OXO-BIODEGRADABLE PLASTICS ASSOCIATION

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OPA RESPONDS TO ATTACK FROM HYDRO-BIO INDUSTRY

18th August 2009

On 22 July 2009 "European Bio-plastics" (a Trade Association for the hydro-biodegradable or "compostable" plastics industry)[5] published an extraordinary attack on the oxo-biodegradable plastics industry.

The Chairman of the OPA's Scientific Advisory Board, Professor Gerald Scott[6] DSc, FRSC, C.Chem, FIMMM, has responded as follows:

"Oxo-bio plastic is intended to harmlessly degrade then biodegrade if it gets into the open environment. All plastics will eventually become embrittled, and will fragment and be bioassimilated, and the only difference made by oxo-biodegradable technology is that the process is accelerated. For millions of years nature has had enzymes known as oxygenases, which will degrade hydrocarbons, whether oxidized or not. The problem with the modern (xenobiotic) plastic molecules is that they are too long (increased by lack of polarity, crystallinity and chain rigidity).

The pro-degradant additives which cause accelerated degradation are usually compunds of cobalt, iron, nickel or manganese and are added to conventional plastics at the time of manufacture. These reduce the molecular weight of the material over a pre-determined period – allowing them to be ultimately consumed by bacteria and fungi. The additives have themselves been tested and proved not to be eco-toxic. They do not contain "heavy metals." About 20 billion oxo-biodegradable plastic products were made in the last year.

Reputable companies in the oxo-bio sector do not make "self-declared" claims – their products are subjected to independent testing, based on well-established science.[7]

The issues raised by EBP are not about clarification – they seem to me to be an attempt to confuse the public by suggesting that a plastic product is not "biodegradable" unless it can comply with EN13432 (and similar standards such as

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4 Ph. D. Australian National University, Molecular Microbial Ecology; M. Sc. Medical Microbiology, and B. Sc., Botany, Zoology and Chemistry, Mysore University, India.
5 They have another trade association in the US called the "Biodegradable Products Institute" (BPI) which regularly makes similar allegations.
6 Professor Emeritus in Chemistry and Polymer Science of Aston University, UK; Chairman of the British Standards Institute Committee on Biodegradability of Plastics.
7 See eg *Degradable Polymers: Principles and Applications*, Kluwer, 2002, Chapter 3

ISO 17088, ASTM D6400, ASTM D6868, and Australian 4736-2006). This is not correct.

EBP knows that while these standards are appropriate for composting they are not suitable for products designed to biodegrade in the environment. Indeed EN13432 itself says that is not appropriate for plastic waste which may end up in the environment through uncontrolled means.

Composting is not the same as biodegradation in the environment, as it is an artificial process operated according to a much shorter timescale than the processes of nature.

I am a member of the relevant European standards committees, and have found that the "compostable" plastics industry has consistently lobbied to prevent the amendment of EN13432 to include tests suitable for plastics which are designed to biodegrade in the environment - because they have a commercial interest against a European Standard with tests appropriate to oxo-bio.

Consistent with this approach, EBP have disputed the validity of statements that oxo-bio products will biodegrade - on the ground that this could not be verified according to a recognised international standard. This is also incorrect.

Oxo-biodegradable plastic products are normally tested according to ASTM D6954-04 "Standard Guide for Exposing and Testing Plastics that Degrade in the Environment by a Combination of Oxidation and Biodegradation." There are two types of Standards – Standard Guides and Standard Specifications ASTM 6954 is an acknowledged and respected Standard Guide for performing laboratory tests on oxo-biodegradable plastic. It has been developed and published by ASTM International – the American standards organisation – and it is impossible to say that it is not a recognised standard. The second Tier of ASTM D6954-04 is directed specifically to proving biodegradation.

Para 4.1 provides that "The guide may be used to compare and relatively rank, the rate and degree of thermal oxidative degradation of a plastic material to a molecular weight range that can be established as biodegradable in a chosen environment. Subsequently, the biodegradation of these degraded polymers in diverse environments such as soil, compost, landfill, and water may be compared and ranked using standard biometric test methods and measuring carbon dioxide evolution."

The tests performed according to ASTM D6954-04 tell industry and consumers what they need to know – namely whether the plastic is (a) degradable (b) biodegradable and (c) non eco-toxic. It is not necessary to refer to a Standard Specification unless it is desired to use the material for a particular purpose such as composting. Note 3 to ASTM D6954-04 provides that if composting is the designated disposal route, ASTM D6400 should be used.

ASTM D6954-04 not only provides detailed test methods but it also provides pass/fail criteria. For example, para. 6.6.1 requires that 60 % of the organic carbon must be converted to carbon dioxide. Therefore if the material does not achieve 60% mineralisation the test cannot be completed and the material cannot be certified. Having achieved 60% mineralisation, the Note to para. 6.6.1 provides that testing may be continued to better determine the length of time the materials will take to biodegrade. It is not however necessary to continue the test until 100% has been achieved, because it is possible, by applying the Arrhenius relationship to the test results, to predict the time at which complete biodegradation is likely to occur.

It is in fact difficult to keep microorganisms working for years in closed respirometric cells. It is known that many soil microorganisms are unable to be cultured in a

laboratory and so it is already an artificial approximation to take microorganisms from the environment and observe them in the laboratory. They live in consortia with many other organisms, especially fungi and bacteria, under natural aeration and rainwater flow, changing mass and energy.

There is no requirement in ASTM D6954-04 for the plastic to be converted to $C0_2$ in 180 days because, while timescale is critical in an industrial composting process, it is not critical for biodegradation in the environment. Timescale in the natural environment depends on the amount of heat, light, and stress to which the material is subjected. Nature's wastes such as leaves twigs and straw may take ten years or more to biodegrade, but oxo-bio plastics will biodegrade more quickly than that, and much more quickly than ordinary plastic.

In oxo-biodegradable plastics there are anti-oxidants mixed with the resins, and they must be consumed before degradation starts. People sometimes do not understand this sequence and conclude that the additives do not work. An induction period must elapse before degradation starts, due to the presence of the anti-oxidants.

The requirement in EN13432 and similar standards for 90% conversion to CO_2 gas within 180 days is not useful even for composting, because it contributes to climate change instead of contributing to the fertility of the soil. "Compostable" plastic, 90% of which has been converted to CO_2 gas, is virtually useless in compost. Nature's lignocellulosic wastes do not behave in this way.

Composting of organic waste makes sense, but "compostable" plastic does not. It is up to 400% more expensive than ordinary plastic; it is thicker and heavier and requires more trucks to transport it.[8] If buried in landfill, compostable plastic can emit methane, which is a greenhouse gas 23 times more powerful than CO_2.

In addition, starch-based plastic is unlikely to be strong enough for weight-bearing packaging unless mixed with oil-based plastic. It is not even "renewable" because large amounts of non-renewable hydrocarbons are likely to be burned by the machines used to produce and polymerise the crop.[9] It makes little sense at a time when there is concern about food-security, to use scarce land and water to grow crops to make plastic bags.

Tests on oxo-biodegradable plastic products are usually conducted according to the test methods prescribed by ASTM D6954-04 by independent laboratories such as Smithers-RAPRA (US/UK), Pyxis (UK), Applus (Spain), OWS (Belgium) etc. I have seen many laboratory test reports and am satisfied that if properly manufactured, oxo-bio products will totally biodegrade in the presence of oxygen.

Conditions in the laboratory are designed to simulate so far as possible conditions in the real world, but have to be accelerated in order that tests may be done in a reasonable time. Pre-treatment does not invalidate the results as extrapolated to real-world conditions.

There is no evidence that degradable plastics (whether oxo or hydro) have encouraged littering.

Oxo-bio plastic can be recycled in the same way as ordinary plastic (see www.biodeg.org/recycling.htm), and does not need special collection points. By contrast, "compostable" plastic cannot be recycled with ordinary plastic, and will ruin

[8] http://www.biodeg.org/files/uploaded/Oxo%20vs%20Hydro-biodegradable.pdf
[9] See http://www.biodeg.org/files/uploaded/Hydro-biodegradable%20Plastic%20Production%20Process.pdf

the recycling process if it gets into the waste stream. Recyclers should therefore be very worried about bio-based plastics – but not about oxo-bio.

EBP also says “An environmental claim that is vague or non-specific or which broadly implies that a product is environmentally beneficial or environmentally benign shall not be used.” Reputable companies in the oxo-bio sector do not make such claims.

EBP quotes the definition of “degradable” according to the ISO 14021 standard as: “A characteristic of a product or packaging that, with respect to specific conditions, allows it to break down to a specific extent within a given time". Oxo-bio products possess this characteristic.

Oxo-degradation has been defined by CEN/TR15351-06 (published by the European Standards Organisation) as “degradation identified as resulting from oxidative cleavage of macromolecules.” And oxo-biodegradation as “degradation identified as resulting from oxidative and cell-mediated phenomena, either simultaneously or successively.” This is exactly what oxo-bio plastic does.”