenolphthalein endpoint.



Figure 5. Photograph of the bench-scale soil incubation vessels.

# Understanding the data

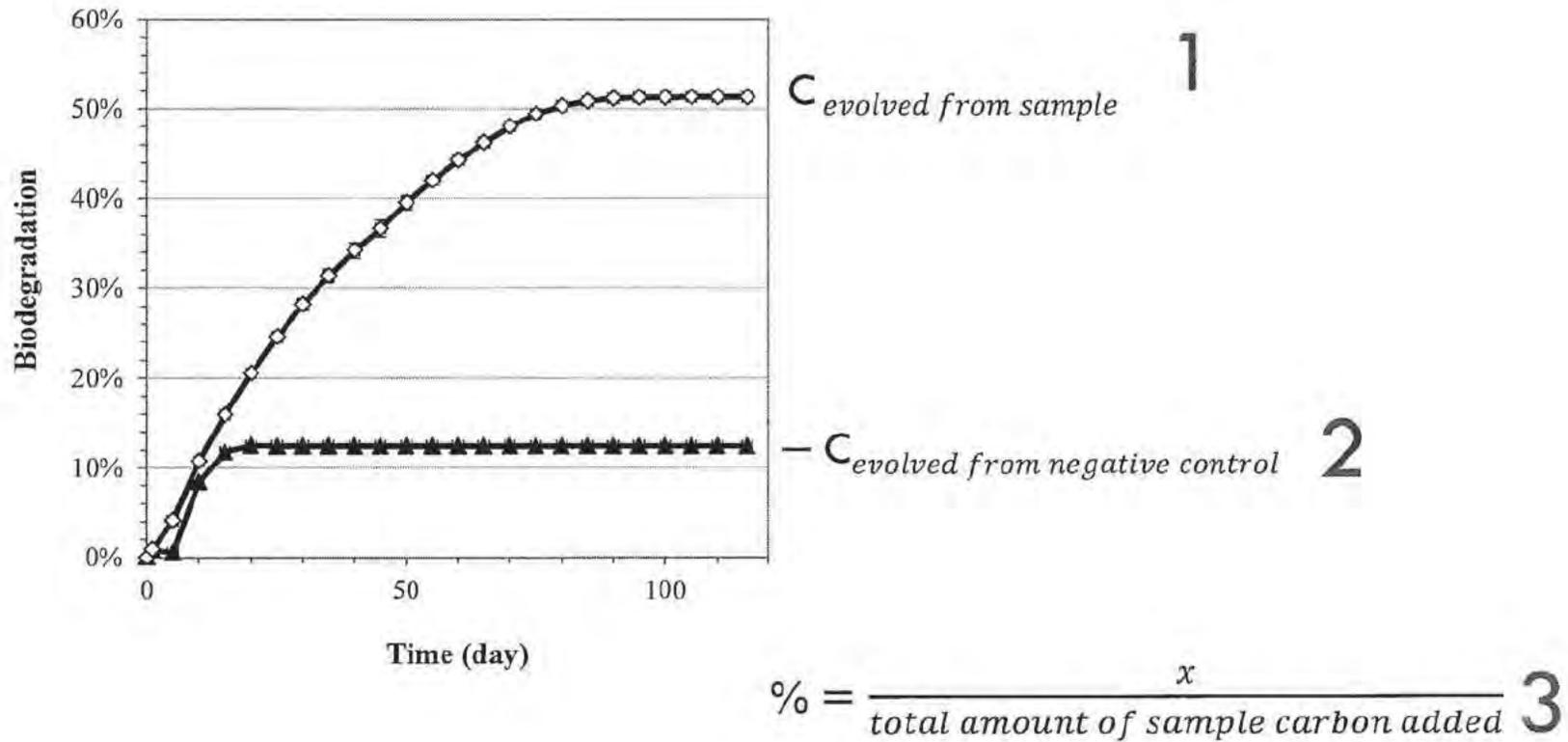


Figure 6. Example of cumulative carbon loss (CO<sub>2</sub>-C) as the percentage of initial carbon.

# Results – composting

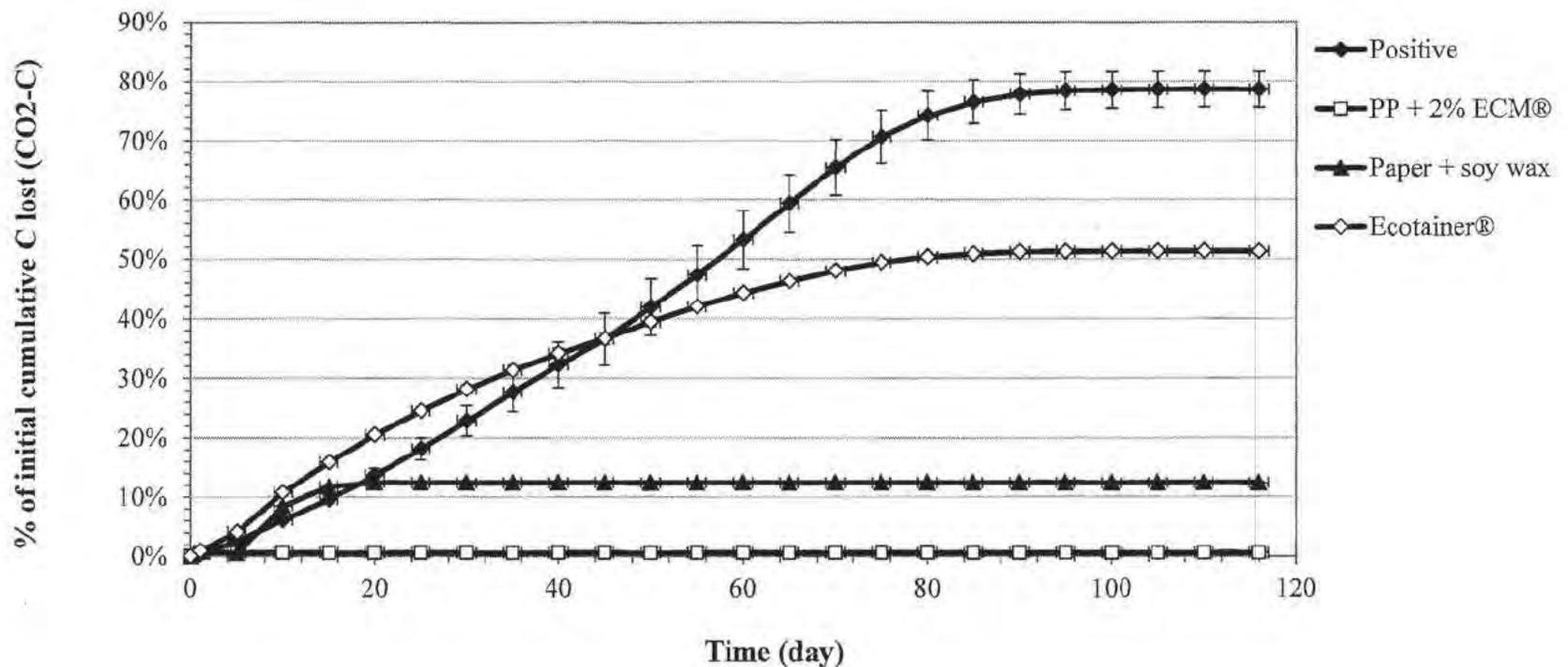


Figure 7. Cumulative carbon loss (CO<sub>2</sub>-C) during composting as the percentage of initial carbon ( $\pm$ SD) over time. For some data points SD bars are smaller than markers.

# Results – anaerobic digestion

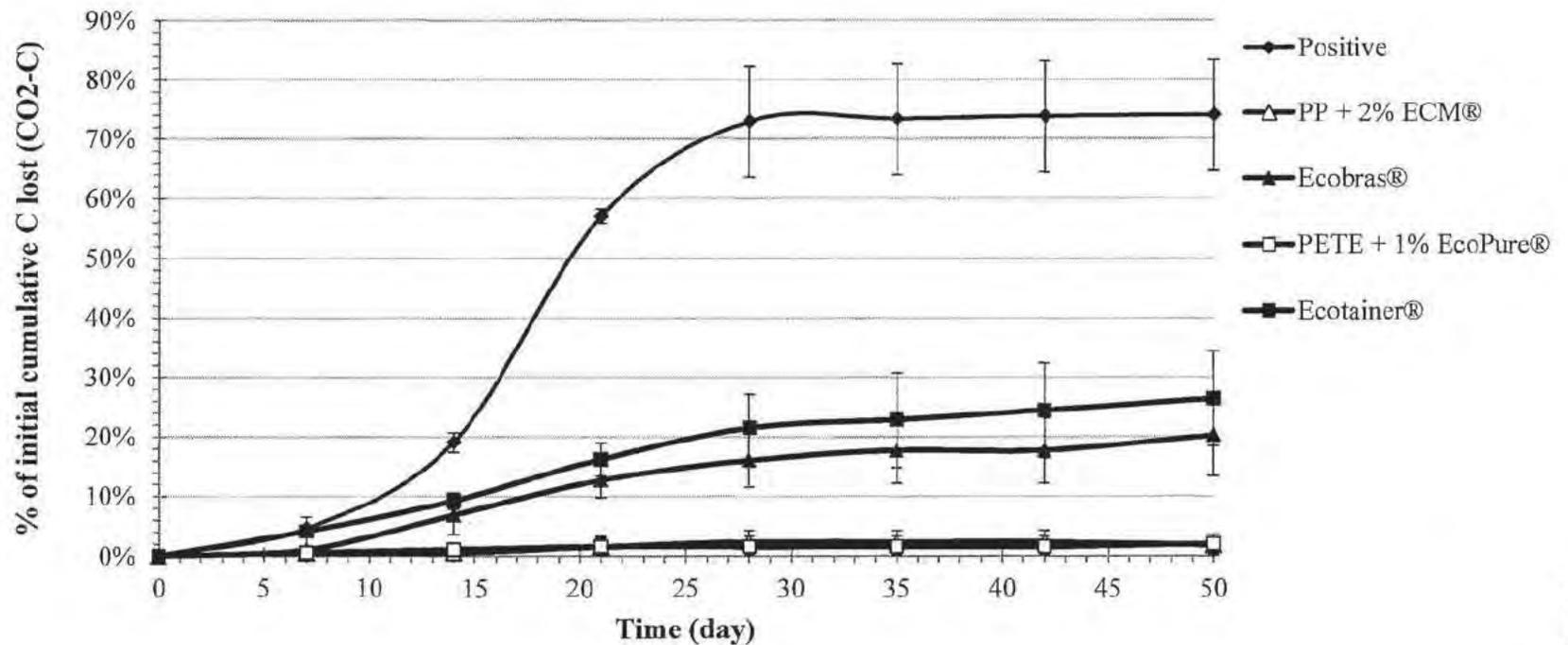


Figure 8. Cumulative carbon loss (CO<sub>2</sub>-C) during anaerobic digestions as the percentage of initial carbon ( $\pm$ SD) over time. For some data points SD bars are smaller than markers.

# Results – soil incubation

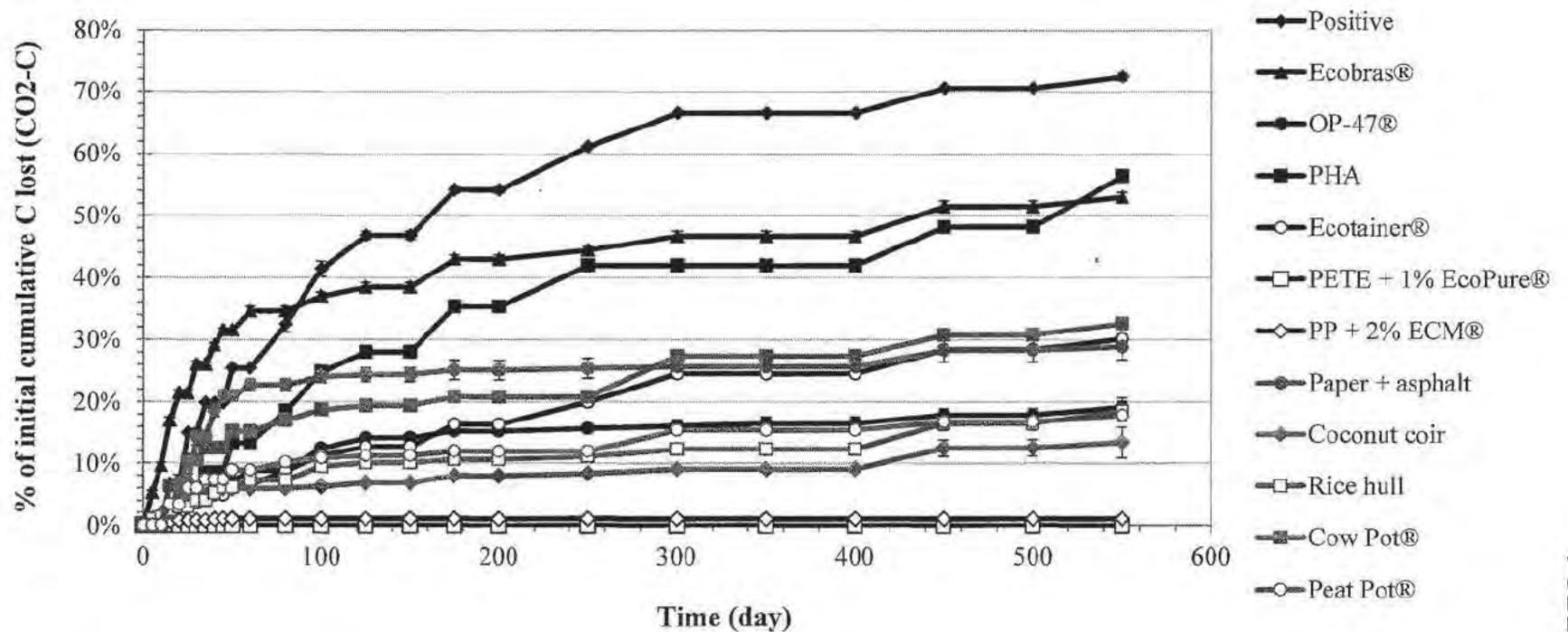


Figure 9. Cumulative carbon loss (CO<sub>2</sub>-C) during soil incubation as the percentage of initial carbon ( $\pm$ SD) over time. For some data points SD bars are smaller than markers.

# Conclusion

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- Certain biopolymers and natural fibers biodegraded to an appreciable extent during composting, anaerobic digestion and soil incubation
- Conventional plastics did not biodegrade differently than non-additive containing plastics and neither biodegraded to an appreciable extent.
- None of the test materials degraded at the same rate or to the same extent as the positive controls.

# What's next?

- **Stage 1:** study of the biodegradation of materials that are available in the market.
  - Method 1: CO<sub>2</sub> evolved. Status: completed.
  - Method 2: SEM microscopy. Status: ongoing.
  
- **Stage 2:** development of a biodegradable polymer from agricultural residues to understand the factors affecting biodegradation and production costs. Status: ongoing.
  
- **Stage 3:** a novel approach of complete Life Cycle Assessment (LCA) study that will account for various end of life fates including composting, landfilling, soil degradation and environmental release. Status: ongoing.

# Biodegradation of Bioplastics and Natural Fibers during Composting, Anaerobic Digestion and in Soil

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Thanks for your Attention



# SEM microscopy

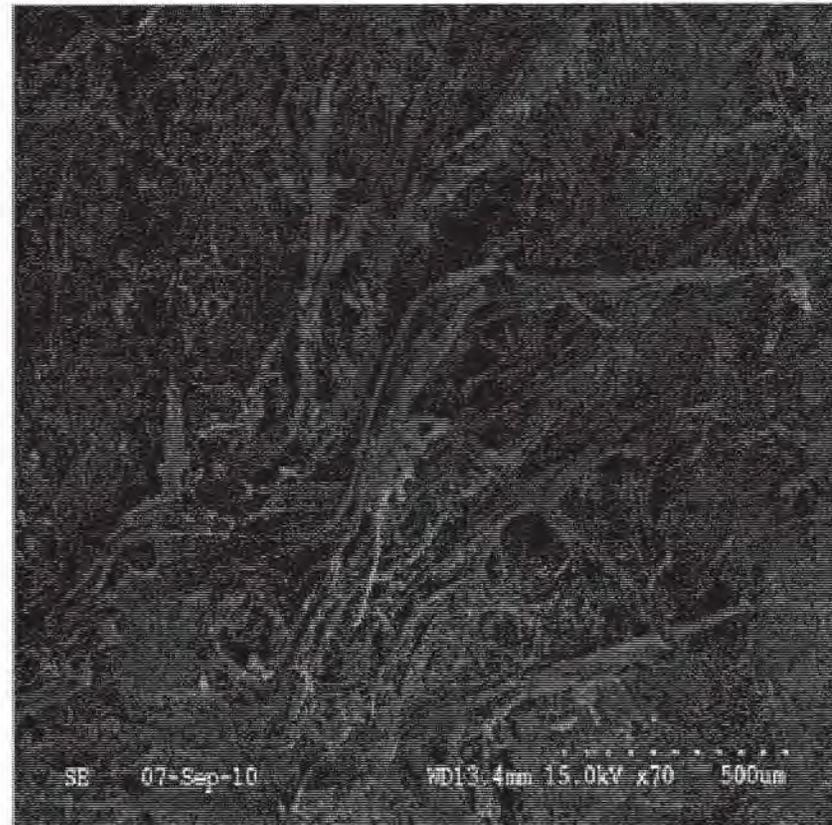


Figure 10. SEM microscopy images of coconut coir (left) and paper + asphalt (right) materials before testing.

