

SUMMARY OF PEER REVIEWERS' COMMENTS

(Note: This summary has not been able to fully capture the content of the very detailed reports provided by the reviewers. These should be read in their entirety.)

Key questions:

1. In your opinion, has the available scientific information been adequately reviewed, both in the original report and in the research team's reply to the Industry Response? If not, please provide details and explain your reasons.

- A** The original Defra/Loughborough University report is basically sound and concise in the coverage of the degradation of polyolefins and ODB (oxo-degradable) polymers.

The reviewer agrees with the researchers in considering that these plastics are not compostable and will cause problems with recycling unless only used to make other ODB products. The arguments presented in the report are strongly supported by the literature. There is conclusive evidence that polyethylene will crosslink and prevent further degradation resulting in smaller long lasting micro-fragments.

- B** No. The authors stand by the original conclusions which are partially incorrect and partially speculative.

For instance: In Annex 2 first sentence – the authors declare that the use of prodegradants does not improve the environmental impact, this is pure speculation not supported by any scientific evidence.

The first conclusion under “Degradation and biodegradation” is incorrect. The length of time to degradation can be predicted quite accurately. Moreover, using suitable types and amounts of stabilizers and prodegradants the lifetime of a material can be customized.

Another example is the statement “Biodegradation of oxo-degradable plastics, if it occurs at all...” which questions the evidence for biodegradability presented in the comprehensive scientific literature.

- C** The available scientific information has been adequately reviewed by the research team. The results of report are in agreement with the published data, however, the reviewer notes that the conditions used to establish the published data are far from those encountered in nature, except in rare situations.

2. Have all the points raised in the Industry Response been adequately addressed by the research team in their reply. If not, please provide details and explain your reasons.

- A** This reviewer went through the report and industry response point by point and appears to consider that all points were adequately covered. However, some additional points are raised that neither the researchers nor industry had considered.
- B** No. For instance, the authors question the evidence put forward to support biodegradability because “all studies require extensive accelerated ageing...”. Firstly, the authors disregard the results of naturally aged materials and they do not seem to understand that accelerated ageing is the same as natural ageing achieved in a shorter time. They also try to show that it will take very long time for oxo-degradable materials to degrade. Unfortunately, they make a mistake assuming “the average outdoor temperature” in their calculations.

Another example is where they found some lack of information in the scientific papers claiming synergistic effect between oxidation and biodegradation and consequently question the conclusion of the scientists that performed the work.

- C** The conclusions put forward by the researchers seem to be logical and reasonable for most of the points except for the assessment of biodegradability using composting standards or biodegradability under specific conditions. They should have considered tests made under aerobic degradability conditions, under anaerobic degradation conditions and for compostability.

3. Are the conclusions put forward by the researchers logical and reasonable in the context of the evidence considered. If not, please provide details and explain your reasons.

- A** Loughborough University Polymer department is a renowned centre of excellence worldwide with many areas of expertise and possibly represent the better group of experts able to provide an independent and unbiased overview of the effects of degradation in the recycling industry. There are no serious errors in their assessment.
- B** Some conclusions are reasonable but some are not and should be changed. Especially when contradictory conclusions are drawn. For instance on page 7 it is concluded that the oxo materials will last for many years while on page 25 under “Re-use” it is stated that bags “are unsuitable for storing items for an extended length of time.”

- C** To assess the environmental impacts of the oxo-biodegradable plastics, a cradle-to-grave analysis of the OBP-plastics will need to be carried out from raw material extraction to final disposal. The environmental impacts should include climate change, resources, ecosystem quality and human health. The inventory analysis should quantify all inputs, for instance, materials/resources used, energy consumption, and all outputs in terms of air and water emissions, solid wastes, by-products, involved in the manufacture and final disposal or treatment of the OBP-plastics. The environmental impacts could be determined for different end-use scenarios, for instance, landfilling, composting, incineration and recycling.

4. Are there any other points that you consider important and that you consider have not been adequately covered and assessed in the original report and reply. Please detail and explain.

- A** The fate of the oxo-degradable plastic after it has fragmented to a fine powder of course as mentioned in the report is not clear. If the fine particles are found to persist in the environment for a long period of time then further research is required as mentioned to assess not only the impact this may have on the eco-system in general but also and more importantly to determine whether or not the fine particles emanate from the use of ODBs. One recommendation to the ODB industry here is to perhaps look at more effective ODB additives, which are effective and long lasting and remain in the polymer material to the bitter end. Some of the more viable catalytic metal oxides such as nanotitanias might be worth investigation here.

The other important issue is the uncertainty surrounding the effect of oxo-degradable plastics on the conventional plastics recycling process. A useful way forward here is to either keep ODBs out of the main stream recycling operations or if indeed included then to ensure that the products end up in ODB applications.

As for the use of plastics waste in composting there is clearly some misuse of the term in the industry not for this report to dwell on but basically this is for natural polymers only. How can one obtain "Compost" from polyethylene if in fact it eventually decomposes to carbon oxides and other gases compounded by the fact that small micro-particulates are left which may be undesirable.

- B** Biodegradable plastics have an expanding range of potential applications, and driven by the growing use of plastics and the perception of being environmentally friendly, their use is predicted to increase. However, issues are also emerging regarding the use of all kinds of biodegradable plastics and their potential impacts on the environment and effects on established recycling systems and technologies.

There is a need of an objective and scientific review to identify issues of relevance including various technologies, applications, disposal options,

standards, recycling, labeling, education of consumers etc. However, these issues are not only related to oxo-biodegradable materials but to all kinds of biodegradable materials. An objective report should provide information about advantages and limitations of various materials and also identify the areas where more research is needed.

- C** My analysis of the reports has shown that despite a comprehensive set of degradation and biodegradation studies were verified and used to compare the results in this specific work, it is still not correct to advocate that these results are complete. This is because the present work has not addressed the crux of the degradability behaviour of OBD-plastics in a true environmental framework. It is totally wrong to have assumed mimicry of lab-based results which are promising to be a more or less, if not almost similar, to expected prevailing natural conditions to which the OBD-plastics would be exposed. Also, I consent on that oxidation catalysts used in OBD technology have not yet proven to accelerate the normal degradation processes.