OXO-BIODEGRADABLE PLASTICS ASSOCIATION

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BRIEFING NOTE
on
BIODEGRADABLE PLASTICS

23rd March 2009

EXECUTIVE SUMMARY

In no country in the world is it possible to collect all the plastic waste. Some of it will always escape into the environment where it could lie or float around for decades. Oxo-biodegradable plastic ("oxo-bio") is intended as low-cost insurance against this form of pollution.

There is mounting public concern about the longevity of plastic in the environment, and the plastics industry needs to respond to it by adopting oxo-biodegradability.

We have all heard of the massive patch of plastic waste floating in the Pacific Ocean. What supermarket director wants his or her grandchildren to find on a beach a plastic bag with their company's name on it, which has been floating around the oceans for 50 years or more?

Oxo-bio plastic is NOT intended to degrade deep in a landfill, but if it is landfilled it becomes inert under anaerobic conditions and does not emit methane.

Oxo-bio plastic can be recycled with other oil-based plastics.

Recycled plastics are good, and this Association supports the recycling industry, but they are not degradable and will still lie around in the environment for decades. However, ordinary plastic and recycled plastic can now be made oxo-biodegradable.

- This is done by including at the extrusion stage a formulation which makes it degrade, then biodegrade, on land or at sea, in the light or the dark, in heat or cold, in whatever timescale is required, leaving NO fragments NO methane and NO harmful residues. Oxo-biodegradable plastics do not contain organo-chlorine, nor PCBs nor "heavy metals" and they are safe for direct food contact

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- Using the test methods prescribed by American Standard D6954-04 it has been shown that oxo-bio is (1) degradable, (2) biodegradable, and (3) not exo-toxic.

Oxo-bio is made from a by-product of oil-refining which used to be wasted, so nobody is importing extra oil to make it.

There is little or no additional cost.

Oxo-bio plastic is NOT currently marketed as compostable. The chemical formulation inside it breaks the molecular chains and converts it into a material which is no longer a plastic but can be bio-assimilated by micro-organisms found in the environment. It therefore simulates the way nature disposes of wastes such as leaves and straw, but much more quickly.

Biodegradation in the environment is NOT the same thing as composting.

Composting is an artificial process operated according to a much shorter timescale than the processes of nature. Standards (such as ASTM D6400 and EN13432) designed for compostable plastic should not therefore be used for plastic which is designed to biodegrade if it gets into the environment.

Composting of organic waste makes sense, but compostable plastic for shopping bags, food packaging, shrink-wrap etc. does not. It is up to 400% more expensive than ordinary plastic; it is thicker and heavier and requires more trucks to transport it; recycling with oil-based plastics is impossible; it uses scarce land and water resources to produce the raw material, and substantial amounts of hydro-carbons are burned and CO_2 emitted, by the tractors and other machines employed. If buried in landfill, compostable plastic will emit methane (a greenhouse gas 23 times more powerful than CO_2) in anaerobic conditions.

Many industrial composters of organic waste around the world do not want plastic of any kind in their feedstock, because it is difficult to separate biodegradable plastic from ordinary plastic.

On 18th July 2008 Dr Caroline Jackson MEP[6] issued a press statement as follows:

"European legislation on waste has tended to concentrate on waste which can be collected, and to encourage people to reduce, re-use, and dispose responsibly of their waste, by recycling, incineration with energy-recovery, or by other disposal routes."

"However, we also need to take account of the fact that there we will never succeed in collecting all the waste and that some may remain to disfigure the landscape. This is particularly the case with plastic waste, from errant supermarket bags to agricultural plastic. Where this goes uncollected it can accumulate in the environment, polluting the land and the oceans for many decades, and perhaps for hundreds of years."

"Technologies have now become available which can produce plastic products such as shopping bags, garbage sacks, packaging etc. which are fit for purpose, but will harmlessly degrade at the end of their useful life. These fall into two broad categories, namely:

6 Dr. Jackson is the immediate past-Chairman of the Environment, Public Health, and Food Safety Committee of the European Parliament, and was the Rapporteur for the EU Waste Framework Directive. See also www.packagingnews.co.uk/News/833174/MEP-Jackson-calls-EC-support-hydro-oxo-biodegradable-plastics/

1. Hydro-biodegradable plastics, made wholly or partly from crops, which biodegrade in a highly microbial environment, such as composting, and
2. Oxo-biodegradable plastics, made from a by-product of oil-refining, which degrade in the environment by a process of oxidation initiated by an additive formulation, and then biodegrade after their molecular weight has reduced to the point where naturally-occurring micro-organisms can access the material."

"We need to encourage both of these technologies, and to ensure that European Standards are developed which are appropriate to both. It is worth bearing in mind that the Parliament is concerned by the use of scarce land and water resources around the world to produce biofuels in competition with food-crops and the same concern applies to growing crops to make biodegradable plastics, so I hope the European Commission will give more positive support to oxo-bio plastics."

DIFFERENT TYPES OF BIODEGRADABLE PLASTIC

It is essential to distinguish between the different types of biodegradable plastic, as their costs and uses are very different

In the case of oxo-biodegradable and hydro-biodegradable, degradation begins with an abiotic process (oxidation and hydrolysis respectively), followed by a biological process. Both types emit CO_2 as they degrade, but hydro-biodegradable can also emit methane. Hydro-biodegradable is much more expensive than oxo-biodegradable, and only oxo-biodegradable can be economically recycled.

A. OXO-BIODEGRADABLE PLASTIC

This technology produces plastic products which degrade by a process of OXO-degradation, caused by a very small amount of a pro-degradant formulation being introduced into the manufacturing process of the product. Degradation begins when the programmed-service life is over (as controlled by the stabilisers within the formulation) and the product is no longer required.

In the first phase of the degradation process the formulation breaks the molecular chains so that the material is no longer a plastic but a material with an entirely different molecular structure. The material does not just fragment, but will be consumed in the second phase by bacteria and fungi[7] after the formulation has reduced the molecular weight to a level[8] which permits living micro-organisms access to the carbon and hydrogen. It is therefore “biodegradable.” [9] This process continues until the material has biodegraded to nothing more than CO_2, water, and humus, and **it does not leave fragments of petro-polymers**.

Oxo-biodegradable plastics degrade, then biodegrade, on land or at sea, in the light or the dark, in heat or cold, in whatever timescale is required, leaving NO fragments NO methane and NO harmful residues. Oxo-bio is made from a by-product of oil refining which used to be wasted, so nobody is importing extra oil to make it.

Degradation and biodegradation of an oxo-biodegradable polyethylene specimen consistent with changes expected by Tiers 1 and 2 of ASTM D 6954-04 has been

7 “Degradable Polymers – Principles and Applications” Kluwer Academic Publishers 2002 Chapt 3; "Environmental biodegradation of polyethylene", S.Bonhomme, A. Cuer, A-M.,Delort, J. Lemaire, M.Sancelme and G.Scott, Polym. Deg. Stab., 81, 441-452

8 sub 40,000 Daltons

9 Oxo-degradation is defined by TC249/WG9 of CEN (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.”

found by RAPRA[10] Oxo-biodegradable additive also passes the eco-toxicity tests prescribed by Tier 3 of ASTM D 6954-04, including seed germination, plant growth and organism survival (daphnia, earthworms).[11]

There is little or no additional cost involved in products made with this technology, which can be made with the same machinery and workforce as conventional plastic products.

In rivers, lakes and oceans most oxo-biodegradable polyethylene films float on the surface, where they are oxidised with consequent fragmentation and biodegradation. Conditions in the ocean are ideal for oxo-biodegradation. There is oxygen and ultraviolet light on the surface, there are sufficient micro-organisms, and the wind and waves subject the material to stress. Even if the material sinks, and uv light is reduced, degradation will continue while oxygen is present. There are normally enough micro-organisms, and there may also be stress caused by sub-surface currents.

Specimens of oxo-biodegradable LDPE (low-density polyethylene) and PP (polypropylene)[12] and PS (polystyrene)[13] have been tested and demonstrated under the conditions of test to be fully compliant with the current European food contact material requirements.[14] Oxo-biodegradable additives approved by the Oxo-biodegradable Plastics Association have also been certified as compliant with US Food & Drugs Administration requirements[15].

Oxo-biodegradable bags are being bought and distributed by the UK Soil Association and supermarkets worldwide, and used for direct contact with food products. [16] Oxo-biodegradable plastic is ideal for frozen food packaging, as it can be kept for extended periods at low temperature, and will then quickly degrade when it becomes a waste product at normal temperatures.

Oxo-biodegradable plastic products are now being used by the leading UK supermarkets. In Portugal the country's largest retail group, Sonae, has adopted oxo-biodegradable plastic for their Continent, Mondelo and Mondelo Bonjour supermarket chains. Other users include TigerBrands South Africa, the Inditex Group[17] (owners of Zara), the Bimbo Group of Bakeries in Latin America, Marriott Hotels, BUPA Care Homes, Subway fast food chain, News International, Pizza Hut, KFC, French Railways, The Brazilian Post Office, Barclays Bank, Marks & Spencer (Middle East) and Walmart (Argentina).

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10 Tier 1 (Degradability) test 46023 20th March 2006. Tier 2 - (Biodegradability) test 46303 7th June 2006. RAPRA Technology Analytical Laboratories are accredited by the United Kingdom accreditation authorities as meeting the requirements of International Standards Organisation norm no.17025

11 Organic Waste Systems NV Belgium - Reports 1812/93224 8th Mar 2006. See also G. Scott and D.M. Wiles, *Degradable Polymers: Principles and Applications*, Kluwer, 2002, Chapter 13, Section 9.11, page 472, et seq.

12 RAPRA report 19th March 2007. RAPRA Technology Analytical Laboratories are accredited by the United Kingdom accreditation authorities as meeting the requirements of International Standards Organisation norm no.17025.

13 RAPRA report 12th April 2005

14 European Directive 2002/72/EC (as amended 2004/19/EC).

15 RAPRA confirmation 14th November 2007. Keller & Heckman certificate 18th February 2009

16 In September 2007 the Commercial Packaging Manager of the Co-op said "I am happy to say that we are using oxobiodegradable polythene films for direct food contact applications. We currently use these materials for pre-packed produce, self serve produce, pre-packed bread, frozen vegetables and fresh turkeys as well as for carrier bags. The approval for use has been based on the very strict EU requirements under EU Directives 2002/72/EC and 2004/19/EC relating to plastic materials and articles intended to come into contact with foodstuffs. We have been using these materials for food contact use since 2004."

17 See 2007 Annual Report page 163
http://www.inditex.com/en/shareholders_and_investors/investor_relations/annual_reports

In May 2007 the Periodical Publishers Association of the UK[18] recommended to all its members that oxo-biodegradable film should be used for wrapping their newspapers and magazines for distribution.

The length of time it takes for oxo-biodegradable products to degrade can be 'programmed' at the time of manufacture and can be as little as a few months or as much as a few years. They are protected from degradation by special antioxidants until ready for use, and storage-life will be extended if the products are kept in cool, dark conditions.

Unlike PVC, the polymers from which oxo-biodegradable plastics are made do not contain organo-chlorine. Nor do oxo-biodegradable polymers contain PCBs, nor do they emit methane or nitrous oxide even under anaerobic conditions.

Fossil Resources

Oxo-biodegradable plastics are currently made from naphtha, which is a by-product of oil refining, and oil is of course a finite resource. However, this by-product arises because the world needs fuels and oils for engines, and would arise whether or not the by-product were used to make plastic goods.

Unless the oil is left under the ground, carbon dioxide will inevitably be released, but until other fuels and lubricants have been developed for engines, it makes good environmental sense to use the by-product, instead of wasting it by "flare-off" at the refinery and using scarce agricultural resources to make plastics.

A Life Cycle Assessment was carried out in January 2005 by GUA – (Gesellschaft für umfassende Analysen) of Vienna which shows that:

"Plastic products are made of energy resources. Additionally, their production needs further energy resources. Nevertheless, plastic products frequently enable energy *savings* from the perspective of the energy balance of the total life cycle compared to the energy balance of an alternative material. Examples for such energy savings by plastic products are:

• Substitution of materials which consume much more energy for production of the same functional unit (e.g. glass)
• Performance of a certain function with much less material (e.g. packaging)
• Fuel savings because of reduction in mass (transport)
• Energy savings due to thermal insulation (where insulation with other materials would be less effective, technically complicated or too expensive)
• Savings of resources by avoiding loss or damage of packed products."

Recently, interest has been shown in manufacturing sugar-derived polyethylenes. These, like fossil-derived PE, are not biodegradable, but they can be made oxo-biodegradable in the same way, by the addition of a pro-degradant formulation.

Deliberately and totally lost?

The argument that oxo-biodegradable plastics are undesirable because their components are designed to be deliberately and totally lost is a fallacy, because the advantages of oxo-biodegradable products are not mutually exclusive. If people want to incinerate with heat recovery, or mechanically recycle them, or re-use them, then that's acceptable, and they cost very little if anything more than conventional products. The key point is what happens to the plastic which is *not* collected, and gets into the environment.
Oxo-biodegradability is not a disposal option. It is a low-cost insurance against the accumulation of plastic waste in the environment.

18 www.ppa.co.uk/cgi-bin/go.pl/news/article.html?uid=11657

In any event Oxo-biodegradable plastics are not “deliberately and totally lost” even if they degrade in the environment, because biodegradation on land is a source of plant nutrients, just as straw, grass, leaves etc.

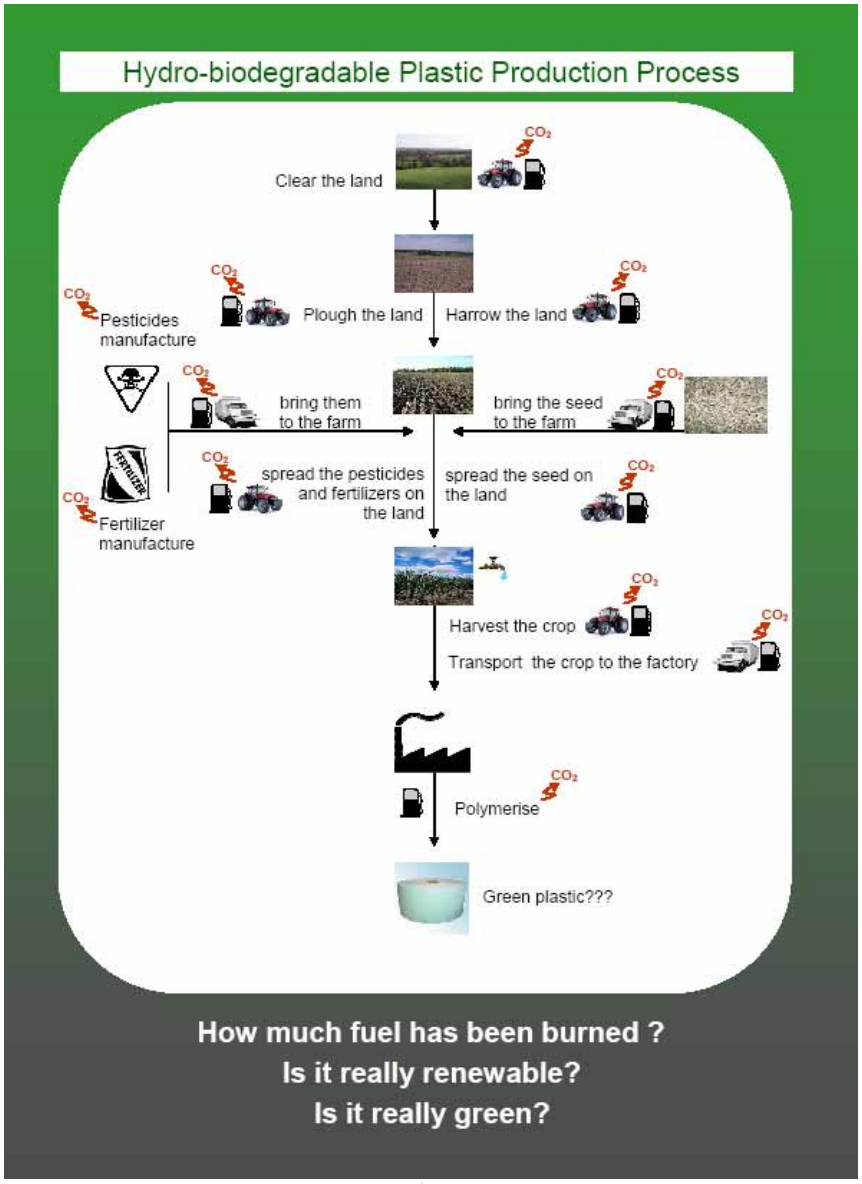
B. HYDRO-BIODEGRADABLE PLASTICS

These are usually made from crops.

Hydro-biodegradation is initiated by hydrolysis.

Some plastics in this category have a high starch content and it is sometimes said that this justifies the claim that they are made from renewable resources. However, many of them contain up to 50% of synthetic plastic derived from oil, and others (e.g. some aliphatic polyesters) are entirely based on oil-derived intermediates. Genetically-modified crops may also have been used in the manufacture of hydro-biodegradable plastics.

Hydro-biodegradable plastics are not genuinely “renewable” because the process of making them from crops is itself a significant user of fossil-fuel energy and a producer therefore of greenhouse gases. Fossil fuels are burned in the autoclaves used to ferment and polymerise material synthesised from biochemically produced intermediates (e.g. polylactic acid from carbohydrates etc); and by the agricultural machinery and road vehicles employed; also by the manufacture and transport of fertilisers and pesticides. They are sometimes described as made from “non-food” crops, but are in fact usually made from food crops.



A disproportionate amount of land would be required to produce sufficient raw material to replace conventional plastic products, and a huge amount of water, which is in such short supply in so many parts of the world.

Residues from some native starches can be seriously toxic; bitter cassava for example (tapioca) has a high level of hydro-cyanic glucoside present, which has to be removed by careful washing. During growth the plant is toxic to wildlife. Cassava is exhaustive of potash[19].

Three recent articles in the international press have drawn attention to the danger of using "renewable" resources derived from plants as a substitute for petroleum products. They focus on the use of corn and palm oil to make "biofuels" for motor vehicles, but the same danger arises from the use of corn and other agricultural products to make hydro-biodegradable plastics.

The International Herald Tribune wrote on 31st January 2007 *"Just a few years ago politicians and green groups in the Netherlands were thrilled by the country's adoption of "sustainable energy" by coaxing electricity plants to use biofuel. Spurred by government subsidies, energy companies designed generators that ran exclusively on this fuel, which in theory would be cleaner than fossil fuels because it is derived from plants.*

But last year, when scientists studied plantations in Indonesia and Malaysia, this green fairy-tale began to look more like an environmental nightmare. Rising demand for palm oil in Europe caused the razing of huge tracts of southeast Asian rain forests, and the over-use of chemical fertilisers there. Worse still, space for the plantations was often created by draining and burning peat land, which sent huge carbon emissions into the atmosphere.

In Mexico on 25th January the **financial newspaper "24 ORE"** asked *"Food or fuel? Is maize better on the table as tortillas or in the tanks of cars, converted into ethanol and then bio-fuel? The price of the cereal has doubled in a year because of the high demand for ethanol obtained from maize to produce bio-fuels. It has created a real food crisis because the price of tortillas has increased greatly. They used to cost seven pesos per kilo but now exceed 18 pesos. Tortillas are the basic element of the Mexican diet.*

According to the Earth Policy Institute, "The trade off between food and fuel risks creating chaos in the world market of food products" and they predict that shortages and higher food prices will lead to starvation and urban riots

Business Week 5 Feb 2007 edition *"The rise in the price of corn that's hurting US pig farmers isn't caused by any big dip in the overall supply. In the U.S., last year's harvest was 10.5 billion bushels, the third-largest crop ever. But instead of going into the mouths of pigs or cattle or people, an increasing slice is being transformed into fuel for cars. The roughly 5 billion gallons of ethanol made in 2006 by 112 U.S. plants consumed nearly one-fifth of the corn crop." US chicken producers are also being hit. The industry's feed costs are already up $1.5 billion per year. Ultimately, these increases will be passed on to consumers, and there could be dramatic inflation in food costs.*

The UK House of Commons Environmental Audit Committee has found[20] *that "the stimulation of biofuels production by the [UK] Government and EU is reckless in the absence of effective mechanisms to prevent the destruction of carbon sinks internationally"*

[19] Pyxis CSB "Comparative Life Cycle Analyses for a variety of Degradable Food Packaging Materials" June 2007

[20] Report 15th January 2008 (HC 76-1 of 2007-08). Para 53 http://www.publications.parliament.uk/pa/cm200708/cmselect/cmenvaud/76/76.pdf

The Committee continued [21] *"A large biofuel industry based on current technology is likely to increase agricultural commodity prices and, by displacing food production, could damage food security in developing countries."*

The use of biofuels in the EU have come under assault once again, this time from the European Commission's own scientific institute, the Joint Research Centre.[22] An unpublished internal report from the research body questions whether the cost of their use is worth the benefits.

The report buttresses worries over biofuels expressed by environment commissioner Stavros Dimas and research from environmental campaign groups that suggests biofuels may actually contribute to global warming through the deforestation and peat bog burning that is required for biofuel sources such as corn or oil palm trees.

Friends of the Earth Europe said on 9th July 2008[23] "The political tide in Europe is now turning against biofuels. This vote [in the European Parliament] gives a clear political signal that an expansion of biofuels is unacceptable." Originally viewed by both European leaders and environmentalists alike as an alternative to fossil fuels, biofuels have in the last year become something of an eco-villain, with countless reports showing how production of the fuel source in fact can result in greater greenhouse gas emissions and is a key cause of skyrocketing food prices.

The British Royal Society for the Protection of Birds is also highly critical of using land and water resources for this purpose[24] "Driven by the thoughtless policies of governments around the world, biofuels production is decimating swathes of important habitat and threatening the survival of many species, including Sumatran tigers, orang utans and countless bird species.

Biofuels advocates justify this destruction by citing their potential for combating climate change. However, whilst biofuels can play a part, many of those on the market today don't deliver the greenhouse gas savings they promise and some are even more polluting than the fossil fuels they're meant to replace. There is also evidence that taking land used for growing food, and converting it to growing biofuels, is reducing the amount of food produced and contributing to increasing prices."

On 6th March 2008 the United Kingdom's Chief Scientific Adviser warned that if this continues the world will soon be unable to feed itself.[25]

Plastics made from crops, are up to 400% more expensive, they are sometimes not strong enough for use in high-speed machinery, and they emit methane (a powerful greenhouse gas) in landfill. Also, it is wrong to use land, water and fertilisers to grow crops for bioplastics and biofuels, which drives up the cost of food for the poorest people. See also The Guardian 26th April 2008[26]

The same applies to growing cotton or jute to make durable bags. These rapidly become unhygienic if a tomato is squashed or milk spilled, and they become a durable form of litter, but they can be made from washable oxo-bio plastic, to last up to 5 years.

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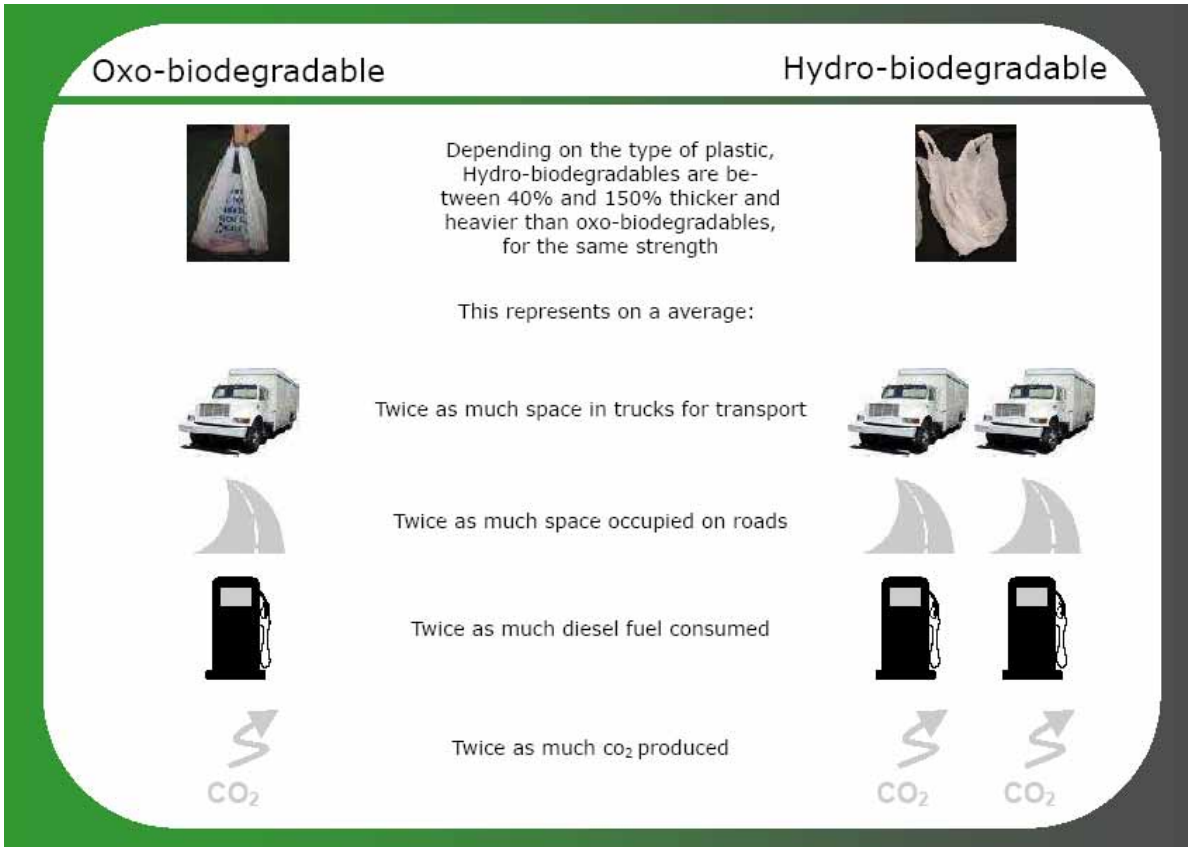
[21] ibid para 63
[22] EU Observer.com 18 Jan 2008
[23] http://euobserver.com/19/26463/?rk=1
[24] http://campaigning.rspb.org.uk/eactivist/user/userJ.jsp?CLS@74YQcNH906cWOsj3K3
[25] The Times 7th March 2008 http://www.timesonline.co.uk/tol/news/environment/article3500954.ece
[26] http://www.guardian.co.uk/environment/2008/apr/26/waste.pollution?gusrc=rss&feed=networkfront

Oxo-bio plastics degrade in the upper layers of a landfill, but they are completely inert deeper in the landfill in the absence of oxygen.

Paper bags use 300% more energy to produce, they are bulky and heavy and are not strong enough, especially when wet. They will also emit methane in landfill



For the reasons given under “Composting” below, compostability of plastics is an irrelevance

Also, for the reasons mentioned below, oxo-biodegradable products are in many respects more useful and cost-effective than hydro-biodegradable.

C. PHOTO-DEGRADABLE PLASTICS

These are not biodegradable. They react to ultra-violet light, but unless they are also oxo-biodegradable they will not degrade in a landfill, a sewer, or other dark environment, or if heavily overprinted.

ENVIRONMENTAL BENEFITS OF OXO-BIODEGRADABLE PLASTICS

There are several areas where oxo-biodegradable plastic can have a major beneficial impact on the environment:

1. RECYCLING OF DEGRADABLE PLASTICS

As indicated above, the Oxo-biodegradable Plastics Association supports the recycling industry, but recycled plastics are not normally degradable and will, like ordinary plastics, accumulate for decades if they get into in the open environment. However, recycled plastic and ordinary plastic can now be made oxo-biodegradable by the inclusion of a pro-degradant formulation at the extrusion stage.

There is mounting public concern about the longevity of plastic which gets into the rivers, oceans and landscape and cannot realistically be collected for disposal. The plastics industry needs to respond to this concern by adopting oxo-biodegradability so that the plastic will self destruct in that environment. Otherwise more and more plastic products in more and more countries will be banned outright, and more people in the industry will lose their livelihood.

Oxo-biodegradable plastics are now a fact of life. They provide a significant environmental benefit and they are increasingly popular. In 2008 one company alone sold enough formulation to make more than 5 billion plastic products.

Oxo-biodegradable plastics can be recycled together with other clean commercial polyolefin wastes, but hydro-biodegradable plastic (normally made from crops) cannot.

This briefing is intended to assist recyclers and the public to understand the relationship between biodegradability and recyclability of plastics.

1(a) OXO-BIODEGRADABLE PLASTICS

Oxo-biodegradable plastics have been in commercial use since the 1970s, and are based on commodity polyolefins, particularly polyethylene and polypropylene. Their performance during manufacture and use is indistinguishable from that of regular polyolefins, and their biodegradation is caused by formulations that promote transition metal ion oxidation in the presence of oxygen.

The length of the useful life of an oxo-biodegradable plastic product is determined by antioxidants (processing stabilisers and UV stabilisers) contained within the formulation, which can be modified so that the plastic product degrades according to whatever timescale is required.

A. New oxo-biodegradable products made with recyclate

If a new product is to be made with recyclate which contains or might contain a pro-degradant formulation and it is intended to be degradable, the process is obviously straightforward, as a pro-degradant effect is actually desired. This applies particularly to recycling of oxo-biodegradable offcuts in plastic factories, or where used oxo-biodegradable “back-of-shop” plastics (e.g. shrink-wrap pallet-wrap, bread-wrapping etc) are sent back for recycling into more oxo-biodegradable products.

B. Short-life products

If the new product to be made from recyclate whch contains or might contain a pro-degradant formulation, is intended for short-life products such as refuse-sacks, bin-liners, shopping bags, bread wrappers etc. the effect of any pro-degradant formulation is unlikely to manifest itself during the intended service-life, and biodegradability for such items is in any event desirable. This is because a proportion of these items will always find their way into the land or sea environment, where they would otherwise subsist for decades after they had been discarded.

C. Long-life products

Since polymers lose stabilisers every time they are reprocessed, it is good practice to add new stabilisers each time, whether the feedstock contains oxo-biodegradable plastic or not. If suitably formulated, the stabilisers will also neutralise any pro-oxidant which may still be effective.

C(1) Building Films

If the new product to be made is a plastic film intended for long-term durability - such as a building film for damp-proofing or waterproofing - the specification in some countries for some of these films requires the use of a virgin polyolefin compound[27] and recyclate is not therefore relevant. For all other building films the specification will usually require the use of stabilisers where necessary.[28] There will of course be no pro-degradant formulation in recyclate made from in-house scrap, or from other feedstock whose origin is known.

In the case of lower-grade building films, where no guarantee is given, these are often made from recyclate whose origin is not known, and the manufacturer should always add stabilisers as above, whether the feedstock contains a pro-degradant formulation or not.

C(2) Pipes

(a) ISO Standard 8779 “Plastics piping systems — Polyethylene (PE) pipes for irrigation” provides at para. 4.2 that only clean reprocessable material generated from a manufacturer's own production may be used if it is derived from the same resin as used for the relevant production. As the origin of the material will be known, it will not therefore be used for this purpose if it could contain any pro-degradant formulation.

(b) SABS29 piping is manufactured to a specification which permits the use of recyclate only from “in-house scrap.” Small bore piping class 6 and 10 is usually LDPE and, larger sizes, HDPE.

“In-house scrap” is scrap which has been generated during manufacture of the SABS grade pipe which can be chipped up and added back.

There is therefore no difficulty with the manufacture of such piping, as the origin of the recyclate is known and it will not therefore be used for this purpose if it contains any pro-degradant formulation.

(c) “SABS Equivalent” piping is manufactured from 100% recycled material according to the SABS specification but is not marked. Usually HDPE with from 5-20% LDPE blended for flexibility. For a quality product where a guarantee is

[27] Eg South African Bureau of Standards Specification 952-1985 para. 3.2.2
[28] South African Bureau of Standards Specification 952-1985 para. 3.2.1
[29] South African Bureau of Standards

demanded, clean industrial scrap is used where product history (material source and material grade) is known. This will not therefore contain a pro-degradant formulation.

(d) Agricultural and Domestic piping is manufactured in South Africa from 100% LDPE scrap. Normally the same scrap is used as in (c) above, but it should only be used in low-tech situations if the origin of the recyclate is unknown. Stabilisers should always be added if there is any doubt about the origin of the recyclate, and there is a case for an industry specification for this category of piping, which would include a requirement to add stabilisers.

"Low tech situation" refers to small bore piping Class 3 and 6 used for piping water to cattle or game troughs or on domestic irrigation systems, essentially at low pressures.

1(b) HYDRO-BIODEGRADABLE PLASTICS

The second class of biodegradable plastics is the hydro-biodegradables (or "compostables"), which are generally based on intermediates of biological origin derived from crops. Crop-based plastics were developed some 20 years after their oxo-biodegradable counterparts, and there are two sub-classes of different origins.

The earliest was poly (3-hydroxy butyrate). PHB is produced biologically from sucrose. This is an expensive product with a relatively low thermal decomposition temperature, which was partially overcome by varying the alkanoate structure (PHA). The second sub-group of hydro-biodegradable polyesters are the synthetic aliphatic polyesters, which are in some cases based on biological intermediates (e.g. polylactic acid - PLA).

Both sub-groups are physically incompatible with main stream packaging wastes (PE, PP, ABS and PET) and aliphatic polyesters cannot be readily reprocessed with commercial polyesters, due to their thermal incompatibility

Plasticised-starch is a different type of bio-based plastic used in packaging. This material has acceptable initial properties but is sensitive to hydrolysis during use, and cannot normally be re-processed for use in the same application. Starch-based plastics hydro-biodegrade rapidly in microbial environments, and they emit methane under anaerobic conditions (e.g. in landfill). Like other bio-based plastics, they are not compatible with mainstream plastics used in packaging and cannot be co-recycled into useful secondary products.

Hydro-biodegradable plastics, unlike oxo-biodegradable plastics, cannot therefore be recycled with the most abundant components of plastic waste. They therefore have to be segregated from the waste stream and treated separately, with considerable increase in cost. Furthermore it is difficult for the manufacturers of recyclate to physically distinguish between hydro-biodegradable and normal plastic.

Hydro-biodegradable plastics (often referred to as bioplastics) have been called into question by recyclers[30] and Recoup's project manager has warned that starch-based plastics could "have a negative impact on plastics recycling as a whole.31 …. the fear is that bioplastics will increasingly find their way into the plastics recycling stream – impacting on quality and un-doing the work done on raising public awareness of plastics recycling."

Recyclers should therefore be concerned to see that hydro-biodegradable plastics are not encouraged.

[30] Materials Recycling Weekly 20 Nov 2006
[31] Addressing the Local Authority Recycling Advisory Committee conference in November 2006. RECOUP (www.recoup.org) is the UK's national NGO developing plastics-recycling, promoting best practices and providing educational and training tools.

2. LITTER

Policymakers need always to consider what happens to waste plastic products which escape collection and end up as litter.[32]

According to The Independent Newspaper[33] a "plastic soup" of waste floating in the Pacific Ocean is growing at an alarming rate and now covers an area the size of the continental United States. If all short-life plastics had been oxo-biodegradable this environmental menace would not exist.

Discarded conventional plastics remain in the environment for many decades, and are often impossible or too expensive to collect, so recycling, landfill, composting, and incineration are not options for dealing with them. If collected, oxo-biodegradable plastics can be recycled or incinerated, and if not collected they will degrade and disappear, leaving no harmful residues.

Exposure to sunlight accelerates degradation, but the process of oxo-bio-degradation, once initiated, continues even in the absence of light, so long as air is present. The plastic will degrade much more quickly in the open than in a building, and in warm weather will disappear more quickly. Of course, if the product has been exposed to air for some time before being discarded it will disappear in an even shorter time thereafter.

Hydro-biodegradable plastics do not rapidly fragment and degrade in an abiotic outdoor environment but they do biodegrade in a highly biotic environment (such as a composting plant), in contact with soil micro-organisms.

More careless disposal?

Degradable plastic bags have been dispensed by supermarkets for more than four years, but there is no evidence that people dispose more carelessly of them (whether oxo or hydro biodegradable) and they have not been encouraged to do so.

But suppose for the sake of argument that 10% more were discarded. If 1,000 conventional and 1,100 oxo-biodegradable bags were left uncollected in the environment, 1,000 conventional bags would remain in the rivers, streets and fields for decades, but none of the oxo-biodegradable bags would be left at the end of the short life programmed into them at manufacture.

There will always be people who will deliberately or accidentally discard their plastic waste. What will happen to all the plastic waste that will not be recycled or will not be incinerated, and instead will litter the countryside - would it not be better if the discarded plastic were all oxo-biodegradable?

To limit or discourage the availability of all types of plastic bags is not the answer, as there are so many purposes for which they are ideal. For the following reasons paper bags and re-usable bags should not be encouraged.

ALTERNATIVES

Compare different materials, according to criteria like weight, energy and volume of reduction. If we take 100% as a starting point - without plastic we would have about 484% in terms of **weight**. In terms of **energy consumption**, with plastics if we take

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[32] See statement by Member of European Parliament, footnote 6

[33] **05/02/2008**
http://www.independent.co.uk:80/environment/the-worlds-rubbish-dump-a-garbage-tip-that-stretches-from-hawaii-to-japan-778016.html

100%, without plastic we will have around 300%. The same in **volume** of waste - with plastic and without plastic we have almost 300%. [34]

Paper Bags

The process of making paper bags causes 70% more atmospheric pollution than plastic bags. Paper bags use 300% more energy to produce, and the process uses huge amounts of water and creates very unpleasant organic waste. When they degrade they emit methane and carbon dioxide.

A stack of 1000 new plastic carrier bags would be around 2 inches high, but a stack of 1000 new paper grocery bags could be around 2 feet high. It would take at least seven times the number of trucks to deliver the same number of bags, creating seven times more transport pollution and road congestion.

Also, because paper bags are not as strong as plastic, people may use two or three bags inside each other. Paper bags cannot normally be re-used, and will disintegrate if wet.

Re-usable Bags

Long-term re-usable shopping bags are not the answer. They are much thicker and more expensive, and a large number of them would be required for the weekly shopping of an average family. They are not hygienic unless cleaned after each use. Whilst sometimes called “Bags for Life” they have a limited life, depending on the treatment they receive, and become a very durable form of litter when discarded.

Shoppers do not always go to the shop from home, where the re-usable bags would normally be kept, and consumers are unlikely to have a re-usable bag with them when buying on impulse items such as clothing, groceries, CDs, magazines, stationery etc.

However, for those who believe in long-term re-usable bags, they can be made from extended-life oxo-biodegradable plastic and will last for five or more years.

Risk Of Persistency and Bio-accumulation?

Fragmentation occurs as an intermediate stage during degradation of both oxo-biodegradable and hydro-biodegradable plastics.

It is not of course acceptable to apply conventional plastics to the soil even if they are fragmented, since physical shredding alone does not transform plastic into a biodegradable product. However, the properties of oxo-biodegradable plastic are quite different from those of the original plastic. The transformed plastic behaves in the same way as nature’s wastes. It is bio-assimilated by the same bacteria and fungi, and they convert the degraded plastic to cell biomass, just like lignocellulosic materials such as straw, leaves and twigs.

Eco-toxicity tests[35] have demonstrated that oxo-biodegradable formulations produce no immediate, or cumulative, adverse effects on the soil, The major

[34] Prof. Emo Chiellini, Professor of Fundamentals of Technologies, University of Pisa. Simpósio Internacional de Plásticos Degradáveis e Biodegradáveis 6th June 2007. See also Polymers and the Environment, 1999, Chapter 4, Management of Polymer Wastes, p. 78-81 and Degradable Polymers 2nd edition, Chapter 1)

[35] See G. Scott and D.M. Wiles, *Degradable Polymers: Principles and Applications*, Kluwer, 2002, Chapter 13, Section 9.11, page 472, et seq

elements are naturally bio-degradable, and the traces remaining after degradation are in such minor parts per million (in some cases, per billion) that no harmful effects will occur. Some of these materials can also be found in hydro-biodegradable ("compostable") products.

Oxo-biodegradable plastics do not contain "heavy metals."[36]" Metal compounds used in oxo-biodegradable polymers and listed in European Directive 67/548/EC are not banned. The Directive simply controls their marketing and use, and they are marketed and used accordingly.

The UK Food Standards Agency's Expert Group on Vitamins and Minerals[37] has carried out a risk assessment which shows that the metal salts used in commercial oxo-biodegradable plastics are trace-elements necessary for healthy plant and human growth.

Like lignocellulose (and unlike the hydro-biodegradable plastics which discharge their CO_2 to atmosphere during composting), oxo-biodegradable plastics are sequestered by the soil and enhance the "land carbon sink"

3. LANDFILL

The main benefit of oxo-biodegradability is not for plastic waste which is sent to landfill, but for plastic waste which gets out into the environment, where it will otherwise accumulate for many decades on land and in the oceans.

Oxo-biodegradable plastic waste should not be sent to landfill. After collection it should be recycled[38], or incinerated for energy-recovery. However, the recycling option for a normal plastic waste stream is not practicable for hydro-biodegradable plastics, which have to be treated separately and at high cost. Also, hydro-biodegradable plastics have a lower calorific value when incinerated.

Some plastic waste will nevertheless be collected and sent to landfill.

The aims of the EU Landfill Directive 1999/31/EC (as amended[39]) are stated in the following recitals at the beginning of the document:

(3) the prevention, recycling and recovery of waste should be encouraged as should the use of recovered materials and energy so as to safeguard natural resources and obviate wasteful use of land.

Oxo-biodegradable plastics, like their traditional counterparts, can be re-used during their useful life and/or recycled and incinerated with high energy-recovery.

The most valuable asset for a landfill-operator is space. Plastic bags are extremely compact, and plastic grocery bags and all plastic retail bags together take up less than 1% of space in landfills - a tiny amount. However, conventional plastic bags take up more space than necessary because they trap air, they do not disintegrate rapidly, and thus inhibit the decomposition of their contents in the landfill.

Oxo-biodegradable plastics approved by this Association will disintegrate in the surface layers of a landfill so long as oxygen is present. Oxygen levels will vary according to factors such as how loose or compressed the waste was when it was buried, how much u/v light is available, and how much further waste material or earth is added to the

[36] The EU Packaging and Packaging Waste Directive 94/62/EC Article 11 designates "heavy metals" as lead, cadmium, mercury and hexavalent chromium. These are not transition metals and are therefore not used as peroxidation catalysts in oxo-biodegradable plastics.
[37] UK Food Standards Agency (May 2003) *Expert Group on vitamins and minerals" Part 3 Trace Elements, Risk Assessment.*
[38] See OPA Position Paper on Recycling above, and at http://www.biodeg.org/recycling.htm
[39] 1882 of 2003

landfill over what period of time. A fragmented oxo-biodegradable bag will settle more easily than an ordinary plastic bag with trapped contents, and will occupy less space. Test reports for individual products will measure the ability of the material to degrade within a reasonable period.

(4) further consideration should be given to the issues of incineration of municipal and non-hazardous waste, composting, biomethanisation, and the processing of dredging sludges;

Oxo-biodegradable plastics can be incinerated with high energy recovery.

(12) protective measures [should] be taken against any threat to the environment in the short as well as in the long-term perspective, and more especially against the pollution of groundwater by leachate infiltration into the soil.

Oxo-biodegradable plastics do not cause harmful leachate infiltration, and commercial oxo-biodegradable formulations approved by the OPA have been certified non eco-toxic.

(16) measures should be taken to reduce the production of methane gas from landfills, inter alia, in order to reduce global warming, through the reduction of the landfill of biodegradable waste and the requirements to introduce landfill gas control;

Hydro-biodegradable ("compostable") plastics will biodegrade and emit CO_2 at a high rate in the surface layers of a landfill if there is enough microbial activity, and in the depths of a landfill, in the absence of air, they generate methane, which is a powerful greenhouse gas. Methane is also highly combustible and is a cause of explosions.

Decomposition deep in a landfill is not therefore desirable. Whilst oxo-biodegradable plastics fragment and biodegrade in the upper layers of the landfill (see above) and emit CO_2 at a low rate there in the presence of oxygen, they are completely inert deeper in the landfill in the absence of oxygen.

Article 2 (m) of the Landfill Directive defines "biodegradable waste" as *"any waste that is capable of undergoing anaerobic or aerobic decomposition, such as food and garden waste and paper and cardboard."* However, the reason stated in recital 16 above for reducing the landfill of biodegradable waste does not apply to oxo-biodegradable plastics because, as indicated in para. 13 above, they are completely inert in the landfill in anaerobic conditions - unlike food and garden waste, paper, cardboard, and hydro-biodegradable plastics, which all emit methane.

It is an important factor that an oxo-biodegradable plastic bag is much lighter than a paper, cotton, or jute bag, and is even lighter than a hydro-biodegradable bag.[40] As municipalities and waste-management companies have to pay to put trash in landfills, and as charges are based on weight, it costs much more to put paper, cotton, jute or hydro-biodegradable plastic bags in a landfill than ordinary or oxo-biodegradable plastic bags.

The Report on "The impacts of degradable plastic bags in Australia" prepared by ExcelPlas/ Nolan-ITU on 11 September 2003 for the Australian Government noted at 7.3 that: "[hydro] degradable polymers with starch content have higher impacts upon greenhouse due to methane emissions during landfill degradation and N_2O emissions from fertilizing crops." Methane is 23 times more potent for global warming[41] than CO_2.

[40] depending on the type of plastic, hydro-biodegradables are between 40% and 150% thicker and heavier than oxo-biodegradables for the same strength.
[41] IPCC (Inter-Governmental Panel on Climate Change) Report page 47
www.ipcc.ch/pub/wg1TARtechsum.pdf

4. AGRICULTURE AND HORTICULTURE

Oxo-biodegradable plastic has useful applications in agriculture and horticulture.[42] For many years farmers and growers have used plastic sheets to protect their crops and to inhibit weeds, but after the crop has been harvested many thousands of square kilometres of dirty plastic have to be removed and disposed of. This is a very expensive process, and creates huge quantities of contaminated waste, which cannot be burned, or recycled into useful products.

Oxo-biodegradable plastic sheets can however be programmed at manufacture to degrade soon after the harvest. The degraded material can then be ploughed into the soil where it completes the biodegradation process and becomes a source of carbon for next year's plants**.**

Oxo-biodegradable plastics have been used as protective films in agriculture in many countries (including USA, China, Japan and the EU). They are applied to the land in the same way as straw to retain moisture and to increase root temperatures.

On 20th May 2003 the Development and Cooperation Committee of the European Parliament passed a resolution calling on the European Commission not to fund environmentally harmful projects in the ACP (Africa, Caribbean and Pacific) countries. The Committee specifically called on the Commission to encourage the use of biodegradable materials in the banana-growing process in ACP countries who benefit from the EU's Special Framework of Assistance for suppliers of bananas. Oxo-biodegradable plastic films are being used as banana bags in commercial operations.

5. ENERGY RECOVERY

In some countries, including Germany, incineration is popular, and the necessary equipment is in place. Oxo-biodegradable plastic can be incinerated with energy recovery in the same way as conventional plastic, and has a higher calorific value than the hydro-biodegradable alternative.

6. WASTE COLLECTION

There has to be a collection method for organic waste. Transparent oxo-biodegradable sacks are currently in common use for this purpose and are much better than wheeled bins or conventional plastic sacks. Oxo-biodegradable sacks are much better than bins because:

They are quicker and easier to collect than bins, which require the collectors to walk the distance from vehicle to house four times.
They can be produced in a wide variety of sizes to suit particular requirements
They do not need expensive vehicles with bin-lifting equipment
They are easy for householders to store, and can be supplied in rolls
They can be sealed when filled, so eliminating smells and flies which usually attend conventional waste bins
Transparent sacks enable collectors to see the contents
They are not as visually-intrusive as bins
Bins need to be washed
Bins are bulky items, which are expensive to purchase, store, and transport
The bins themselves, usually made from heavy non-degradable plastic, eventually have to be disposed of.

[42] see also COMPOSTING (section 7 below).

7. COMPOSTING

Composting is an artificial process operated according to a much shorter timescale than the processes of nature. Standards (such as ASTM D6400 and EN13432) designed for compostable plastic should not therefore be used for plastic which is designed to biodegrade if it gets into the environment.

Composting of organic waste makes sense, but compostable plastic for shopping bags, food packaging, shrink-wrap etc does not. It is up to 400% more expensive than ordinary plastic; it is thicker and heavier and requires more trucks to transport it; recycling with oil-based plastics is impossible; it uses scarce land and water resources to produce the raw material, and substantial amounts of hydro-carbons are burned and CO_2 emitted, by the tractors and other machines employed. If buried in landfill, compostable plastic will emit methane (a greenhouse gas 23 times more powerful than CO_2) in anaerobic conditions.

Many industrial composters of organic waste around the world do not want plastic of any kind in their feedstock, because it is difficult to separate biodegradable plastic from ordinary plastic.

Home composting of plastic packaging is dangerous and should not be encouraged, as it is often contaminated with meat, fish, or poultry residues, and temperatures may not rise high enough to kill the pathogens.

European standard EN 13432 and ASTM D6400[43] are specifications for *compostable* plastic packaging, and EN13432 states specifically at para. 1 that it does not take into account packaging waste which may end up in the environment through uncontrolled means, ie as litter.

EN 13432 and ASTM D6400 are not appropriate for testing oxo-biodegradable plastics. This is because they are based on measuring the emission of carbon dioxide during degradation over a short timescale. Hydro-biodegradable plastic is compliant precisely because it emits CO_2 (a greenhouse gas) at a high rate. Oxo-biodegradable plastics do not mineralise rapidly in the artificial biometric test in EN 13432 and ASTM D6400 but they do biodegrade in soil after application of the compost to the soil.

It is worth noting that EN 13432, does not require that plastics biodegrade during and after composting within any particular time-scale. The Note to paragraph 5 of EN 13432 says: "It is important to recognise that it is not necessary that biodegradation of packaging material or packaging be fully completed by the end of biological treatment in technical plants but that it can subsequently be completed during the use of the compost produced." This is what oxo-biodegradable plastic does, and it is consistent with the behaviour of nature's waste products such as twigs, leaves and straw, which take years to biodegrade fully. Oxo-biodegradable plastics will biodegrade much more quickly than these natural materials.

If a leaf were subjected to the CO_2 emission tests included in EN13432 it would not be considered biodegradable or compostable!

Another problem with EN 13432 is that it requires almost complete conversion of the carbon in the plastic to CO_2, thus depriving the resulting compost of carbon, which is needed for plant growth, and wasting it by emission to atmosphere.

Conversion of organic materials to CO_2 at a rapid rate during the composting process is not “recovery” as required[44] by the European Directive on Packaging and

[43] There are also other national and international equivalents.
[44] Annex II para. 3

Packaging Waste (94/62/EC as amended),[45] and should not really be part of a standard for composting. Nature's lignocellulosic wastes do not behave in this way, and if they did they would have little value as soil improvers and fertilisers, having lost most of their carbon.
The EU Directive does NOT require that when a packaging product is marketed as "degradable" or "compostable" conformity with the Directive must be assessed by reference to EN13432. In the first place although the Directive[46] provides that conformity with its essential requirements may be presumed if EN 13432 is complied with, it does not exclude proof of conformity by other evidence, such as a report from a reputable testing institution. Indeed Annex Z of EN13432 itself says that it provides only **one means of conforming** with the essential requirements.

Secondly, EN 13432 does not apply at all to applications other than *composting* of *packaging.*

Oxo-biodegradable plastic does not degrade quickly in low temperature "windrow" composting, but development is ongoing for "in-vessel" composting of oxo-biodegradable plastic at the higher temperatures required by the EU animal by-products regulations.

8. WASTE MINIMISATION

As oxo-biodegradable bags are thinner than hydro-biodegradable or paper bags of the same strength, they produce a much smaller tonnage of plastic waste. Also, as they will totally degrade, they cease to exist at the end of their programmed life. As noted above, a stack of 1000 new plastic carrier bags would be around 2 inches high, but a stack of 1000 new paper grocery bags could be around 2 feet high.

9. COUNTERFEITING

Many high-value cosmetics and other products are sold in plastic bottles, jars, and other plastic containers. Often these empty containers are collected and refilled with an inferior product and sold as the genuine article.

Manufacturers of high-value products are now demanding oxo-biodegradable containers which will degrade soon after use and will therefore make counterfeiting more difficult.

10. OXO-BIODEGRADABLES v HYDRO-BIODEGRADABLES

To summarise, **oxo**-biodegradable plastics have the following advantages:

- They will degrade in any outdoor or indoor environment where air is present, even in the absence of water. This is a very important factor in relation to litter, because a large amount of plastic waste cannot be collected. Hydro-biodegradables need a highly microbial environment such as a compost heap.

- Oxo-biodegradable plastic can be programmed at manufacture to degrade within a timescale to suit the user's requirements. The rate of degradation of hydro-biodegradable plastics cannot be controlled.

- Oxo-biodegradable plastics are stronger and more versatile.

- They are much cheaper

[45] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:1994L0062:20050405:EN:PDF
[46] Article 9(2)

- They are thinner, and use less space to store and transport, and less material to produce
- They can be transparent, so that the food or other contents within can be clearly seen.
- They can be recycled and can be made from recyclate.
- Less energy is required to produce and transport them.
- No genetically-modified ingredients
- They do not emit methane when oxidising
- Ideal for frozen food
- Can be used in high-speed machinery (such as for bread packaging) but the performance of hydro-biodegradable plastics in these machines is often not acceptable.
- Can be incinerated with much higher energy-recovery than hydro-biodegradable plastic
- They can be made with the same workforce and machinery as conventional plastic products, but hydro-biodegradable products are made by a quite different process.

It seems wrong to divert agricultural resources away from food production when there is so much hunger in the world, and to use fertilisers and pesticides unnecessarily

OXO-BIODEGRADABLE PRODUCTS AVAILABLE

Carrier bags or “shopper-bags” which consumers use to take away their purchases from the shop
Refuse sacks, which consumers buy in rolls at the shop, and use for disposal of their ordinary household waste.
Aprons, for the protection of garments, in the home, hospitals, restaurants, workshops etc.
Bags to contain dog faeces collected in parks, gardens, etc
Bin liners
Gloves
Plastic sheeting for a variety of applications in agriculture and horticulture.
Plastic film for wrapping newspapers and magazines.
Bread bags
Frozen food bags
Wrappers for cigarette packets
Shrink-wrap and pallet-wrap
“Bubble-wrap”
Rigid products such as bottles and cups

More products will become available in due course.

STANDARDS

EN13432 and ASTM D6400 have been discussed above.
The French Standards organisation, AFNOR, published in July 2007 a Standard for oxo-biodegradable plastics in agriculture.[47]

A draft standard[48] for oxo-biodegradation has also been published by the British Standards Institution.

Malta has published a standard for oxo-biodegradable plastic

Oxo-biodegradable plastic has been tested according to all three Tiers of American Standard ASTM D6954-04 for "Plastics that Degrade in the Environment by a Combination of Oxidation and Biodegradation."

Packaging made from oxo-biodegradable plastic complies with paras. 1, 2 3(a), (b) and (d) of Annex II of the European Parliament and Council Directive 94/62/EC (as amended) on Packaging and Packaging Waste. This Annex specifies the essential requirements for the composition and the reusable and recoverable, including recyclable, nature of packaging.

Oxo-biodegradable plastic satisfies para. 3(a) because it can be recycled. It satisfies para. 3(b) because it can be incinerated. It satisfies para. 3(d) because it is capable of undergoing physical, chemical, thermal or biological decomposition such that most of the finished compost ultimately decomposes into carbon dioxide, biomass and water. It can even satisfy para. 3(c) if composted in an "in-vessel" process.

The then EU Environment Commissioner, Margot Wallstrőm, said, in a letter to the Irish MEP Avril Doyle on 18th February 2002 that "it would be consistent with the spirit of Community environment policy and legislation if a member state applying a plastic bag tax were to decide to adopt a more beneficial tax rate in relation to biodegradable carrier bags."

LEGISLATION

In Brazil, Argentina, Slovenia, Mauritius and India there is legislation which gives preferential treatment to degradable plastic. There is draft legislation in several other countries.

47 XP_T_54-980__F
48 BS 8472