

Research Summary

Oxo-degradable plastics are made of petroleum-based polymers (usually polyethylene (PE)) which contain additives (usually metal salts), that accelerate their degradation¹ when exposed to heat and/or light. The plastics are fairly common in the market, being used in a range of applications including carrier bags, packaging and agricultural films. Oxo-degradable plastics are often marketed as being 'degradable', 'bio-degradable'² or 'oxo-biodegradable'; implying a reduced environmental impact at the point of disposal compared to plastics without the additive. This research project assessed the environmental effects of oxo-degradable plastics from their production to disposal. The main **purpose of the project** was to assess what happens to the polymers and metal salts after the material starts to degrade and to assess whether this has beneficial or negative effect on the environment, compared to plastics that do not contain the additive. The project reviewed evidence behind the marketing claims being made about oxo-degradable plastics, in particular, assessing the evidence that these materials degrade or biodegrade, and under what conditions and timeframe.

Key findings

The study concluded that incorporating additives into petroleum-based plastics to accelerate their degradation does not improve the environmental effects of the plastic because:

a. The length of time it takes for oxo-degradable plastics to first degrade and then biodegrade cannot be predicted accurately

- The length of time it takes for oxo-degradable plastics to first degrade, then biodegrade, ultimately depends on the environmental conditions to which they are exposed. Although it is likely that oxo-degradable plastics will start to degrade between 2-5 years in the UK, it is unclear how long the material takes to biodegrade.
- Oxo-degradable plastics do not meet established composting standards, such as EN13432, though they do not claim to. Therefore, oxo-degradable plastics should not be disposed of in home or industrial composting facilities.
- As oxo-degradable plastics are not compostable (and as all types of plastics are likely to biodegrade given enough time), the term 'biodegradable' on oxo-degradable plastic packaging is meaningless and potentially confusing to consumers when choosing how best to dispose of the material.

b. Oxo-degradable plastics may have undesirable consequences on disposal facilities and the on natural environment

- There is a lack of evidence about the fate of oxo-degradable plastics in the natural environment. As the concentration of metal additives contained in the plastics is low,

¹ **Degradation** of oxo-degradable plastics occurs through a chemical process called oxidative degradation, where the molecules are broken down into shorter lengths by the action of oxygen, ultra-violet light and/or heat.

² **Bio-degradation** is a separate process that occurs after initial degradation, when the plastic is colonised and ingested by microbes.

they are unlikely to significantly increase concentrations which occur naturally in the environment.

- Oxo-degradation is sometimes promoted as a strategy to reduce litter, but whether this is actually a beneficial or harmful, depends on what happens to the plastic fragments in the environment. There is concern that the plastic fragments may be ingested by insects and animals, but this has not been investigated.
- Oxo-degradable plastics are not suitable for inclusion in conventional recycling systems.
- The available evidence suggests that oxo-degradable plastics do not degrade in anaerobic conditions, such as would be found in landfill.
- Any degradation to carbon dioxide that occurs is contributing to fossil-based carbon emissions.
- The best means of disposal for oxo-degradable plastics is incineration, or if incineration is not available, then landfill is the next best option. Both of these options make the 'degradable' property of oxo-degradable plastics irrelevant.

Researchers' Recommendations

- The term 'biodegradable' on its own is problematic for labelling packaging. Thus the authors recommend that:
 - The term 'biodegradable' on packaging must be qualified with the type of disposal environment and timeframe it would take to complete biodegradation;
 - Alternatively, rather than using the term 'biodegradation' at all, it would be more meaningful to label with instructions about the most appropriate means of disposal.
- The uncertainties surrounding the effect of oxo-degradable plastics on conventional plastics recycling processes means that the safest solution would be to keep oxo-degradable plastics out of mainstream plastics recycling processes.

Methodology

This study reviewed published research and journal articles on oxo-degradable plastics, as well as other literature available in the public domain. The researchers also engaged with stakeholders, including additive manufacturers, producers, retailers, end-users and those involved in recycling and composting, to gain further information and views on oxo-degradable plastics.

Limitations and Robustness

This study reviewed 56 studies and assessed the 'robustness' of each study. Some of the reports did not contain all the original data, leading to uncertainty about the robustness of the evidence. In other areas (particularly surrounding the environmental effects of the plastics in the natural environment) there was a limited number of studies to assess their effects. Specific information on the composition of additives was not obtained because of the commercial sensitivity of the information. One of the major limitations was the lack of hard evidence produced by systematic, well-controlled studies carried out by independent parties. This is perhaps understandable because of the long time scales involved and high cost of such studies. However, the broad range of studies reviewed and the use of stakeholder

engagement to test and verify the findings, provide solid support for the main conclusion of the study, that ‘degradation’ property of oxo-degradable plastics does not improve their environmental performance.

Identified Research Gaps

The authors have identified the following research gaps:

- Over what time scale oxo-degradable plastics biodegrade in conditions representative of their proposed disposal environment;
- The wider effects of oxo-degradable plastic fragments in the natural environment;
- The effect of oxo-degradables on recycling facilities.

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Loughborough University, 2009. *Assessing the Environmental Impacts of Oxo-degradable Plastics Across Their Life Cycle*