Oxo-bio
FREQUENTLY ASKED QUESTIONS

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The problems caused by plastic litter in the environment have compelled governments, manufacturers and brand owners to rethink the way plastic is produced, used and ultimately disposed of. Many are now looking for products and technologies that are inexpensive, non-disruptive to manufacture, and can be reused and recycled at the end of their useful life, without increasing CO2 emissions in the process.

A technology called oxo-biodegradable plastic (OBP) has now been invented, which destroys plastic at the end of its useful life, and removes it from the eco-system if it has not been collected and escapes instead into the open environment.

A study for the UK Environment Agency by Intertek http://www.biodeg.org/life-cycle-assessments/life-cycle-assessments-2/ shows how plastic bags are environmentally friendly. If these were banned, it would actually be worse for the environment as the alternatives to plastic bags have a higher 'global warming potential'. See also plastic bag bans and taxes www.biodeg.org/bagbansandtaxes. The message therefore is "don't ban plastic bags – upgrade them with OBP technology."

Academics agree that replacements could be vastly worse than plastic

A 40-strong group of academics from Heriot-Watt University in Scotland said that replacing plastics with other packaging such as glass or metal could double global energy consumption, adding that it could also lead to a tripling of greenhouse gas emissions.

BBC News Scotland 20-11-2018

In the process of degradation, OBP allows the transfer of valuable carbon material back to the eco-system via micro-organisms. Studies have demonstrated that the carbon-based organic materials developed as the result of the degradation mechanism are biodegradable and therefore absorbed by living organisms in the soil. This is not the case with conventional plastic that tends to lock in the carbon for many decades, or hydro-degradable ("compostable") plastic that releases the carbon very rapidly to atmosphere as CO_2 gas, which contributes to climate-change

1. Why do we need oxo-biodegradable plastic (OBP)?

Because **thousands of tons of plastic waste are getting into the world's environment every day, and will remain there for decades.** There is nowhere in the world where it possible to collect every piece of plastic for recycling or any other form of responsible disposal. **OBP has been specifically tested and found biodegradable in the oceans** at Bandol laboratories in France, Queen Mary University in the UK, and at l'Observatoire Oceanologique de Banyuls sur mer (Lomic) in France.

2. What is oxo-biodegradable plastic?

OBP is ordinary plastic to which a catalyst has been added during the manufacturing process. The resulting plastic is then made into products like carrier bags, produce or courier bags, straws and other short-life/single-use items. The big difference between oxo-biodegradable and ordinary plastic is that if oxo-biodegradable plastic escapes collection and ends up in the open environment as litter, it will degrade and biodegrade much more quickly than ordinary plastic.

OBP is the lowest cost alternative to ordinary plastics and are best suited to low value plastics which are either unsuitable or uneconomic for recycling. Accordingly this should not inhibit innovation for more expensive alternatives aimed at replacing higher value plastics.

3. Definitions

There is a lot of confusion in the terminology relating to degradable plastics, and it is necessary to bring clarity to this area.

"**Oxo-degradation"** is defined by CEN (the European Standards authority) in TR15351 as "degradation identified as resulting from oxidative cleavage of macromolecules." This describes ordinary plastics, which abiotically degrade in the open environment, but do not become biodegradable except over a very long period of time.

"**Oxo-biodegradation"** is defined by CEN as "degradation resulting from oxidative and cell-mediated phenomena, either simultaneously or successively". This describes OBP.

4. How does OBP work?

In the presence of oxygen, the catalyst accelerates the natural oxidation process and reduces the molecular weight of the polymer at a much faster rate, to the point where it is no longer a plastic and can be bio-assimilated by bacteria and fungi in the natural environment. **The process continues until the material has biodegraded to nothing more than CO2, water, and humus. It does not leave fragments of petro-polymers in the soil, and it does not contain heavy metals.** It is tested according to US Standard ASTM D6954 by independent laboratories for degradation, biodegradation, non-toxicity and absence of metals in excess of the limits prescribed by Art 11 of the EU Packaging Waste Directive. This was tested on 27th July 2017 by Eurofins laboratory in Spain, which is a laboratory accredited to ISO 17025. They found 88.86% biodegradation, with no prohibited metals and no Ecotoxicity.

5. Does oxo-biodegradable plastic biodegrade, or does it just fragment?

Oxo-biodegradable plastic does just what it says, the clue is in the name – It is called oxo-biodegradable plastic because it is biodegradable.

The process has been described as follows by Professor Ignacy Jakubowicz, one of the world's leading polymer scientists who has studied OBP for more than 20 years:

"The degradation process is not only a fragmentation, but is an entire change of the material from a high molecular weight polymer, to monomeric and oligomeric fragments, and from hydrocarbon molecules to oxygen-containing molecules which can be bioassimilated."[1]

Oxo-biodegradable plastic degrades, and then biodegrades in the open environment in the same way as nature's wastes. If oxo-biodegradable plastic merely fragmented without biodegrading, CEN (European Committee for Standardization) would not have defined oxo-biodegradability as "degradation resulting from oxidative and cell-mediated phenomena, either simultaneously or successively" and the American, British and French standards organisations would not have included tests for biodegradability in ASTM D6954, BS8472 and ACT51-808.

6. Is oxo-biodegradable technology supported by the science?

Yes. Oxo-biodegradable plastic has been studied by scientists for at least 20 years. R**ecently a former judge of the High Court in England was asked to review the scientific evidence,** and he concluded[2]:

- that OBP does facilitate the ultimate biodegradation of plastics in air or seawater by bacteria, fungi or algae, within a reasonable time, so as to cause the plastic to cease to exist as such, far sooner than ordinary plastics, without causing any toxicity;
- that "the benefit is obvious of reducing future contributions to the scourge of plastic pollution of land and sea";
- that OBP is compatible with composting and recycling;

7. Do any countries legislate in favour of OBP?

Yes. Many governments in the world have realised that oxo-biodegradable plastic offers a solution to plastic waste that escapes into the open environment and cannot realistically be collected. **Ten countries have legislated to make oxo-biodegradable plastic mandatory,** and they include Saudi Arabia, the UAE and Pakistan.
It is not now possible to export to these countries a wide range of plastic products or goods wrapped in plastic, unless the plastic is OBP.

8. What does it cost?

Very little, because the additive represents only 1% of the polymer, and because **OBP products can be made with the same machines and workforce as ordinary plastic.**

9. Won't it put existing factories out of business, with loss of jobs?

No, because commercial customers can still use the factories which supply them with ordinary plastic products. **OBP is a "drop-in" technology – it does not disrupt the usual supply chain.**

1. http://www.biodeg.org/Reply%20to%20Ellen%20MacArthur%20Foundation%20from%20Prof%20Ignacy%20Jakubowicz%20-%2021-8-17.pdf
2. https://www.symphonyenvironmental.com/resource/uk-judge-finds-the-case-for-oxo-biodegradable-plastic-proven/

10. What other types of biodegradable plastics exist?

The two main types are oxo-biodegradable and hydro-biodegradable. In both cases degradation begins with a chemical process (oxidation or hydrolysis), followed by a biological process.

Hydro-biodegradable plastic (HBP) - usually starch-based and marketed as "compostable" or "bioplastic" - **is not a sensible alternative to ordinary plastic because it is designed to be taken to an industrial composting or anaerobic digestion unit, and to biodegrade in the special conditions found in those industrial facilities.** It does not address the problem of plastic litter in the open environment because the original vegetable materials have been polymerised and have become plastics. Also:

1 HBP cannot be recycled with ordinary plastics, so anyone who is in favour of recycling should be against it. Even if intended for industrial composting, some of this plastic will get into the oil-based plastic recycling stream and contaminate it.

2 It is too expensive for everyday use – costing up to 400% more than ordinary plastic. Even if this cost were substantially reduced in the future it is far too expensive for ordinary people and there is no justification for subsidising it out of taxpayers' money.

3 When something is described as compostable an ordinary person would think that it can be converted into compost, but the Standards for this type of plastic (ASTM D6400, EN13432 etc.) require it to convert into CO_2 gas within six months. You cannot therefore make compost from it – only greenhouse gas. This process contributes to climate change but does nothing for the soil, and it cannot be described as organic recycling.

4 It should not be described as "biodegradable" because although it will fragment in the open environment it is tested for biodegradation in the special conditions found only in industrial composting or anaerobic digestion.

5 It is not suitable for shopper bags because they need to be strong and inexpensive, and to be capable of re-use many times before final disposal.

6 It cannot be made by plastics factories with their existing machinery and workforce, and any large-scale introduction of this type of plastic would lead to job-losses in the plastics industry.

7 It is not "renewable" as it contains up to 70% oil-based polyester. Consider also, the non-renewable fossil fuels consumed and CO2 emitted by the machines used to clear the land, plough the land, harrow the land, sow the seed, make the fertilisers and pesticides and bring them to the farm, spray the crops, harvest the crops, take the crops to a polymerisation factory, and operate the autoclaves.

8 Deep in landfill it can generate methane, which is a greenhouse gas much more powerful than CO_2.

9 It is not desirable to use land and water resources to grow crops to make plastic. Those resources should be used to produce food for the people in the world who do not have enough to eat. The European Parliament has resolved not to encourage the use of land and water resources for producing bio-fuels (and the same reasoning applies to bio-plastics). The UN issued a report to the same effect on 31st March 2014. Nestlé believes that allocating agricultural land and water to biofuel production will severely impact food and water security. In their view "Forecasts of food production suggest that significant challenges exist for the world to feed future generations..... Even a small percentage of energy from crop based biofuels had a devastating effect on the food market,

10 There is not nearly enough available arable land and water to grow crops to make enough crop-based plastic to replace ordinary plastic, even for shopping bags.

11 It is sometimes claimed that the crops being grown to make crop-based plastics will absorb CO_2, but that would be true of the vegetation which was there before.

12 It is not really suitable for agricultural mulch films, because (unlike OBP) the degradation time cannot be controlled in line with the growing cycle.

13 It is thicker and heavier for the same strength, so it needs more trucks to transport it, using more road space, consuming more fuel, and emitting more CO2 and other forms of pollution to atmosphere.

14 HBP will not comply with the laws of the United Arab Emirates, Pakistan, Saudi Arabia and other countries which require short-life plastic goods and packaging exported to those countries to be oxo-biodegradable.

15 An LCA by Intertek, published by the UK Government in 2011 and a further LCA by Intertek in 2012 found that ordinary plastic and oxo-bio plastic have a better LCA than crop-based plastic or paper bags.

16 A consortium consisting of Friends of the Earth, Surfrider Foundation, Zero Waste Europe, Ecos, and the European Environmental Bureau published a paper in 2017 in which they say "The bioplastics industry use their green-sounding credentials to position themselves as helping to speed the reduction in fossil fuel use and solving the ever-growing plastic pollution and marine litter issues. However, there is clear evidence that bioplastics do not solve many of these problems and in fact may create new ones."

11. Surely education is the way to solve the litter problem?

Hopefully education will reduce the litter problem over several generations, but there is a huge amount of plastic litter today and there will always be some litter. **Action needs to be taken today to switch to oxo-biodegradable before millions more tons of plastic waste accumulate in the environment.** This what the United Arab Emirates, Pakistan, Saudi Arabia and other countries have now done by law, and other countries will be doing.

12. Isn't it better to recycle than to let it biodegrade?

Yes, but if the plastic is not collected it cannot of course be recycled, so it needs to degrade instead of accumulating in the environment. However, one of the benefits of oxo-biodegradable plastic is that it can be recycled as part of a normal plastic waste stream[3]

13. What about energy recovery?

In some countries incineration is popular, and modern equipment is in place. Oxo-biodegradable plastic can be incinerated for energy recovery in the same way as conventional plastic, and has a higher calorific value than the compostable alternative or damp paper.

14. Can OBP be composted?

OBP has been found to compost satisfactorily by industrial composters, but it does not emit CO_2 quickly. This is an environmental advantage, but prevents OBP passing the tests in EN13432 or ASTM D6400, which are designed for hydro-biodegradable plastic.

Hydro-biodegradable ("compostable") plastic is compliant with EN 13432 and D6400, precisely because it emits CO_2 (a greenhouse gas) at a rapid rate. Another unsatisfactory feature of EN 13432 is that it requires almost complete conversion of the carbon in the plastic to CO_2, gas thus depriving the resulting compost of carbon, which is needed for plant growth, and wasting it by emission to atmosphere

3. http://www.biodeg.org/recycling-and-waste/

15. What happens to OBP in a landfill?

OBP is intended to deal with plastic litter which escapes into the open environment, and oxo-biodegradation is not necessary for plastic which has been collected and disposed of in landfill, where it is no longer litter. OBP will fragment and partially biodegrade to CO2 and water in the parts of the landfill where oxygen is present, but degradation cannot continue deeper in the landfill in the absence of oxygen. This is an advantage over hydro-biodegradable (starch-based) plastics and paper, because in the depths of a landfill those materials will generate methane, which is a more powerful greenhouse gas than CO2.

16. Does OBP contain "heavy metals"?

No. **OBP does not contain heavy metals.** It contains metal salts, which are trace elements required in the human diet. They should not be confused with toxic heavy metals such as Lead, Mercury, Cadmium and Chromium, which are never used in oxo-biodegradable plastics. OBP does not contain any metals over the limits allowed by Art. 11 of the EU Packaging Waste Directive.

17. Is OBP made from oil?

Yes. Oxo-biodegradable plastics are currently made from a by-product of oil or natural gas. These are of course finite resources, but the by-product arises because the world needs fuels, and would arise whether or not the by-product were used to make plastic goods. **Until other fuels and lubricants have been developed for engines, it makes good environmental sense to use the by-product to make plastic, instead of using agricultural resources to make plastics.**

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

18. Are hydro-biodegradable (compostable) plastics renewable?

No – 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 and CO2 is emitted by the machines which clear and cultivate the land, and in the manufacture and transport of fertilisers and pesticides and in transporting the crop itself. Energy is also used by the autoclaves which polymerise material synthesised from biochemically produced intermediates (e.g. polylactic acid from carbohydrates etc). When the material biodegrades it emits CO2 and can emit methane, so the total fossil fuels used and greenhouse gases emitted will be more than for conventional or oxo-biodegradable plastic.

In June 2009 Germany's Institute for Energy and Environmental Research concluded that oil-based plastics, especially if recycled, have a better Life-cycle Analysis than compostable plastics. This was also the conclusion of two LCAs done by Intertek http://www.biodeg.org/lifecycleassessments.html

Hydro-biodegradable ("compostable") plastics are sometimes described as made from "non-food" crops, but are in fact usually made from food crops, and drive up the price of human and animal food.

19. Does oxobio plastic leave any harmful residues?

No. **Oxo-biodegradable plastic passes all the usual eco-toxicity tests, including seed germination, plant growth and organism survival** (daphnia, earthworms) tests carried out in accordance with OECD standards.

20. 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 if people want to incinerate with heat recovery, or mechanically recycle them, or compost them in-vessel, or re-use them, all of these are possible with oxo-biodegradable plastic products. Also they cost very little if anything more than conventional products to produce. The key point is what happens to the plastic which is not collected, and gets into the environment as litter?

In any event, oxo-biodegradable plastics are not "deliberately and totally lost" even if they degrade in the environment, because biodegradation is a source of plant nutrients, just as is straw, grass, leaves etc., and is a way of recycling the carbon content of the plastic back into the environment.

By contrast, hydro-biodegradable ("compostable") plastics ARE "deliberately and totally lost" because the applicable international standards require them to convert to CO_2 gas within 180 days. They do not therefore convert into compost or indeed anything useful for the soil.

21. More Careless disposal?

Degradable plastic bags have been supplied by supermarkets for more than ten 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. The type of person who causes litter will not bother to look for a biodegradable label before tossing it out of a car window.

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 plastic were all oxo-biodegradable?

22. Is it safe for food-contact?

Yes. **Oxo-biodegradable plastic has been certified by RAPRA Technology Analytical Laboratories as safe for long-term contact with any food type** at temperatures up to 40°C according to European regulations. RAPRA is accredited by the United Kingdom accreditation authorities as meeting the requirements of International Standards Organisation norm no.17025. Oxo-biodegradable plastic samples were also successfully tested by Sidwell Consulting & Analytical Services on 27th February 2018 for specific migration according to the requirements of EU Regulation 10/2011 (Plastic Materials and Articles in contact with food). Oxo-biodegradable plastics are also certified as compliant with FDA requirements in the US.

23.Isn't it better to use paper bags?

No. 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.

In addition, paper bags are not as strong as plastic, which means people use more bags. They also tear easily so cannot normally be re-used, and they will disintegrate if wet.

24. Isn't it better to use durable re-usable bags?

No. 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 problem 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 washable plastic containing an anti-microbial additive.

25.How long does it take to degrade?

It is not possible to say precisely how long a particular OBP item will take to degrade in a particular place, because conditions in the open environment are variable. **The key point is that it will degrade much more quickly than an ordinary plastic item in the same place.** Heat and light will accelerate the process, but they are not essential. Controlled conditions are necessary for compostable plastic but not for OBP.

An important advantage of OBP is that it can be programmed to degrade in whatever timescale is required. The average useful life of a carrier bag is usually designed to be about 18 months (to allow for distribution, stocking, and re-use), but shorter or longer times are possible. During that time bags are often re-used for shopping or for use as bin-liners etc.

26. What products are available in OBP?

- 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.

27. What national or international standards exist?

Oxo-biodegradable plastic is tested according to American Standard ASTM D6954 for Plastics that Degrade in the Environment by a Combination of Oxidation and Biodegradation. Also, according to British Standard 8472, or UAE Standard 5009 of 2009, or the French Accord T51-808.

The French Standards organisation, AFNOR, has also published XP T 54-980, for oxo-biodegradable plastics in agriculture.

UAE No: 5009/2009 The Emirates Authority for Standards & Metrology (ESMA) has developed , implemented and enforced on October 26, 2009 the UAE Technical Regulation Standards: 5009/2009; with the title Standard & Specification for Oxo-biodegradation of Plastic Bags and other Disposable Plastic Objects.

SAUDI Standard: SASO 2879/2016 – Saudi Standards, Metrology and Quality Org (SASO) has developed, implemented and enforced in April 2016 the Specification 2879/2016 with the title Degradable Plastic Products.

The above two standards (UAE and Saudi), which include complete Pass/Fail criteria are the most recent oxo-biodegradable standards in use around the globe.

European standard EN 13432 and the American standard ASTM D6400 are not designed for testing oxo-biodegradable plastics. They are used for testing degradation of plastic in the special conditions found in industrial composting.