

Response to the Welsh Government's 2025 *Updated Evidence and Literature Review on Oxo-degradable and Oxo-biodegradable Plastics*

- 1 We understand and sympathise with the Welsh government's wish to protect the environment from plastic litter. We are concerned that if oxo-biodegradable technology were banned, Wales would be rejecting a technology specifically designed to protect its environment from the long-term effects of plastic which has escaped into the open environment, and from which it cannot be collected for recycling or anything else.
- 2 The experience of the past 20 years shows that plastic leakage into the environment is persistent and has not been prevented by existing policies even in the developed countries. If leakage is ever eliminated, then oxo-biodegradability will be unnecessary.
- 3 Recycling and circularity policies are effective for collected materials but are, by definition, incapable of addressing plastics that escape into unmanaged environments. Oxo-biodegradable technology addresses a different risk domain (unmanaged leakage), and should be assessed against that risk rather than against circular economy criteria. The policy question is therefore whether plastic products placed on the market should be designed to persist for decades after escape, or to degrade more rapidly if they get into the open environment
- 4 In the absence of reliable evidence that oxo biodegradable materials create greater environmental harm than conventional plastics, a prohibition on such materials lacks a rational basis, and would favour persistent pollution over mitigation.
- 5 The key point to remember is that oxo-biodegradable technology does not cause the plastic to break up into small pieces of plastic – it converts the plastic into non-toxic biodegradable materials, which are bio-assimilated by naturally-occurring microbes in the environment. It requires no special conditions. The process is initiated by sunlight and will then continue even in the dark, with access to oxygen. If collected during its useful life it can be recycled with ordinary plastic without the need for separation.
- 6 In this response, BPA documents are not presented as evidence in themselves but for the authorities and arguments they contain. Some eg the Oxomar report or the evidence of Dr. Swift to the UK Government are not BPA documents at all, even though they can be found on the BPA website.
- 7 Plastic products are very useful, and Life-cycle assessments consistently show that plastics often outperform alternative materials, including paper, in overall environmental impact. <https://www.biodeg.org/subjects-of-interest/life-cycle-assessments/> but if they escape into the open environment they can lie or float around for decades and create microplastics. This is the principal reason for public concern about plastic, and plastic waste that escapes collection remains a persistent and well-documented environmental challenge.

Introduction and context

- 8 This problem has historically been addressed in Wales by restricting the sale of plastic products. Nevertheless, plastic products continue to escape into the open environment and there is still public concern about this.
- 9 Oxo-biodegradability has not as yet been accepted by the Government of Wales, and the previous Labour administration had made provision for a legislative ban on the sale or supply of oxo-biodegradable plastic products to consumers. However, no Commencement Order has been made for this, and our research shows that there is no real public demand or evidential basis for a Commencement Order.
- 10 In support of this potential ban, an updated evidence and literature review was written for the Labour Government and was dated October 2025. For the reasons given below, this document does not provide justification for restricting the sale of plastic products by reason of the fact that they are oxo-biodegradable.
- 11 Similar reviews have been commissioned by DEFRA and the Scottish Government, neither of which provide any justification for banning oxo-biodegradable plastic products. As to DEFRA see <https://www.biodeg.org/opa-critical-od-hsac-report/> As to Scotland see www.biodeg.org/wp-content/uploads/2023/04/Symphony-Review-of-Hutton-Report-26.10.22.pdf All three governments have been influenced by the flawed approach taken by the EU Parliament, as to which see <https://www.biodeg.org/eu-news/>
- 12 Oxo-biodegradable technology was invented more than fifty years ago, not by marketeers or salesmen, but by the scientists who had themselves created plastics, and who realised that the durability which they had achieved could be a problem. Foremost among these scientists were Professor Gerald Scott, Professor of Chemistry at Aston University, UK; Professor Jacques LeMair of Clermont-Ferrand, France; Professor Emo Chiellini of the University of Pisa, Italy; and Professor Ignacy Jakubowicz of Gothenburg, Sweden
- 13 A paper by Professor Jakubowicz and his colleagues in “Polymer Degradation and Stability” 96 (2011) 919e928 is one of the strongest peer-reviewed pieces of evidence relating to oxo biodegradable plastics but is not mentioned in the 2025 Review. It addresses, directly and quantitatively, almost every criticism that has appeared in policy documents (including the Welsh Review and the HSAC report and the EU SUP Directive).
- 14 These scientists have shown that oxo-biodegradable polyethylene, once oxidised, will undergo extensive biodegradation, with minimal risk of persistent microplastic residues, and with most polymer carbon converted to CO₂ water, and biomass rather than accumulating as fragments of plastic.
- 15 Oxo biodegradable technology has been successfully deployed at national scale for nearly a decade in the UAE and Saudi Arabia, after due diligence and technical evaluation. Its use is compulsory for a wide range of products likely to be littered, and the national standards in both jurisdictions are based on ASTM D6954. Compliance with those standards is required for products placed on the market, and this demonstrates that ASTM D6954 is not merely an industry reference but a standard with regulatory effect, already adopted and enforced by governments. Comparable national Standards exist in many other countries.

- 16 The Welsh Review cites jurisdictions where “oxo-degradable” plastic is banned, but it is not banned in most countries of the world, and the Review does not mention the jurisdictions in which the use of oxo-biodegradable plastic is actually compulsory.
- 17 The sustained use of this technology for more than 20 years without evidence of environmental harm, is inconsistent with claims that oxo-biodegradable plastics are unsafe, or unsuitable for regulatory acceptance.

We are not against-recycling:

Our message is that plastic should be recycled if collected, and should biodegrade if it has not been collected and finds its way into the open environment.

So, what should governments do?

A rational, evidence-based answer is:

1. Continue to maximise collection, reuse, and recycling
2. Reduce unnecessary use of plastic without forcing a change to materials with a worse life-cycle assessment
3. Accept that leakage can be reduced but not yet eliminated
4. Explicitly address the environmental fate of leaked plastics
5. Require that materials likely to escape are less persistent than conventional plastics
6. Regulate claims and quality rather than banning the technology outright

A government cannot realistically eliminate all uncertainty. Any remaining uncertainties are not sufficient to justify a prohibition, when assessed against existing plastics.

The process so far in Wales

The Consultation - WG40193 30th July 2020

The BPA responded to this on 19th October 2020 as follows:

- 18 “The reason for the consultation is described by the Deputy Minister when she says in the introduction “Single use plastic items make up a significant proportion of litter on our streets, parks and seas. It blights our communities and has a devastating impact on our wildlife.”
- 19 It was to address this very problem that oxo-biodegradable plastic was invented.
- 20 The BPA’s response is published in full at www.biodeg.org/wp-content/uploads/2022/09/bpa-response-to-wales-19.10.20.pdf

On 3rd September 2022 Symphony Environmental Technologies Plc (a founder-member of the BPA) commented as follows on the responses to the public consultation on the Environmental Protection (Single-use Plastic Products) (Wales) Bill:

- 21 “The responses to the consultation on the Bill have now been published on the Welsh Government’s website, and as we expected, they do not show any significant level of support for any ban on “oxo-degradable” or “oxo-biodegradable” plastics. There were 33 responses, and only 7 of them made any mention of this material at all. Four of them did not support a ban, and only 3 (out of 33) did support a ban.
- 22 Symphony’s Response is published in full at <https://www.symphonyenvironmental.com/wp-content/uploads/2022/09/Sym-response-3.9.22-to-Welsh-Bill.pdf>
- 23 The National Farmers’ Union of Wales said: “In the case of oxo-degradable plastics, the Welsh Government cannot have had any understanding of the impact or the costs and benefits, since it did not appear to know what specific products it was proposing to ban, the extent of their use on Welsh farms or the availability and costs of suitable alternative products.”
- 24 The Vending and Automated Retail Association, said “This Bill will contribute little towards the policy intention of reducing litter and will result in significantly increased costs and challenges to the sustainability of their businesses for many vending operators. Those who litter will not change their behaviour because of a change in material. The Bill would simply replace one type of litter with another.”
- 25 The BBIA supported a ban but this is a lobby group which argues in favour of a bio-based plastic marketed by their clients as “compostable.” They are ostensibly concerned for the environment, but they have for more than ten years been campaigning against oxo-biodegradable plastic to further their own commercial interests. See <https://bioplasticsnews.com/2021/12/06/history-anti-oxo-biodegradable-plastics-history/> This is an article researched and written by the editor of Bioplastics News in which he reveals ruthless anti-competitive behaviour by the bio-based plastic industry, and especially by large German and Italian companies in that industry. They have also sought to mislead the UK government. See <https://bioplasticsnews.com/2020/06/04/battle-biodegradable-oxo-compostable-industry/>
- 26 Foodservice Packaging Association: Like the BBIA, they cite no evidence against oxo-biodegradable plastic, and they copy the definition offered by the BBIA. They too ignore the only scientific definition – the CEN TR15351 definition. However, they also said: “many of the items included in the list of those to be banned do not feature in litter survey data while those most featured are not included. No explanation was given for this.”
- 27 Newport City Council said: “The Bill may result in an increase in other items that can have a negative impact on recycling initiatives – for example, the use of ‘compostable’ products that end up mixed with food waste and that may not be accepted by food waste treatment facilities.
- 28 Natural Resources Wales : “We support the inclusion of oxo-degradable plastics, and this reflects that they can pose many of the impacts and risks of harm to the environment as plastics produced from petrochemicals, in particular the production of micro-plastics.” In fact, oxo-biodegradable technology is designed not to create microplastics but to convert the

plastic into a waxy substance which is biodegradable. [This is confirmed by Sciscione et al – Reference 8 in the Welsh Review]

- 29 NRW seem to have been unaware that in 2017 the EU Commission referred oxo-biodegradable plastic to the European Chemicals Agency (ECHA) because the Commission was concerned that it might create microplastics. ECHA made a call for evidence, and after studying many hundreds of pages of evidence, including <https://www.biodeg.org/wp-content/uploads/2021/02/Scientific-evidence-to-ECHA.pdf> and <https://www.biodeg.org/wp-content/uploads/2021/01/Intertek-Report-to-ECHA-24.5.18.pdf> they said on 30th October 2018 that they were not convinced that microplastics were formed. If the EU's scientific experts have not been convinced, on what basis could NRW or the Welsh government be convinced?

On 10th October 2022 Symphony commented further on the Consultation

- 30 “We have responded to the public Consultation on this Bill, which did not show any significant level of public support for any ban on “oxo-degradable” or “oxo-biodegradable” plastics.
- 31 We requested the Welsh Government to send us the responses to their Consultation which they claimed to support a ban on oxo-biodegradable plastic, and we received the responses on 7th October 2022. The majority do not mention oxo-degradable or oxo-biodegradable plastic at all.
- 32 We had said that we would be surprised if the general public responding to the consultation had any real understanding of oxo-biodegradable technology, and so it has proved.
- 33 Some reveal an emotional hatred of any kind of plastic, based on little or no understanding of the advantages and disadvantages of this material.
- 34 One respondent said “I don't know what Oxo-degradable plastics means, but I'm assuming it breaks down into micro plastics which isn't good for the environment. Another admitted “I'm not qualified to comment on this subject.”
- 35 Another respondent said “The impact of this plastic on the environment is just awful. Images of animals feeding young with plastic pieces and masses of the stuff spilling out of their stomachs is truly heartbreaking. We MUST do something to stop this. We HAVE to make a change.”
- 36 Indeed we do. This respondent is referring to the harm caused by ordinary plastic, and this is why Wales should replace it with oxo-biodegradable plastic, which is proved to biodegrade much more quickly instead of fragmenting and lying or floating around for decades, as ordinary plastic does. The Senedd should lead the way by refusing to ban oxo-biodegradable plastic and by making it compulsory for the short-life plastic products which are not being banned.

MICROPLASTICS

There is a fundamental misunderstanding here.

- 37 Very many of the respondents focus on microplastics, and express concern about the harm they do. We agree with them, but the respondents do not seem to know that these microplastics are coming from the fragmentation of ordinary plastic under the influence of weathering, and it is these materials which can lie or float around for decades. There is no evidence that any of the microplastics to which the respondents refer have come from oxo-

biodegradable plastic products. This is not surprising, because oxo-biodegradation has been invented to deal with this very problem.

- 38 **There would be no point in putting additives into plastic if all they did was to cause fragmentation**, and we know of no manufacturer who does so. Oxo-biodegradable technology has therefore been designed to convert the plastic at the molecular level into a waxy substance which is biodegradable. None of the respondents seem to be aware that biodegradation has been proved beyond doubt by the Oxomar study <https://www.biodeg.org/subjects-of-interest/agriculture-and-horticulture/the-marine-environment/> – a three-year scientific study sponsored by the French government. This is not a marketing statement – it is scientific proof at a high level.
- 39 Nor do the respondents seem aware that the European Chemicals Agency (ECHA) have produced no dossier to support a ban and have said that they were not convinced that microplastics were formed.

EUROPEAN UNION

- 40 Some respondents say that because oxo-degradable plastic has been banned in the EU, then oxo-biodegradable plastic should be banned in Wales.
- 41 However, it is most unusual for any substance to be banned in the EU without a dossier from ECHA. There was no ban in the Commission's proposal for the SUP Directive, but a ban was slipped into the draft Article 5 by lobbyists acting for the "compostable" plastics industry at the Committee stage in the European Parliament, thus circumventing all the safeguards against arbitrary legislation in Arts. 69-71 of the REACH Directive.
- 42 The European Parliament did not use the definitions written by the scientific experts at CEN in TR15351 (which distinguish between oxo-degradable and oxo-biodegradable plastics), but adopted the definition proposed by the lobbyists, which the same lobbyists are inviting the Senedd to adopt.
- 43 The Consumer Goods Forum support the global use of oxo-biodegradable (as distinct from oxo-degradable) technology <https://www.biodeg.org/oxo-degradable-vs-oxo-bio-degradable-plastics/> but the irony in the EU is that, due to failure to distinguish clearly between oxo-degradable and oxo-biodegradable plastic in the Art. 3(3) definition, and in the May 2021 Commission Guidance, sustainable alternatives have been effectively restricted. This has resulted in confusion in the marketplace, a failure of due-process, and a challenge to Art. 5 in the EU courts (Case T-745/20) - as to which see www.biodeg.org/wp-content/uploads/2026/05/Comment-on-EU-Judgment-MS-10.2.24.pdf

WRONG PRODUCT

- 44 Some of the respondents have mistaken oxo-biodegradable plastics for some other product. For example: "I work for Welsh Water and have seen first-hand the detrimental effect oxo-degradable plastics have on the environment. I worked on a scheme in Mermaid Quay in Cardiff where we extracted 500 tons of wet wipes and other materials which were clogging the sewer." However, wet wipes have nothing to do with oxo-biodegradable plastic.
- 45 Another respondent said "Microplastics being recovered from the oceans are from "oxo-degradable" plastics, which degrade and fragment but do not biodegrade." However, these are not from oxo-biodegradable plastics - they are from conventional plastics which undoubtedly create persistent microplastics, and this is why they need to be banned. They have already been banned in Saudi Arabia and 11 other countries, and it is now mandatory to make them oxo-biodegradable.

RECYCLING

- 46 Some respondents object to oxo-biodegradable plastic because they say it is incompatible with recycling. This is not correct, as explained in detail at <https://www.biodeg.org/subjects-of-interest/recycling-2/> Further, oxo-biodegradable technology is not used in P.E.T. – it is used only in PE and PP.
- 47 If some recyclers have created a perception that oxo-biodegradable plastic is incompatible with recycling, it is for them to change that perception. They cannot expect legislators to ban oxo-biodegradable plastic and accept the accumulation of ordinary plastic in the oceans for decades, just because recyclers are failing to correct a wrong perception.

NOT COMPOSTABLE

- 48 There is nothing wrong with composting, but plastic of any kind has no role in this process.
- 49 As one respondent to the consultation said “We need to be careful not to be “greenwashed” by alternatives to single use plastic, such as products which claim to be compostable (but in fact only compost in industrial composting units) - or use plant-based plastics (such as some tampon applicators which still behave the same in the ocean as normal plastic).”
- 50 This has nothing to do with oxo-biodegradable plastics – which do not claim to be compostable – but it draws attention to the need to ban plastics which falsely claim to be compostable and biodegradable. This is greenwashing, because there is no such thing as compostable plastic. The reason is that the relevant standard (EN13432) requires the plastic to convert into CO₂ gas (not compost) within 180 days. It is also greenwashing to call them “biodegradable,” because they are designed to biodegrade in an industrial composting unit, not in the open environment.
- 51 As one respondent pointed out “There are limited in-vessel composting facilities available in most areas in Wales (definitely no capacity to meet the current waste plastic tonnages) meaning the issue would persist.” Even if enough facilities existed, there are better things to do with plastic than waste it by turning into CO₂.
- 52 Another respondent drew attention to a study which “showed that PLA underwent less than 10% relative biodegradation in all unmanaged environments tested (soil, fresh water, marine and anaerobic aquatic digestion) and was not home compostable.” The type of plastic deceptively marketed as “compostable” is usually made from PLA.

LANDFILL

- 53 A few respondents object because oxo-degradable or oxo-biodegradable plastic (they are not quite sure which) will not degrade in landfill. Oxo-degradable plastic will not degrade in landfill because it is just ordinary plastic. Oxo-biodegradable plastic will degrade in landfill if oxygen is present, but if a piece of plastic has been put into a landfill it has been responsibly disposed of and there is no need for biodegradation. Indeed, biodegradation in anaerobic conditions is undesirable, because it generates methane, and most landfills are not designed to collect the gas.

TOXIC

- 54 Some respondents think that oxo-degradable or oxo-biodegradable plastic (again they are not sure which) leaves toxic residues in the environment. This might be the case with ordinary plastic, because it does not have to be tested for ecotoxicity, and because it can lie

or float around for long enough to attract extraneous toxins to its surface, but it is not the case with oxo-biodegradable plastic. Oxo-biodegradable plastic is tested according to ASTM D6954, and has to pass specific ecotoxicity tests. It has been tested according to OECD standards and shown to be non-toxic to plants, fish and earthworms

LABELLING

- 55 Some respondents refer to confusion in the public mind.
- 56 One reason for this is that even public authorities fail to distinguish between oxo-degradable and oxo-biodegradable plastic. Also, they use the word “biodegradable” which is confusing as there are different types of biodegradable plastic with very different characteristics.
- 57 For the reasons mentioned above the “compostable” plastics industry falsely markets its product as “compostable” and “biodegradable” and this practice should be stopped.
- 58 By contrast, the oxo-biodegradable plastics industry does not set out to deceive the public. We do not refer to our product as simply “biodegradable” and we make it clear that it is intended to biodegrade not in compost but if it gets into the open environment.

EVIDENCE

- 59 Most of the respondents who mentioned “oxo-degradable” plastic make statements which are simply wrong, and their statements are not supported with any kind of evidence. The statements were very repetitive, which suggests that they had been orchestrated by a lobbying organisation.
- 60 Those few respondents who do attempt to support their statement with evidence have cited Wikipedia, which is not a reliable source (and is being constantly amended by the “compostable” lobby), and they also cite a paper published by “European Bioplastics” which is part of that lobby.
- 61 We, and the BPA have responded to the Report by the Group of Chief Scientific Advisors (GCSA) of the European Commission, and the Report by Science Advice for Policy by European Academies (SAPEA) See <https://www.biodeg.org/wp-content/uploads/2021/03/OPA-Response-to-SAM-Report-Feb-2021-1-3-21.pdf>
- 62 Also the Eunomia Report <https://www.biodeg.org/wp-content/uploads/2020/08/BPA-Comment-on-the-Eunomia-Report-2016.pdf> The EU Commission Report <https://www.biodeg.org/wp-content/uploads/2018/01/BPA-RESPONDS-TO-EUROPEAN-COMMISSION.pdf> the Ellen MacArthur Report <https://www.biodeg.org/wp-content/uploads/2019/11/emf-report-1.pdf> and the Plymouth Report <https://www.biodeg.org/wp-content/uploads/2019/04/BPA-Comments-on-Plymouth-10.pdf>
- 63 **None of these studies justifies a ban on oxo-biodegradable plastic.**
- 64 EN13432 requires 90% biodegradation for plastic which biodegrades in compost, but in the case of oxo-biodegradable plastic 92.74% biodegradation has been proved by Intertek in 180 days according to the relevant standard (ASTM D6954) but nobody is claiming that it will necessarily biodegrade to that extent within that timescale under all conditions in the open environment. The process will proceed more slowly in cold conditions than in warm sunny conditions, but it will continue even in cold conditions and in the dark. The key point is that it will proceed much more quickly than ordinary plastic under the same conditions. That must therefore be a much better and more reasonable timescale than for ordinary plastic.
- 65 Nobody has advanced any reason why biodegradation should stop before completion, but even if it did it would still be better than ordinary plastic, which would have fragmented but not biodegraded at all.

- 66 Some make the point that that testing is in the laboratory, not in the open environment, as to which see <https://www.biodeg.org/wp-content/uploads/2021/02/Swift-evidence-to-BEIS.pdf> Abiotic degradation has in fact been tested in the real world, but biotic degradation and ecotoxicity of all plastics have to be tested in the laboratory.

CONCLUSION

- 67 **The Senedd should not impose any ban which could apply to oxo-biodegradable plastic.** Instead, it should lead the way by making oxo-biodegradability compulsory for all the short-life plastic products which are not banned. It really is the only way to deal with plastic in the environment which cannot realistically be collected
- 68 The technology is not banned in England or Scotland, and we are communicating with the authorities in both countries. When they introduced bans on single-use plastics they did not include a ban on oxo-biodegradable plastic.
- 69 We are advised by Leading Counsel that any ban which applies to oxo-biodegradable technology, and which is not supported by clear and sufficient scientific evidence, and/or inconsistent with UK single-market rules, would be unlawful. It would be challenged in the High Court.

Senedd Climate Change, Environment and Infrastructure Committee

- 70 On 16th November 2022 Symphony wrote to the Minister, Julie James: “We have read the transcript of the Climate Change, Environment and Infrastructure Committee meeting on 9th November. There seems to be a clear danger here that if the Senedd passes this legislation in its present form it will be taking into account irrelevant factors, and failing to take into account important relevant factors. This would leave it open to challenge in the courts
- 71 As Janet Finch-Saunders MS said, “Neither oxo-degradable nor oxo-biodegradable plastics were included in the impact assessments, nor were any alternative materials included. It appears that the Welsh Government has included oxo-degradable plastic in the Bill without even understanding what it is, the usage, the alternatives or the cost of alternatives.”
- 72 It is also clear from the responses to the public consultations that there is no significant level of informed public support in Wales for any ban on oxo-biodegradable plastics, and that the public, and the Committee are confused to the point that there is a danger of continuing to permit the use of single use plastics (except those specifically mentioned in the Bill) which create persistent microplastics and banning those which do not.
- 73 It does not seem from the debate that any members of the Committee, except perhaps Janet Finch-Saunders, has had time to read or understand the evidence which we have submitted. See <https://www.biodeg.org/wp-content/uploads/2022/09/Symphony-comment-10.10.22-on-consultation.pdf>
- 74 We are writing to you and other members of the Senedd because it is clear from the debate that members are confused, and that there is no sufficient basis for a ban on “plastic containing any substance added for the purpose of accelerating the oxidation and fragmentation of the plastic when exposed to heat or light (whether or not this is, or may be, followed by partial or complete breakdown of the material by microbial action).” This is a definition which is clearly intended to refer to oxo-biodegradable plastic.
- 75 If all the plastic were disposed of via the established disposal routes there would be no need for oxo-biodegradable technology, but this is not the case, and litter is the main reason for

public concern about plastic. Oxo-biodegradable plastic is intended to REPLACE conventional polyethylene and polypropylene for a wide range of products.

- 76 Use of oxo-biodegradable technology should not be confused with, and is not intended to be, a disposal route for plastic products. Oxo-biodegradable plastics are intended to be used and disposed of in the same way as ordinary plastic via the established disposal routes, and are perfectly compatible with a circular economy.
- 77 Joyce Watson MS was rightly concerned about “bits of plastic—pink, or blue, or green, whatever colour it might be—on the hedgerows,” but these are conventional plastics. If the Welsh Government and Senedd are concerned about plastic waste and microplastics they need to focus on conventional plastics, which are the source of most of the microplastics found in the environment. That is why oxo-biodegradable plastic technology was invented. It is not practicable to ban all conventional plastics, so all short-life plastics should be made with oxo-biodegradable technology, which converts the plastic into a waxy substance which is biodegradable.
- 78 Jenny Rathbone MS said “allowing oxo-degradable plastic to be littering the environment, when it can take 200 years or more for the product to disappear.” This would be correct in the case of conventional plastic but if they were oxo-biodegradable they would biodegrade much more quickly. She continued “The countryside is littered with scraps of that black plastic that farmers wrap their silage or hay in, and that is because it is not biodegradable in the sense that I understand it, which is that it's not soluble.” Again, these are not oxo-biodegradable plastics. “Soluble” is not relevant here as it refers to water-soluble plastics, which nobody would use for outdoor applications. They are used for laundry bags.
- 79 However, oxo-biodegradable mulching films have been tested on a farm in Wales, <https://www.biodeg.org/wp-content/uploads/2020/09/Pembroke-Mulch-Film-Trial-Report-30.09.13V1.pdf> and they are being successfully used around the world. Welsh farmers should not be prevented from obtaining them.
- 80 Jenny Rathbone MS continued “it doesn't disappear, to not pollute the environment with something that is not natural.” This is correct in the case of conventional plastics, but oxo-biodegradable plastics are proved by testing against OECD standards to leave no toxic residues. They leave only humus, water and CO₂, - which are left by anything on the planet which biodegrades.
- 81 The Minister said in the debate that “there is not yet a settled scientific opinion that oxo-biodegradable plastic behaves differently to oxo-degradable plastic in nature.” With respect, this is not correct. The French scientists who conducted the three-year Oxomar study, and also the scientists at Queen Mary University, are quite sure that oxo-biodegradable plastic behaves differently to oxo-degradable plastic. By contrast, oxo-degradable plastic degrades and creates microplastics, but does not become biodegradable for a very long time.
- 82 The issues still being debated are the rate and extent of biodegradation. Complete biodegradation in a short time-frame is clearly desirable, and oxo-biodegradable plastics have been designed with that in mind. 92.74% biodegradation has been proved by Intertek in 180 days after exposure
- 83 The abiotic phase has been observed in the real world, but the biotic phase has to be assessed in a laboratory, as to which see the evidence of Dr. Swift, Vice-chairman of the relevant Standards Committee. <https://www.biodeg.org/wp-content/uploads/2021/02/Swift-evidence-to-BEIS.pdf> He says “It has been my experience that results from laboratory testing are very likely to be reproduced in the real world. I can see no cause for concern that they would not, and have seen no evidence that they have not. In particular I do not

- consider that persistent plastic fragments and smaller, microplastics would be left behind which could have any harmful effect on the open environment, and in particular marine life.”
- 84 The important point for members to remember is comparison with ordinary plastic. The purpose of prodegradant systems is to reduce the impact of littered plastics by facilitating faster rates of degradation and biodegradation under any conditions in the open environment, as compared with the conventional plastic products which they are intended to replace. The abiotic process would be slower in Welsh conditions than in a uniformly warm sunny climate, but the key point is that it will proceed much more quickly than ordinary plastic under the same conditions in the open environment. That must therefore be a much better and more reasonable timescale.
- 85 The use of a prodegradant additive system not only accelerates the oxidation of polymers during sunlight exposure, but facilitates the continued degradation of plastics with or without sunlight, to the point where the molecular weight is reduced to c5,000 and the material is biodegradable.
- 86 Nobody has advanced any reason why biodegradation should stop before completion, but even if it did it would still be better than ordinary plastic, which would have fragmented but not biodegraded at all.
- 87 Oxo-biodegradable plastic has been successfully used for more than ten years by the largest bread producer in the western world for its packaging.
- 88 The Minister said in the debate that there is “credible evidence of the harm oxo-degradable plastic causes to the environment.” We have seen no evidence to that effect, and she did not cite any. In fact the evidence is that they are less harmful because they are not persistent, and they have been proved by testing to OECD Standards to be non-toxic to plants, daphnia, fish, and earthworms.
- 89 The use of elements which may cause toxicity is prohibited in oxo-biodegradable plastics by ASTM D6954 para. 6.9.6, and BS8472 para. 9. Therefore the elements most commonly used are manganese and iron. Further, no substances are allowed in excess of the limits specified in Art. 11 of the EU Packaging Waste Directive 94/62/EC.
- 90 The Minister also said that there is “clear evidence that nanoplastics could be even worse than the microplastics we're currently used to.” It is quite possible that conventional plastics create nanoplastics, because they can persist as plastics for a very long time, getting physically smaller and smaller, but we have seen no evidence, and she did not cite any, that this occurs with oxo-biodegradable plastics, which rapidly convert into biodegradable materials which are not plastics at all.
- 91 In 2017 the European Commission referred to the European Chemicals Agency (ECHA), the very question of whether what they called “oxo-degradable” plastic created microplastics. This led to a Call for Evidence by ECHA, who received many hundreds of pages of scientific evidence. However, ECHA produced no dossier to support a ban, and on 30th October 2018 they said that they were not convinced that microplastics were formed. If they are not convinced, then how can the Welsh government or Senedd be convinced?
- 92 There is however indisputable evidence that single use products made from ordinary plastic fragments into microplastics and causes harm to the environment. As Janet Finch-Saunders MS said “This legislation will not ban plastic. It will not prevent the littering of materials. Plastic will continue to, unfortunately, be littered into the environment. By providing an exemption for oxo-biodegradable plastics, we can ensure that we begin to turn the tide on plastic and its impact on the environment and our health. The plastic that is littered, as single-use products commonly are, will break down quicker, and will not leave

microplastics. We must not prohibit materials that are able to break down and leave no trace.”

DEFINITIONS

- 93 Joyce Watson said “there aren't clear definitions.” There are in fact clear definitions, but the Committee is choosing not to use them. “Oxo-degradable” and “oxo-biodegradable” plastics are distinguished by the abiotic and biotic processes of degradation, which are scientifically ascertainable and do not depend on definitions written for commercial or political purposes. The processes have been scientifically defined by the European Standards Organisation, CEN in TR15351.
- 94 We know of no manufacturer who puts prodegradant additives into plastics and markets them as “oxo-degradable.” There would be no demand for such plastics if they simply fragmented, and this terminology has therefore no relevance in the real world. “Oxo-degradable” is a political definition invented by those who do not wish to admit that oxo-biodegradable plastics are biodegradable. Political definitions are not however relevant to the scientific question whether oxo-biodegradable plastics are better for the environment than conventional plastics.
- 95 The Minister is correct in saying that “oxo-degradable” plastic would include almost all plastic, as most conventional plastics degrade by oxidative cleavage of macromolecules over time. The problem is that it can take many decades for their molecular weight to reduce to the point when they are biodegradable. It is the purpose of oxo-biodegradable technology to speed up that process, so that their dwell-time in the environment is minimised.

CONCLUSION

- 97 As the Minister said in the debate, “oxo-degradable plastic” is a complex area still being researched. It is indeed complex, and it would be wrong to proceed to a ban. She said that “we recognise the need to consider certain evidence further—so, whether there are sub-categories of oxo-degradable plastic that ought to be exempt before the ban is brought into force. Commencement of the ban, therefore, on oxo-degradable plastics is being phased, to enable that particular piece of work to be completed.”
- 98 A ban would be very damaging to the reputation of oxo-biodegradable technology, and to our reputation as a British public company, in respect of which we are advised that we would have a claim against the Welsh government for compensation. This could be many millions of pounds per year if we were shut out of a market of more than 3 million people. It would also cause damage and uncertainty even if the commencement of the ban were to be delayed.
- 99 Even worse, the Senedd would be rejecting for an indefinite period THE ONLY WAY to deal with plastic in the environment of Wales which cannot be collected.
- 100 We would respectfully submit that the best way to proceed would be to remove all reference to oxo-degradable plastic from the Schedule to the Bill. Section 3 provides power to reinstate it in the event that new robust evidence could satisfy a court that such action would be justifiable and proportionate.

Symphony wrote to the Minister, Julie James, again on 3.1.23

- 101 “We understand and sympathise with your wish to protect the environment of Wales from plastic litter, and we have been trying to help you to come to the right conclusion. We are

concerned that if oxo-biodegradable technology were banned, Wales would be rejecting a technology specifically designed to protect its environment from the long-term effects of plastic which has escaped into the open environment from which it cannot be collected for recycling or anything else.

- 102 Plastic can of course be reduced and re-used, and some of it can be collected for recycling, and if all the plastic were disposed of via the established disposal routes there would be no need for oxo-biodegradable technology, but this is not the case, and litter and microplastics are the main reason for public concern about plastic.
- 103 For this reason we think that polyethylene and polypropylene should no longer be used to make short-life plastic products unless they are upgraded with oxo-biodegradable technology. Oxo-biodegradable plastic is intended to REPLACE conventional polyethylene and polypropylene for a wide range of products.
- 104 Upgrading would mean that if they did escape they would biodegrade much more rapidly, leaving no microplastics or harmful residues. If they did not escape they could be dealt with by the normal waste management processes, including recycling. Oxo-biodegradation is not an intended disposal option - it is an insurance in case all else fails.
- 105 We notice that in the debate in Senedd on 6th December 2022 you said "We recognise the need to consider evidence further; for example, whether there are sub-categories of oxo-degradable plastic that ought to be exempt before the ban is brought into force."
- 106 Oxo-biodegradable plastic is not really a sub-category of oxo-degradable plastic. They are two fundamentally different materials, whose performance is very different. "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 by oxidation in the open environment and create microplastics, but do not become biodegradable except over a very long period of time.
- 107 By contrast, "oxo-biodegradation is defined by CEN as "degradation resulting from oxidative and cell-mediated phenomena, either simultaneously or successively". This means that the plastic degrades by oxidation until its molecular weight is low enough to be accessible to bacteria and fungi, who then recycle it back into nature.
- 108 As we have said, it is clear from the responses to the public consultations that there is no significant level of informed public support in Wales for any ban on oxo-biodegradable plastics, and that there is a danger of continuing to permit the use of single-use plastics (except those specifically mentioned in the Bill) which create persistent microplastics, and banning those which do not.
- 109 In the debate, you continued "The commencement of the ban on oxo-degradable plastics is, therefore, being phased to allow time for further research and policy development."
- 110 Our scientists have been working on degradation of plastics for more than 25 years, and indeed the inventor of the technology, Prof. Gerald Scott, was our chief technical adviser for many years. We are happy to make their expertise available for your further research and policy development.

We are very familiar with the arguments made against this technology, as follows:

- 111
- that oxo-biodegradable plastics create microplastics. Some of the microplastics found in the environment come from tyres and clothing but it is not disputed by anyone that most of the microplastics are coming from the fragmentation of ordinary plastic. They are very persistent because, whilst ordinary plastics fall into fragments their molecular weight remains too high for biodegradation. Oxo-biodegradable

technology reduces the molecular weight, and no evidence has been produced that microplastics from oxo-biodegradable plastics have ever been found in the environment. The European Chemicals Agency were not satisfied that oxo-biodegradable plastic created microplastics, so on what basis could the Welsh government be satisfied?

- 112 • that oxo-biodegradable plastic will contaminate a recycling stream and is incompatible with a circular economy. This is not correct, but it is correct in the case of plastic marketed as compostable. <https://www.biodeg.org/subjects-of-interest/recycling-2>
- 113 • that they are not satisfied that oxo-biodegradable plastic will fully biodegrade, but no reason has been given why biodegradation should stop before it is complete. Even if it did not fully biodegrade it would still be better than ordinary plastic, which would not have biodegraded at all. We have reports by Eurofins and Intertek showing biodegradation of 88.9% within 121 days and 92.74% within 180 days, respectively. The percentage required by EN13432 for “compostable” plastic is only 90%.
- 114 EN13432 for “compostable” plastic requires biodegradation to be tested in a laboratory (not in a compost heap) but it is suggested that we should test oxo-biodegradable plastic in outdoor conditions.
- 115 This is not necessary, but see the report from the Oxomar project, sponsored by the French Government. <https://www.biodeg.org/wp-content/uploads/2021/07/Final-report-OXOMAR-10032021.pdf> This was a three-year interdisciplinary study and the scientists said in their report that “The goal of this task (C3 Task2) was to evaluate the biodegradation of OXO-bio in marine waters. This task has been divided in two parts by (i) following several months of OXO-bio colonization by marine microorganisms under natural conditions and (ii) by evaluating the biodegradability of OXO under natural conditions as compared to a cultivated microorganism with known PE-biodegradation abilities.”
- 116 In conclusion they reported that “We have obtained congruent results from our multidisciplinary approach that clearly shows that oxo-biodegradable plastics biodegrade in seawater and do so with a significantly higher efficiency than conventional plastics. The oxidation level obtained due to the d2w prodegradant catalyst was found to be of crucial importance in the degradation process.
- 117 See also the report from Queen Mary University by Rose et. al 11th February 2020. <https://www.biodeg.org/wp-content/uploads/2022/10/QM-published-report-11.2.20-1.pdf> Para 2.6 says “prior to testing, samples of LDPE and oxo-LDPE were surface-weathered in sea water for 82 days, undergoing natural variations in sunlight and UV intensity.”
- 118 As to the correlation between laboratory tests and the real world, see the statement of Dr. Graham Swift, <https://www.biodeg.org/wp-content/uploads/2021/02/Swift-evidence-to-BEIS.pdf> who says “It has been my experience that results from laboratory testing are very likely to be reproduced in the real world. I can see no cause for concern that they would not, and have seen no evidence that they have not.”
- 119 It is said that they cannot be sure how long the plastic will take to biodegrade in the open environment, but it is not disputed that it will be many times faster than ordinary plastic. Queen Mary University say up to 90 times faster <https://www.biodeg.org/wp-content/uploads/2022/10/QM-published-report-11.2.20-1.pdf> para 2.3

- 120 It is said that recycling is preferable to biodegradation. Yes, but see <https://www.biodeg.org/subjects-of-interest/recycling-2/> as to whether this makes sense in economic or environmental terms. It is not however possible to recycle plastic which has escaped into the open environment from which it cannot realistically be collected. The ONLY way to deal with it is biodegradation.
- 121 You mentioned in the debate the type of plastic marketed as compostable, but oxo-biodegradable plastic is not intended for composting. In the UK Parliament on 14th November 2022 the Environment Minister Lord Benyon said:
- 122 “HM Government is not currently providing any specific support for the development of compostable potato starch bag packaging and have not evaluated the commercial viability of using compostable potato starch bag packaging by government agencies.” “Currently there is insufficient industrial composting capacity throughout England to manage compostable plastics at end of life and our call for evidence suggests these materials are often stripped out at the start of the process and landfilled or incinerated.”
- 123 Also, “This packaging also does not contribute to a circular economy in the same way as packaging that can be reused or recycled into new packaging or products do, as compostable plastic packaging is generally intended to be used only once.”
- 124 “The Government consider that compostable plastics must be treated in industrial composting facilities to be broken down and, when processed incorrectly, can be a source of microplastics and contaminate recycling streams. Therefore, our focus will be on reducing unnecessary consumption and working towards a circular economy, not composting of plastics.”
- 125 Further, “HM Government notes the findings from UCL's study into the home composting of plastics. The study has shown that home composting is not a viable destination for managing plastic waste.”
- 126 So we do not understand why the Co-op continue to sell bags described as “compostable” when they know, or ought to know, that the plastic:
- 127 • Does not convert into compost (EN13432 requires it to convert into CO₂ gas)
 - 128 • Is designed for a deliberate linear process and is not circular. The material is intended to be wasted by conversion into CO₂.
 - 129 • Cannot be re-used, recycled, or made from recyclate
 - 130 • Leaves microplastics in the compost and in the open environment
<https://www.chemeurope.com/en/news/1176729/>
 - 131 • Does not deal with the problem of plastic litter in the environment
 - 132 • Is not wanted by industrial composters and local authorities. See <https://www.biodeg.org/subjects-of-interest/composting/>
- 133 You also said “if the farmers can come up with a way of using oxo-degradable plastic that does not harm the environment and that can be demonstrated not to break down to leave nanoparticles in the soil, which, actually, are the worst kind of particles, then, of course, we will exempt them.” In fact, oxo-biodegradable mulching films have been successfully tested on a farm in Wales, <https://www.biodeg.org/wp-content/uploads/2020/09/Pembroke-Mulch-Film-Trial-Report-30.09.13V1.pdf>

EUROPEAN UNION

- 134 We are aware that the Welsh Labour Government wishes to implement EU legislation.
- 135 However, we have never been able to understand how it was possible to impose a ban (by Art. 5 of the Single-use plastics Directive 2019/904) without any dossier from the European Chemicals Agency (ECHA) showing any justification for banning oxo-biodegradable plastic. To make matters worse, the Commission had actually asked ECHA (under Art 69 of the REACH Regulation) to study whether these products created microplastics. ECHA received hundreds of pages of evidence but were then instructed to terminate the study.
- 136 The Parliament and Council then proceeded to legislate, and circumvented all the safeguards against arbitrary legislation provided by Arts. 69-73 of REACH. Could it be that there was some improper influence?
- 137 According to The Sunday Times (18.12.22) "In Roberta Metsola's attempt to blame a few bad apples, critics see a failure to address a fundamental problem: the extent to which the European Parliament, which wields real legislative power, is open to manipulation by lobbyists."
- 138 We look forward to hearing from you and to meeting with your officials.

On 3rd April 2025 Symphony wrote to the new Minister, Huw Irranca Davies MS

- 139 "We have been studying the **Regulatory Impact Statement** which forms the basis for proposals to ban oxo-biodegradable consumer products in Wales. We think that your Government is in danger of being misled by the evidence presented in that Statement
- 140 This type of plastic is not at all problematic (except for those who do not understand it) and is in fact the only way to prevent plastic which has escaped into the open environment from accumulating there for decades.
- 141 We have received Reports of scientific studies performed by Intertek in February 2025 according to ASTM D6954, on samples of plastic containing Symphony's d2w oxo-biodegradable masterbatch, which had proved biodegradation (by carbon-evolution, within 180 days) of 94.55% in the case of polyethylene (PE) and 92.76% in the case of polypropylene (PP). These studies had therefore shown that there was very little if any plastic left.
- 142 100% carbon-evolution would never be achieved because the rest of the organic carbon above the 94.55% in PE and 92.76% in PP is used by microorganisms for their energy requirements and to build their cell-structure. The hydrogen from the original PE and PP converts into water.
- 143 These studies had also included tests according to OECD 207 and 208, showing no adverse effects on plants or earthworms, and tests showing the absence of any metals above permitted levels.
- 144 Symphony nevertheless asked Intertek to examine the soil/compost in which the biodegradation had taken place, and they provided a report dated 7th March 2025 that no microplastics had been found.
- 145 However, in view of the importance of these findings, Intertek carried out a further detailed assessment of the data and reported on 17th March that they had found one particle in the case of PE and two particles in the case of PP. They found a molecular weight of 4,900 Daltons in the case of PP, and 2,200 in the case of PE so if they were remnants of the test

materials at all they were not microplastics but low-molecular-weight oligomers or short-chain polymer fragments which were biodegradable.

- 146 If the PE and PP samples had not contained d2w and had simply fragmented under the influence of sunlight and stress, it is to be expected that many thousands of particles would have been found. Accordingly, even if the particles actually found by Intertek were particles of the PE and PP samples, the fact that hardly any were found is an excellent result, and reinforces the view that d2w is a very useful technology for reducing the prevalence of microplastics in the environment.

WALES REGULATORY IMPACT STATEMENT

- 147 At para. 3.2.9 a report by Markowicz and Szymańska-Pulikowska is cited in support of the proposition that “Although these products have been marketed as a solution to plastic pollution, evidence indicates that oxo-degradable plastics simply fragment into small pieces, including microplastics, presenting a high risk of environmental harm.” You will see from the above that this is not correct.
- 148 This is a 20-page report which examines the performance of various types of bioplastics in the industrial composting process. It shows that even those marketed as compostable contain metals and leave microplastics. See also a study by the University of Bayreuth <https://www.chemeurope.com/en/news/1176729/> which shows that “finished compost from composting plants contains a large number of biodegradable plastic particles. They also found a quantity of metals in the compost, and they said that sources of metals such as zinc, lead, copper, and cadmium in the test materials can be additives such as dyes, fillers, antioxidants, stabilisers, or plasticisers used in the production of various types of plastics. None of these metals are used in oxo-biodegradable masterbatches.
- 149 This evidence does not therefore support a ban on oxo-biodegradable plastic, but it does support a ban on putting plastic bags of any kind into a composting facility.
- 150 In fact many industrial composters are already refusing to accept plastic bags of any kind into their facility. See <https://www.biodeg.org/subjects-of-interest/composting/>
- 151 It is difficult to see why Markowicz and Szymańska-Pulikowska included oxo-biodegradable plastics in their study, as these are not marketed for composting. They are intended to deal with plastic which gets into the open environment as litter. See www.biodeg.org/wp-content/uploads/2024/12/BPA-Position-paper-1.12.24.pdf
- 152 At 3.2.9 the Regulatory Impact Statement also cites the Ellen MacArthur Foundation as an authority, even though the author of their report is not a scientist. See <https://www.biodeg.org/bpa-response-to-emf-report/>
- 153 At 3.2.10 the Regulatory Impact Statement (again citing MacArthur) alleges that oxo-biodegradable plastic causes microplastic pollution, but this is not correct, for the reasons explained above, and in detail at <https://www.biodeg.org/subjects-of-interest/microplastics/> This Position Paper on Microplastics, has been endorsed by scientists in Canada, the United States, and Brazil.
- 154 At 3.2.10 it is also said that oxo-biodegradable plastics are not suitable for long term use, due to their degradation - but they are not used for long-life products.
- 155 At 3.2.10 it is said that oxo-biodegradable plastics cannot be recycled, but this is not correct, for the reasons explained in detail at <https://www.biodeg.org/subjects-of-interest/recycling-2/> It is however true that plastics marketed as “compostable” cannot be recycled, but you are not proposing to ban them. Perhaps you should ban them for this reason and by reason of the contamination of compost referred to above. Also because they are a waste of

- resources and contribute to climate-change (because they are designed to be converted into CO2 gas (not compost) in a composting facility).
- 156 At 3.2.11 it is said that oxo-biodegradable plastic carrier bags are unsuitable for multiple re-use. In fact they can be re-used many times before they degrade, but if the bag is intended as a durable bag for long term use, the formulation can be adjusted to give the bag as long a service-life as may be required.
- 157 At 7.7.28 the Hazardous Substances Advisory Committee is cited, as to which see www.biodeg.org/wp-content/uploads/2020/09/BPA-response-to-HSAC-Report-19-1-23.pdf
- 158 As to 3.2.12-13 plastic packaging has a better LCA than many other materials See <https://www.biodeg.org/subjects-of-interest/life-cycle-assessments/> and also that if the bag is made with oxo-biodegradable technology it will not be persistent in the environment and will not create microplastics

THE WELSH GOVERNMENT'S 2025 REVIEW

Executive Overview

- 159 This is a critical technical analysis of the Welsh Government's "Updated Evidence and Literature Review on Oxo-degradable and Oxo-biodegradable Plastics" (October 2025), commissioned under reference L01555. The review was published in connection with the possible commencement of a ban on oxo-degradable/oxo-biodegradable plastics (ODPs) under s. 2(1) and the Schedule to the Environmental Protection (Single-Use Plastic Products) (Wales) Act 2023.
- 160 The Review states that it is not intended to be exhaustive, yet it nevertheless forms a key evidence base for legislative decisions with substantial economic, environmental, and restraint of trade implications.
- 161 The BPA does not argue that oxo-biodegradable plastics are a substitute for waste management, recycling, redesign, or reduction; nor does it maintain that oxo-biodegradable plastics should be discarded into the environment or into a composting facility. Rather, it is a harm-reduction technology designed to address the inevitable leakage of PE and PP plastics into the open environment.
- 162 There is no single solution to plastic leakage. Waste management in Switzerland is among the most efficient in the world, but the Swiss Federal Office for the Environment <https://www.bafu.admin.ch/bafu/en/home/topics/waste/waste-policy-and-measures/plastics-in-the-environment.html> says:
- 163 "Plastics have no place in the environment. Nevertheless, around 14,000 tonnes of plastics end up in Switzerland's soil and waters every year – primarily due to the abrasion and decomposition of plastic products and improper disposal of plastic waste. Plastics then accumulate in the environment because they degrade very slowly." In developing countries it is dramatically worse.
- 164 This is the reason why oxo-biodegradable plastic was invented, by polymer scientists, foremost among whom was Professor Scott, the holder of several patents for the technology and who was later the Chief Scientific Adviser to the BPA. He published the results of his work in many scientific publications including "Polymers & the Environment" (ISBN 9780854045785); "Degradable Polymers; Principles & Applications" (ISBN 1-4020-0790-6). See also "Programmed-Life Plastics from Polyolefins: A New Look at Sustainability" <http://www.biodeg.org/wp-content/uploads/2023/07/Scott-Wiles-paper-June-2001.pdf> They

- called it oxo-biodegradable because it oxidises and becomes biodegradable. It is essential to understand that this is a two-stage process – oxidation followed by biodegradation.
- 165 Oxo-biodegradable plastic is for use in a wide variety of packaging and other products made from polyethylene or polypropylene, which are among those most likely to be littered. It is also very useful in agriculture See <https://www.biodeg.org/agricultural-plastic-products-2/> It tackles the problem at the molecular level by ensuring that the plastic does not just break up into smaller pieces. It dismantles the molecular chains within the polymer so that it ceases to be a plastic and becomes a biodegradable material which is consumed by bacteria and fungi and cleaned out of the eco-system by them.
- 166 The Review says “there is no suitable waste management strategy for ODPs.” This misunderstands the technology because no special waste management strategy is required. Oxo-biodegradable PE and PP are designed to perform identically to conventional plastics during manufacture, use, reuse, and recycling, with degradation occurring only if the material is discarded into unmanaged environments which, by definition are not managed.
- 167 Oxo-biodegradable plastic is for use in a wide variety of packaging and other products made from polyethylene or polypropylene, which are among those most likely to be littered. It is also very useful in agriculture See <https://www.biodeg.org/agricultural-plastic-products-2/> It tackles the problem at the molecular level by ensuring that the plastic does not just break up into smaller pieces. It dismantles the molecular chains within the polymer so that it ceases to be a plastic and becomes a biodegradable material which is consumed by bacteria and fungi and cleaned out of the eco-system by them.
- 168 The Review, while citing a PRISMA-based methodology, contains fundamental scientific errors, logical inconsistencies, and bias in evidence-selection that render its conclusions unsuitable as a basis for regulatory action. The following analysis examines each substantive section of the report and identifies the specific deficiencies.

DEFICIENCIES

- 169 It dismisses the Oxomar study, which is the most thorough investigation of oxo-biodegradable plastic in the scientific literature, and does not even mention six reports by Intertek - an ISO 17025-accredited test house which found almost complete biodegradation and absence of microplastics.
- 170 It conflates oxo-degradable and oxo-biodegradable plastics without scientific basis, creating a false equivalence that invalidates core conclusions. It incorrectly defines ODP as applying to both technologies.
- 171 It places disproportionate weight on Wales-specific climatic conditions as a disqualifying factor, while apparently not understanding that the technology is designed to function under all climatic conditions
- 172 It dismisses standardised testing frameworks (particularly ASTM D6954) which demonstrate that the technology functions as intended, while the authors rely on laboratory test data which purport to show that it does not - a selective and methodologically inconsistent approach.
- 173 It relies on studies on incorrectly formulated or unverified test samples, without recognising that no conclusions can be drawn from the test unless before the test begins the sample is known to be a correctly formulated oxo-biodegradable plastic product.
- 174 Oxidation is not optional, and studies that omit this step and then conclude that biodegradation is insufficient, are inadmissible as evidence against this technology. They cannot be used to suggest risk or uncertainty to policymakers. The Welsh Review itself

- acknowledges the importance of oxidation but then cites EN 17033 (which omits this step), and a study by Thanh et al. (2025) which found slow degradation because the study was conducted without the required oxidation step. This does not demonstrate failure of the technology; it demonstrates the expected outcome of conducting Stage 2 testing without Stage 1.
- 175 The Review repeatedly and incorrectly asserts a “high potential” for micro and nano plastic generation, yet:
- 176 • Provides no comparative lifecycle analysis against conventional plastics, which fragment into microplastics through mechanical and environmental weathering.
 - 177 • Does not demonstrate that oxo-biodegradable plastics result in higher microplastic burdens.
 - 178 • Does not demonstrate adverse ecological or human health outcomes under realistic exposure scenarios.
- 179 The Review concludes that “oxo-degradable” plastics are unsuitable for landfill, recycling, or composting. However, while oxo-biodegradable plastics can be landfilled and recycled, and have been proved to biodegrade in compost, they were designed to mitigate the environmental impact of plastic that escapes waste management systems altogether.
- 180 By evaluating oxo-biodegradable plastics primarily against circular economy criteria designed for closed loop systems, the Review applies an inappropriate policy lens to a product class designed for a different risk domain (uncontrolled disposal and litter). This methodological choice materially affects the policy conclusions drawn.
- 181 The Review accepts that oxo-biodegradable plastics undergo an initial abiotic oxidation phase followed by slower biotic processes, and that degradation rates are influenced by environmental conditions. However, the Review consistently confuses three distinct concepts:
- a. Fragmentation
 - b. Oxidative depolymerisation
 - c. Biodegradation (mineralisation)
- 182 As oxidation is required to enable biodegradation, this is presented as a policy weakness, despite being entirely consistent with the design intent of materials targeting littered, unmanaged environments rather than closed waste systems
- 183 Fragmentation does not equate to biodegradation. The policy conclusions rely heavily on fragmentation related outcomes (e.g. microplastic formation) as proxies for harm, without recognising that a plastic material which has become biodegradable behaves differently from fragments generated from conventional plastics.
- 184 It fails to make a comparison with conventional plastics and bio-based plastics according to the same parameters, making its conclusions regarding microplastics, recycling, and other factors unsuitable for regulatory decision-making. The Review does not quantify relative environmental risk compared with conventional plastics that persist in the environment for decades or even centuries.
- 185 It cites jurisdictions where “oxo-degradable” plastic is banned, but it is not banned in most countries of the world, and the Review does not mention the jurisdictions in which the use of oxo-biodegradable plastic is actually compulsory.
- 186 The Review does not consider the detailed expert evidence which can be found at <https://www.biodeg.org/subjects-of-interest/recycling-2/> that oxo-biodegradable plastics can be recycled without detriment to a normal recycling stream.
- 187 The Review states that no new evidence overturns previous conclusions. This is not equivalent to demonstrating that previous conclusions were based on a correct understanding of the evidence, nor that they were proportionate, or optimal in light of:
- Persistent failure to control plastic litter through behavioural and enforcement measures and the promotion of a circular economy.

- Continued environmental accumulation of conventional plastics on a substantial scale.
- 188 The Review does not assess whether oxo-biodegradable plastics could form part of a risk-mitigation hierarchy, nor does it consider adaptive regulatory approaches such as independent certification.

The OXOMAR study

- 189 A fundamental weakness of the Welsh Review is the absence of any serious engagement with the Oxomar project, a three-year interdisciplinary study sponsored by the French government and conducted by public research institutions. See www.biodeg.org/wp-content/uploads/2021/07/Final-report-OXOMAR-10032021.pdf - and the six published papers cited at C7 in the report.
- 190 Oxomar demonstrated - for oxo-biodegradable PE in marine environments - oxidation, molecular-weight reduction, microbial assimilation, and absence of ecotoxicity. Failure to engage with this study therefore fundamentally undermines the methodology and conclusions of the Review.
- 191 The Oxomar scientists reported that “We have obtained congruent results from our multidisciplinary approach that clearly show that oxo-biodegradable plastics biodegrade in seawater and do so with a significantly higher efficiency than conventional plastics. The oxidation level obtained due to the d2w prodegradant catalyst was found to be of crucial importance in the degradation process.”
- 192 The Welsh Review says that Oxomar found that “without pre-treatment, oxo-degradable polymers behaved comparably to conventional polymers and did not release any measurable degradation compounds into the water.” This confirms that the oxidation phase is essential before biodegradation commences.
- 193 The Review also says that complete degradation in the marine environment after periods specified in standards (e.g., more than 60% degradation for ISO 18830 and ISO 19679 or 70% for ASTM D6691-09 after 24 months) could not be determined. However, these are standard methods for assessing biodegradation under submerged marine conditions, and do not therefore incorporate the essential oxidation phase. Oxo-biodegradability is intended for plastics which float on water because their specific gravity is less than 1, or lie on the surface on land, in both cases with access to sufficient oxygen and uv light. Sciscione et al (cited at 8 in the Welsh Review) say correctly that “The rate of degradation will be different for a material floating on the surface of the sea, experiencing higher temperature, oxygen and UV light, compared with in deep waters where the photo- and thermal oxidation might be limited due to reduced amounts of oxygen and light, and lower temperatures.”
- 194 Oxomar did not pursue the study to the point of complete biodegradation because this is expensive and is not required in order to prove biodegradability. However, 92.74% biodegradation was proved by Intertek in the 2025 test reports supplied to the Welsh Government. (Only 90% is required by EN13432 for “compostable” plastic).
- 195 Oxomar was the most thorough and authoritative study of oxo-biodegradable plastic in the entire literature, yet it is dismissed by the authors of the Welsh Review.

CARBON 13

- 196 The 2025 HSAC Report for DEFRA says that “To definitively address the question of how completely PAC plastics degrade in soil environments, HSAC recommends that studies are performed utilising isotopically labelled plastics to definitely demonstrate whether the evolved CO₂ derives from the plastic or from soil organic matter.”

- 197 These tests were actually done as a supplement to the Oxomar project, and have demonstrated that the evolved CO₂ does derive from the plastic. The Report from Institut de Chimie de Clermont-Ferrand, France, dated January 2022 confirms that “biodegradation of 13C-Oxo-LDPE and 12C-Oxo-LDPE showed positive results, as the Rhodococcus bacterium was able to grow on both materials.” The incorporation of 13C into the CO₂ started from the beginning of the incubation and increased during the whole experiment.
- 198 This confirms the use of 13C polyethylene as a carbon source by the Rhodococcus strain all along the experiment.” “This enrichment reflects the mineralization of the labelled polymer through respiration and confirms the biodegradation of oxo-polyethylene.”
- 199 See also Goudriaan et al Marine Pollution Bulletin 186 (2023) 114369 “Stable isotope assay with 13C-labeled polyethylene to investigate plastic mineralization mediated by Rhodococcus ruber” <https://doi.org/10.1016/j.marpolbul.2022.114369> “We found that our approach allows tracing isotopically labelled carbon from plastic into the mineralization product CO₂, and thus provided unambiguous proof for the mineralization of plastic-derived carbon by microbes.”
- 200 See also Vaksmaa et al “Polyethylene degradation and assimilation by the marine yeast Rhodotorula mucilaginosa” ISME COMMUN. 3, 68 (2023). <https://doi.org/10.1038/s43705-023-00267-z> “With the aid of stable isotope assays, we provide unambiguous proof that the fungus Rhodotorula mucilaginosa uses polyethylene-derived carbon for cellular incorporation and energy gain. Our results confirm that initial plastic photooxidation is a key process in making plastic available for subsequent microbial degradation. Most produced and discarded plastic types such as polyethylene and polypropylene float at the ocean surface and will consequently be subjected to photooxidation so that fungal degradation can commence there. At least parts of the vast amounts of plastic litter in the ocean may thus serve as a carbon source for fungi and possibly other microbes, too.”

Confusing Oxo-degradable and Oxo-biodegradable

The report's opening definitional section (Section 1.2) states:

- 201 *“The terms oxo-degradable and oxo-biodegradable are used synonymously in industry, and previous studies concluded there is no difference between the two.”*
- 202 This claim is not correct. The terms oxo-degradable and oxo-biodegradable are not used synonymously in industry. Nobody puts a prodegradant masterbatch into plastic and calls it oxo-degradable. The distinction is not merely terminological - it is fundamental to an understanding of the technology:
- 203 “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 plastic, (which does not contain an intentionally-added prodegradant catalyst). It will abiotically degrade by oxidation in the open environment and create microplastics, but does not become biodegradable except over a very long period of time.
- 204 By contrast, “oxo-biodegradation is defined by CEN as “degradation resulting from oxidative and cell-mediated phenomena, either simultaneously or successively”. This means that the plastic (which does contain a prodegradant catalyst) degrades rapidly by oxidation until its molecular weight is low enough to be accessible to bacteria and fungi, who then recycle it back into nature.
- 205 The report cites three recent papers in support of this claimed equivalence (Salcedo-Reyes et al. (2023), Moreno et al. (2023) and Haq et al. (2025)). However, none of these papers are from industry. Moreover they fail to verify exactly what they are testing, and do not

perform controlled comparative testing of verified oxo-biodegradable plastics against oxo-degradable ones.

Misuse of Climate Data

- 206 Section 5.1 of the Welsh Review constructs a detailed comparison between Welsh climatic conditions (average air temperature 10.03°C, precipitation 1584 mm/year) and standard ASTM D6954 test conditions (50 ± 3°C, 0 mm precipitation). The report presents this data as evidence that oxo-biodegradable plastic cannot be expected to degrade in Wales.
- 207 The Welsh Review places strong emphasis on cool, wet conditions, but it is necessary first to understand that oxidation and microbial assimilation are uv and oxygen activated processes, not climate-specific processes. There is uv light, oxygen and ambient heat everywhere in the world. A slower rate of oxidation is to be expected in cold conditions but this does not imply failure, only a longer process - but still much shorter than conventional plastic in the same place (which oxo-biodegradable plastic is intended to replace for the kind of products which are commonly found as litter). Moisture is irrelevant to abiotic degradation.
- 208 Dr. Graham Swift is a polymer scientist who was Vice-chairman of the Technical Committee at ASTM which wrote ASTM D6954. He says in his evidence to the UK Government www.biodeg.org/wp-content/uploads/2021/02/Swift-evidence-to-BEIS.pdf "Of course, conditions in the open environment are variable, but there is no need for a standard for each of these conditions. Provided that oxygen is present, a plastic complying with ASTM D6954 will become biodegradable much more quickly than ordinary plastic, and that is its purpose."
- 209 No evidence is presented in the Welsh Review that anything in polymer chemistry causes oxidation to "stop" in cold or low UV conditions; it simply proceeds more slowly.
- 210 There is no basis for requiring uniform degradation rates across environments, and slower degradation in cooler climates does not imply non functionality. However, the rate of degradation can be controlled. Dr. Swift says: "When an oxo-biodegradable plastic is required to have a life-span of several weeks or several months, a [masterbatch] manufacturer adjusts the catalysts and anti-oxidant concentrations having regard to a laboratory test using ASTM D6954, and correlates the degradation characteristics with real world experience to identify the formulation needed to meet the intended degradation criteria."
- 211 Oxidation rate can be accelerated or slowed by formulation-choices by end-users or governments, including - type of pro-oxidant (Fe, Mn, Co, mixed systems), and balance between pro-oxidants and stabilisers in the masterbatch.
- 212 Dr. Swift continues: "I am aware that standards similar to ASTM D6954 for testing oxo-biodegradable plastics have also been written in the UK, France, Sweden, Saudi Arabia and the UAE, but there is really no need for separate standards for every country, as the principles are the same."
- 213 Oxo-biodegradable plastic is designed to convert into biodegradable materials anywhere in the open environment with access to oxygen. Dr. Swift says "Provided that oxygen is present, a plastic complying with ASTM D6954 will become biodegradable much more quickly than ordinary plastic, and that is its purpose. Most of the plastic litter is found lying or floating around with abundant access to oxygen."
- 214 In any event, the UV intensity data in Table 2 of the Welsh Review is revealing: average UV intensity in Wales (Apr-Sep) is 175.57 W/m², which is much higher than the test condition value of 75.65 W/m². The authors of the Review seem to apply climate data only where it supports their negative conclusions.

- 215 The Welsh Review admits (5.1) that abiotic and biotic degradation will occur, but says that this will likely progress at a slow rate. This will still be a lot faster than conventional plastic, which can accumulate in the environment for decades.

Reliance on academic papers

- 216 The Welsh Review relies heavily on peer-reviewed papers. These are useful for academic research but are not designed to function as regulatory pass/fail assessments. That is the purpose of independent testing by certified test-houses according to international Standards. These academic studies typically use heterogeneous methods, limited or no material characterisation, and non-standard conditions. Many authors, including those cited in the Welsh Review fall into one or more of the following fundamental errors when investigating oxo-biodegradable plastic:

Academic researchers:

- often think that oxo-biodegradable plastic is designed to start biodegrading immediately, and they omit the oxidation phase. They fail to understand that it has a predetermined service-life during which it can be re-used and recycled, and that only after a period of oxidation after exposure in the open environment will it become biodegradable.
 - Have simply relied on labels attached to plastic products, or have not characterised the products before commencing the test to determine that the test sample contains a masterbatch formulated for the particular application and included at the correct concentration, or included at all. This invalidates the whole report ab initio.
 - Have followed the wrong standard e.g. a standard which omits the oxidation phase such as ASTM D6400 or EN13432 or ISO 17088 instead of using ASTM D6954.
 - Did not continue important parts of the test for a sufficient length of time to permit reduction of molecular weight to sub 5,000 Daltons, and commenced the biodegradation test before ascertaining that 5,000 had been achieved. Sciscione et al refer to testing at Plymouth University and conclude “that the test period was not appropriate to test the claims of this PAC material.” We agree. In fact the Plymouth researchers fell into most of the errors mentioned here.
 - Treat fragmentation as an end result, and do not consider whether the fragments are fragments of plastic or are biodegradable materials.
 - Used a sample containing carbon-black or otherwise so heavily stabilized that it would take a very long time before the material became biodegradable.
 - Exposed the sample under conditions unlikely to be experienced in the use for which it was designed. Eg buried in soil or submerged in water. (Oxo-biodegradable plastic products in the open environment will normally lie or float on the surface with access to uv light and oxygen.)
 - Failed to compare for biodegradability and microplastics with ordinary plastic.
 - Failed to compare for biodegradability, recyclability and microplastics with bio-based plastic.
- 217 For an analysis of 30 papers which are leading reviewers and regulators to the wrong conclusion see www.biodeg.org/wp-content/uploads/2026/03/BPA-Dossier-with-links-10-2-26-optimised-V13-31-Mar-26.pdf This dossier demonstrates that papers can be peer-reviewed and published, and still contain fundamental errors. The dossier includes the papers cited at References 2, 8, 9, 10, 12, 41, 43, and 52 in the Welsh Review.
- 218 Faulty research such as this is often cited in literature-reviews and leads policymakers to make the wrong decisions.”
- 219 The BPA have also responded to the Report by the Group of Chief Scientific Advisors (GCSA) of the European Commission, and the Report by Science Advice for Policy by

- European Academies (SAPEA) See <https://www.biodeg.org/wp-content/uploads/2021/03/OPA-Response-to-SAM-Report-Feb-2021-1-3-21.pdf>
- 230 Also to the Eunomia Report for the EU Commission <https://www.biodeg.org/wp-content/uploads/2020/08/BPA-Comment-on-the-Eunomia-Report-2016.pdf> The EU Commission Report <https://www.biodeg.org/wp-content/uploads/2018/01/BPA-RESPONDS-TO-EUROPEAN-COMMISSION.pdf> the Ellen MacArthur Report <https://www.biodeg.org/wp-content/uploads/2019/11/emf-report-1.pdf> and the Plymouth Report <https://www.biodeg.org/wp-content/uploads/2019/04/BPA-Comments-on-Plymouth-10.pdf>
- 231 None of these studies justifies a ban on oxo-biodegradable plastic.

Standards:

- 232 ASTM, ISO, BSI, and CEN standards were developed to define:
- i. What must be measured;
 - ii. How it must be measured;
 - iii. Clear performance and safety criteria.

ASTM D6954

- 233 This American standard is designed for testing Plastics that Degrade in the Environment by a Combination of Oxidation and Biodegradation, and has been replicated in other countries. It deliberately uses accelerated conditions (elevated temperature and UV) to simulate extended outdoor exposure in compressed time. This is standard practice in materials science.
- 234 The Welsh Review argues that standardised testing frameworks (ASTM D6954, PAS 9017, EN 17033) cannot be used to make real-world performance claims, because they are conducted under accelerated, non-representative conditions. The Review states:
- 235 "The current laboratory testing guidelines do not capture the complexity of environmental factors and should not be used to extrapolate performance under real world scenarios." This position is inconsistent with how the same Review uses laboratory data to argue against oxo-biodegradable plastic.
- 236 ASTM D6954 clause 5.2 contains a caveat that results should be used for 'comparative and ranking purposes'. The Welsh report quotes this disclaimer but then uses it to dismiss the standard in its entirety. However as to this Dr. Swift, one of the authors of the Standard says "ASTM D6954 contains a standard caveat, recognising that laboratory environments are isolated, unlike the dynamic natural environment - in which degradation and therefore biodegradation is likely to proceed more quickly. However, ASTM D6954 has been devised by myself and other specialists working in the field over many years to provide practical guidance as to how the product is likely to perform in commercial use."
- 237 "The material can be aged in the natural environment, and this is sometimes done eg by Station d'essais de Vieillissement Naturel de Bandol in France. However, this is a long and expensive process. Artificial ageing is therefore done simply to reduce the time and cost of testing, and does not invalidate the results. If it did it would obviously not be used, and would not have been permitted by ASTM D6954."
- 238 The French scientists who conducted the Oxomar study www.biodeg.org/wp-content/uploads/2021/07/Final-report-OXOMAR-10032021.pdf confirmed (at C6) that "accelerated artificial aging (UV, temperature) which was perfectly mastered in this project, is a tool of choice which is particularly well suited to the study of the fate of OXO-bios in the marine environment. Accelerated artificial ageing does not invalidate the results."

- 239 Dr. Swift continues “It has been my experience that results from laboratory testing are very likely to be reproduced in the real world. I can see no cause for concern that they would not, and have seen no evidence that they have not. In particular I do not consider that persistent plastic fragments and smaller, microplastics would be left behind which could have any harmful effect on the open environment, and in particular marine life.” With regard to the abiotic phase, Sciscione et al (Reference 8 in the Welsh Review) conclude that “a good correlation was found between the samples tested under laboratory and controlled outdoor exposure.”
- 240 The OXOMAR studies were conducted in the laboratory and also under real-world conditions. – The Report says (at C3) Task 2: The goal of this task was to evaluate the biodegradation of OXO-bio in marine waters. This task was divided in two parts by (i) following several months of OXO-bio colonization by marine microorganisms under natural conditions and (ii) by evaluating the biodegradability of OXO-bio under natural conditions.”
- 241 It is not difficult to test for oxidation in the natural environment, and it has been observed in a convincing manner outside laboratory conditions for example in seawater at Bandol in the Mediterranean, and by Oxomar.
- 242 Scientists at ASTM and other Standards institutions have devised laboratory protocols over many years which simulate the natural process of biodegradation. The degraded residue has for example been observed at Queen Mary University London <https://www.biodeg.org/queen-mary-university-london-report/> and by Oxomar to be consumed by bacteria commonly found on land and in the sea.
- 243 Dr. Swift says “Oxo-biodegradable plastics have been known and used commercially for over half a century. They were developed by the scientists who had developed conventional plastics, who found a way to render ordinary plastic susceptible to controlled oxidative degradation, by using catalysis to produce simple hydrophilic compounds, many known and recognized as biodegradable in widely disparate aerobic environments.”
- 244 He continues: “We wrote D6954 at ASTM to guide the user and developer of these plastics in testing the sequential degradation process to be expected in the open environment, using existing ASTM and other certified standard methods at each stage. We called it a Standard Guide, because we reserve the title “Specification” for protocols for testing in a controlled environment eg. ASTM D 6400.”
- 245 “Testing [for biodegradation] is done in the laboratory in a microbial consortium by measuring the rate and extent of carbon dioxide evolution (relative to theoretical). The microbial consortium chosen will be relevant to disposal in the open environment, and the amount of biodegradation required in order to pass the test is specified in sections 6.6.1 and 6.6.2 of ASTM D6954. Similar carbon-evolution testing is done in the laboratory for “compostable” plastic according to ASTM D6400 and EN13432, and this method is widely accepted.”
- 246 “ASTM D6954 is designed for testing plastics which degrade and biodegrade in uncontrolled conditions in the open environment, but it is nevertheless a detailed protocol for proving degradation, biodegradation, and non-toxicity under the conditions expected to be found in the open environment.”
- 247 “ASTM D6954 contains six pass/fail tests 1.for the abiotic phase of the test (6.3 - 5% e-o-b and 5,000DA) 2. the tests for metal content and other elements (6.9.6), 3. Gel content (6.6.1), 4.Ecotoxicity (6.9.6 -6.9.10), 5. PH value (6.9.6) and 6. for the biodegradation phase, (for unless 60 % of the organic carbon is converted to carbon dioxide the test cannot be considered completed and has therefore failed).”

- 248 “Oxygen is ubiquitous, and most of the plastic litter is found lying or floating around with abundant access to oxygen, but it is possible to imagine a piece of plastic in anaerobic conditions where abiotic degradation cannot proceed. However if this is in a landfill it does not matter, because the plastic has already been properly disposed of.”
- 249 “It is also possible for a piece of oxo-biodegradable plastic to find itself in anaerobic conditions outside a landfill but this would be very unusual and does not invalidate the general proposition. It is for example possible for plastic to be deprived of oxygen by being heavily bio-fouled in the ocean or buried in sediment, but this is unlikely to happen quickly enough to prevent sufficient exposure to oxygen for abiotic degradation to commence. If it did happen, then that small proportion of the global burden of plastic litter would perform in the same way as ordinary plastic – no better and no worse.”
- 250 Dr. Swift continues “Once abiotic degradation has commenced, there is no reason for it to stop save in the unlikely event that it is deprived of oxygen. Once the molecular weight has reduced to 5,000 Daltons or less, the material would be in very small particles and would be lost if testing were continued in the open environment. At this level of molecular-weight we would expect the material to have become biodegradable, and this is confirmed by testing residue from D6954 Stage 1 for biodegradation. Once the material has become biodegradable, it can be expected to fully biodegrade, save in the very unlikely event that it is deprived of bacteria.” Bacteria are of course readily available in Wales.
- 251 Dr. Ruth Rose of Queen Mary University London says in her evidence to the European Chemicals Agency on 3rd May 2018 <http://www.biodeg.org/wp-content/uploads/2024/09/Scientist-Letters-combined-06.06.18.pdf> “Once biodegradation of a long carbon-hydrogen chain has begun there is no reason to believe that assimilation would not continue to occur until all the material has been consumed by the micro-organisms. In the laboratory, biodegradation is not expected to proceed as quickly or as fully as it would in the open environment since the plastic is the only source of carbon, and other nutrients cannot be replenished. Additionally, plastic in the environment has been shown to be colonised by many microorganisms, and not, as we have tested, a single species. Nonetheless, we clearly observed higher rates of oxo-plastic consumption compared to [conventional] LDPE.”
- 252 IN VIEW OF THIS EVIDENCE, THE ONUS IS ON THOSE WHO ASSERT THAT BIODEGRADATION COULD STOP BEFORE COMPLETION TO PROVE IT.

Failure to verify test material composition

- 253 The most pervasive technical error across the academic studies cited by the Welsh review and other literature reviews of oxo-biodegradable plastic is the omission of the mandatory pre-oxidation step (Stage 1 of ASTM D6954) before commencing biodegradation testing. The Welsh report acknowledges this requirement but fails to apply it.
- 254 Oxidation is necessary to:
- i. promote chain-scission of the polymer backbone
 - ii. reduce molecular-weight to a threshold at which microbial assimilation becomes possible, and
 - iii. generate carbonyl and other low-molecular weight oxidation products accessible to microorganisms
- 255 Many studies did not verify that the test samples contained correctly formulated pro-oxidant masterbatch at the appropriate concentration or at all. This is the most basic step in any scientific experiment, and its omission deprives the findings of any scientific value.

- 256 Another critical flaw running through many studies cited in the Welsh review is the failure to realise that oxidation is necessary.
- 257 These issues matter enormously because:
- 258 Oxo-biodegradable performance is dependent on the pro-oxidant masterbatch formulation, and its addition to the polymer in the correct concentration
- 259 Incorrectly formulated material, including material with insufficient catalyst concentration, degraded catalyst, or no masterbatch at all will not biodegrade as intended. Testing such material and concluding that 'oxo-biodegradable technology fails' is scientifically meaningless.
- 260 Oxidation is necessary before biodegradation can begin. Any standard or experiment which describes this as "pre-treatment" and excludes it, is not appropriate for oxo-biodegradable plastic.

Absence of comparative analysis with conventional and bio-based plastics

- 261 The Welsh Review acknowledges in Section 4 (Objectives) that:
- 262 *"This review focused only on ODPs, and a comprehensive comparison with other plastic types, e.g., compostable or biodegradable, has not been undertaken."*
- 263 This is a critical omission that fundamentally limits the utility of the review to policymakers.
- 264 The implicit reference-point throughout the Review is a world with no plastic pollution. That is not a realistic comparison. The question for regulators is whether oxo-biodegradable plastic performs better or worse than ordinary PE or PP, or bio-based plastics, in the same environment
- 265 D2W technology is designed to mitigate plastic pollution, and test results clearly show that no microplastics are left behind and that enhanced biodegradation is observed, which would not be the case with non-oxo-biodegradable plastics.
- 266 On each of the concerns raised about ODPs, a balanced review would address:

Concern	ODP (as per Welsh Report)	Absent comparison (Conventional/bio-based)
Microplastics generation	Described as a risk	Conventional plastics also fragment into MPs. No comparison provided.
Chemical leaching	leaching concern raised	Leaching is found from conventional and bio-based plastics. Recent research (Reay et al. (2025)) shows higher leaching from biobased mulch films. Not discussed.
Recyclability	Stated as not viable in conventional streams	Bio-based "compostable" plastics are not recyclable in conventional streams. ODPs are in fact recyclable. See https://www.biodeg.org/subjects-of-interest/recycling-2/
Landfill performance	Stated as degradation inhibited (no light/O ₂)	Conventional plastics do not degrade in landfill. Bio-based plastics in landfills generate methane – a powerful greenhouse gas. No comparison provided.

Deficiencies in the PRISMA methodology

- 267 The Welsh report uses PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) methodology for its literature search, which is appropriate for systematic reviews. However, the implementation contains significant gaps:
- 268 The PRISMA filtered dataset includes only 20 peer reviewed papers (2023–2026), many of which examine highly specific laboratory scenarios that are not representative of product use, disposal pathways, or real-world exposure.
- 269 A PRISMA search would not reveal the six reports of testing on d2w products done by Intertek (an ISO 17025 accredited laboratory) in Feb/March 2025 referred to above. They were however provided to the Welsh government on 3rd April 2025 and have not been mentioned in the Review. These tests are very thorough and show almost complete biodegradation and absence of microplastics.
- 270 The PRISMA search was limited to 2023-2026, deliberately excluding studies prior to 2023. This is described as an 'update' to prior reviews, but the 20 studies ultimately included in the review represent a very small evidence base on which to make regulatory recommendations. Earlier foundational studies (including the work of Professor Gerald Scott and other polymer scientist such as Professors Lemaire, Chiellini, and Jakubowicz, and Symphony's extensive performance documentation provided to the Welsh government) are excluded from the evidential scope.

QUALITY CONTROL

- 271 For oxo-biodegradable products to perform as intended it is necessary for them to be correctly manufactured and to be tested according to ASTM D6954 or a comparable Standard (eg UK BS 8472; France AFNOR T51-808; Sweden SPCR 141; Saudi Arabia 2879; UAE 5009-2009; Jordan 2004-2012; Jamaica JS 355; Mexico MNX E288; Dominican Republic NORDOM 83-2:003; Ecuador NTE INEN 2644-13; Russian Federation GOST 33747-2016). There are no toxic components in an oxo-biodegradable masterbatch, and if there were, the product would not be compliant with ASTM D6954.
- 272 Products placed on the market by all industries are not always properly made, and their properties are sometimes misrepresented. For this reason trading standards authorities exist in most countries.
- 273 Oxo-biodegradable plastic products are usually not made by the supplier of the masterbatch, and it is sometimes found that the manufacturer of the plastic product has applied the supplier's logo and made claims on or about the product, but has failed to include the correct masterbatch for that type of product at the correct concentration, and has sometimes not included any masterbatch at all.
- 274 In the case of oxo-biodegradable plastic (but not "compostable" plastic) it is easy for trading-standards officers to perform random checks, because there are hand-held devices available to them. They can also send samples to the BPA or any other suitable laboratory for testing, and they can ask for evidence that purchases of masterbatch by the manufacturer are consistent with the volume of products produced, and for evidence of type-approval of the product by testing according to ASTM D6954 or the other relevant Standards. Appropriate enforcement and adequate penalties will soon reduce the number of incorrectly made products on the market.

CONCLUSION

275 Policy options:

Once plastic is in the open environment:

- It cannot be recycled
- It cannot be collected at scale
- It cannot be “managed”

So the only options left are:

(1) Persistence and microplastics (the status quo)

- conventional plastics fragment → remain as plastic for decades

(2) Environmental degradation

- abiotic → biotic transformation – oxo-biodegradable technology

In the absence of reliable evidence that oxo biodegradable materials create greater environmental harm than conventional plastics, a prohibition on such materials lacks a rational basis, and would favour persistent pollution over mitigation.