Bioplastics NEWS

The Come Back of Plastic Bags, Compostable Plastic Not Wanted and EASAC

Michael Stephen, an international expert on bioplastics, shares his thoughts and opinion on important issues impacting the bioplastics industry. Today, Michael writes about the come back of plastic bags, compostable plastic not wanted, connecticut and the EASAC report.

Michael Stephen

Come back lightweight plastic bags – all is forgiven!

The Daily Signal said on 24th March that "Mindless virtue signalling doesn't fare well in a real crisis." (Article).

"As the US and the world confront a deadly pandemic, and citizens, businesses, and governments do all they can to tamp down the spread of the coronavirus, some useless measures instituted in less turbulent times will go by the wayside. One of these useless measures is plastic bag bans, which have been proliferating in recent years with the aid of environmental activists."

On 25th March, the Mayor of Boston announced a suspension of its plastic bag ban for essential businesses, in order to promote health safety and give them flexibility amid the coronavirus public health

crisis.

In Haverhill, Mass. The Mayor lifted the plastic bag ban on 26th March until the coronavirus crisis is over. The Mayor's office said, "reusable shopping bags, typically made of cloth or a similar material, … are believed to hold bacteria and possible viruses."

On 25th March the Governor of Massachusetts announced temporary ban on reusable bags.

In Canada, the Regional Council of Wood-Buffalo has suspended their plastic bag ban. (**Article**)

The Plastics Industry Association of the US has sent to the Department of Health and Human Services asking that the department speak out against bans on lightweight plastic bags as a public safety risk, and help stop the rush to ban these products by environmentalists and elected officials that puts consumers and workers at risk.

In New York, New Jersey and other states, the plastics industry and some legislators are calling for rollbacks or easing of prohibitions on single-use plastic bags, arguing that often-unwashed reusable bags are hotbeds for the coronavirus.

Inevitably the bag-banners are fighting back, by trying to portray this as a left-v-right political issue or as Big Business-v-Little People. It is neither.

They are also saying it is a scientifically questionable theory that reusable bags pose an increased risk of spreading COVID-19, but you don't have to be a scientist to realise that a new lightweight bag given to you at the checkout is less likely to spread disease than a bag used time and time again.

It is obvious that any food-residue inside the bag will be a breeding-ground for dangerous microbes. People do not always turn these reusable bags inside-out and disinfect them thoroughly between each trip to the supermarket, and it is not safe to assume that they do.

The bag-banners say that that lightweight plastic bags were exacerbating climate change and destroying the ocean – now that really is a scientifically questionable theory! Not least because they represent only 0.6% of plastic litter.

Plastic straws are particularly important now, as they minimise transmission of disease to the lips. The straws should all be made oxo-biodegradable in case they escape into the open environment

"Compostable" Plastic Not Wanted

On 17th March I drew attention to the rejection of "compostable" plastics by industrial composters and waste-managers around the world.

Yesterday I noticed the advice to householders from the local authority in my home-town as follows:

"You can line your food-waste caddy with plastic bags or liners, which makes it easier, cleaner and cheaper to recycle your food. You can use anything from old shopping bags to bread or salad bags – and you can continue to use newspaper or compostable liners."

Then they explain that "New machinery splits and removes the bags or liners, which are then taken to the energy-from-waste plant to be turned in to electricity."

So, the food-waste is not being composted in "compostable" plastic bags. All the bags are being removed and sent for incineration, so I will not be buying these expensive "compostable" plastic bags, which seem to be a complete waste of money.

Aggressive marketing has persuaded people that these bags convert into compost, but in fact they convert into greenhouse gas, and now we find that they are not even preferred for sending organic waste for composting or digestion.

Connecticut

The 2019 budget Bill exempted certified compostable bags from the plastic bag tax and eventual ban, but the compostable bag exemption has been stripped from the Bill. This was the right decision, as this type of plastic should never have been exempted in the first place.

According to the initial budget language a compostable plastic bag was defined as one that conforms to the American Society of Testing Materials standards and "is capable of undergoing biological decomposition in a compost site such that the material breaks down into carbon dioxide, water, inorganic compounds and biomass at a rate consistent with known compostable materials" –

Yes, the key point is "in a compost site" because ASTM D6400 applies to biodegradation in the special conditions found in an industrial compost, and testing to this standard does not therefore prove that it breaks down naturally in soil. Also D6400 requires the plastic to convert into CO2 gas within 180 days. It does not convert into compost, and the last thing the planet needs is more CO2

The opponents of this exemption are correct when they say that "despite being derived from plant-based materials, bioplastics are still plastic. If not disposed of properly, they too can pollute having devastating impacts on our environment."

The main problem faced in Connecticut, and everywhere else in the world, is plastic which escapes into the open environment, and they had therefore chosen the wrong standard. They should exempt plastic which is tested according to ASTM D6954 for biodegradation under conditions found in the open environment.

EASAC

There are some useful findings in the March 2020 report by the European Academies Science Advisory Council (EASAC), which has annoyed the bio-based plastics industry. EASAC say:

- **Bio-based plastics**

"The term 'bio' does not equate to reduced environmental impact since alternative feedstocks to fossil fuels can be associated with high greenhouse gas emissions, competition with land for food, or driving land use change. To avoid misleading consumers, companies should quantify any environmental benefits claimed."

"LCAs of replacing oil with agricultural crops show that 'bio' feedstocks are not inherently more environmentally friendly than fossil fuels, which is the presumption projected in marketing 'bio' products."

"Applying the label of 'bio' offers a marketing option which has been taken up by some companies in labelling their PET bottles. However, alternative feedstocks can have major sustainability impacts (on land and water use, biodiversity, indirect GHG emissions and creating competition with food production) as is already a concern over current demand for crops for biofuels and bioenergy (e.g. Searchinger, 2009; PBL, 2012; EASAC, 2013; 2017c; IPBES, 2019). Moreover, with current technologies, bio-based plastics cannot be scaled up to meet more than a fraction of potential demand. "

"Replacing PE by a bio-PE would require almost all (93.5%) of global wheat production (Bucknell, 2019). Biomass used to make bio-based plastics should not compete, directly or indirectly, with food production, and should consist of unavoidable waste biomass, such as agricultural and forestry residues of lignocellulose and food supply chain waste. However, use for plastics competes with the use of the same wastes for renewable energy which are supported under the Renewable Energy Directive."

"Thus, even though there are applications where biopolymers are excellent, their overall merits should be evaluated on the basis of full LCAs, rather than on simplistic assumptions or claims that 'bio' signifies a lower environmental impact. The Expert Group considers that, to avoid misleading consumers, companies should have quantified any environmental benefits to support any such claims and that further improvement in the LCA methodology should be researched further."

"A general claim of biodegradability is unlikely to be valid if not accompanied by details of the conditions required; indeed, special conditions are often required such as anaerobic digesters or industrial composting (Albertsson and Hakkarainen, 2017)."

- **Composting**

"Over the timescale of organic recycling processes (composting and anaerobic digestion), most of the plastics biodegrade to only a limited extent, while some generate methane (Gómez and Michel, 2013) in the process. In general consumer use, PLA, starch-based and cellulosic fibre-based materials can be used for compostable packaging but their environmental degradability will depend not just on the environmental

conditions but also on the additives that have been added in processing; these may even prevent degradation (Lambert and Wagner, 2017)."

"Industrially compostable materials are not necessarily capable of being composted under the cooler and less controlled conditions of home-composting. Moreover, even when compostable, materials may not degrade in natural environments. Compostable packaging also interferes with plastic packaging recycling owing to its chemical structure and, if not separated, largescale production could seriously interfere with plastic recycling processes. As with the label 'bio', the appeal to the 'green consumer' of the label 'compostable' may not be based on sound environmental principles."

"Compostability in an industrial composter is achievable with several resins, but extension to wider consumer use is problematic owing to the limits of home composting and the adverse effects on recyclate quality when compostable blends end up mixed with other plastics. At the present state of technology, composting makes sense only when the plastic is contaminated by a substance that is also disposed of by composting: for example, compostable bags used in the closed loops of food waste recycling".

"Some retailers are not seeking to influence their supply chain, while some have chosen policies (e.g. compostable bags) that may interfere with the recycling system."

- **Durability**

"The durability and long life of plastics, which are beneficial characteristics during use, become disadvantages when they 'leak' into terrestrial, freshwater and marine environments, since their breakdown is slow or lacking, with most remaining in some form in the environment."

"Plastics with a degree of biodegradability have been developed but their potential is limited at present. The ideal target of a plastic that breaks down naturally in the environment remains elusive since most applications of plastics require durability, and it is a basic premise that a material which can degrade in the environment should not degrade during its shelf life."

"The most environmentally benign plastic would be a material that can break down through biological processes under a range of conditions to organic molecules and nutrients which can return to the natural environment (Shah et al., 2008). Potentially, such plastics can be produced either from crude oil or renewable resources, and there is no general rule that 'bio'-based materials are more degradable or compostable than those derived from fossil fuels (Adhikari et al., 2016); some may exhibit some degree of biodegradability while others may not be biodegradable at all."

This is the reason why oxo-biodegradable plastics were invented. They are stable in storage and for the useful life for which they are designed (which can be long or short), but if discarded in the open environment their molecular weight reduces rapidly so that they can be consumed by bacteria and recycled back into nature. Degradation and biodegradation are not of course immediate, but will occur much more rapidly than with ordinary plastic.

“Biodegradable plastics have been extensively researched since the early 1980s with agricultural mulches a prime marketing target, since the large amounts of PE used in mulches and silage bales are difficult and expensive to collect and recycle and persist in the soil, interfering with cultivation and harvesting. Several polyester plastics are available for mulching (PHA, PHB and PBS among others) as well as starch-based films, and have been tested on large-scale applications.”

“Biodegradable films are now available that can be ploughed in and subsequently degrade in the soil through the action of humidity and microorganisms, although costs per hectare of biodegradable materials are higher than PE film (for mulches in Spain, between 25% and 188% more expensive (Mari et al., 2019)).”

There are two reasons why oxo-biodegradable plastic is preferable to PHA, PHB and PBS. First, the degradation time can be programmed to fit the timescale required by the farmer for any specified crop. Second, it is much less expensive – and cost is hugely important in farming.

- **Plastic v The Alternatives**

“Plastic packaging usually provides the same function with significantly less material, so that less energy is required in production. In addition, reduced weight and lower volume than substitutes reduce transport space and energy use. In packaging that preserves food, reduced food loss also reduces emissions. Similar results have been obtained by other authors. Galli and Vechellio (2004) compared energy balances for PET versus glass bottles and HDPE versus paper sacks, while an analysis for the American Chemical Council (ACC, 2018) showed that other environmental impacts were lower for plastics than the materials likely to substitute for them (water, solid waste, nutrient emissions and effects on the ozone layer).”

“Comprehensive analyses of life cycle environmental impacts of various options for replacing single use LDPE shopping bags (Danish Environmental Protection Agency, 2018) have also demonstrated that replacements need to be used multiple times before any environmental benefit can be achieved relative to the base case of a single-use bag being used as a bin-liner and then incinerated.”

- **Recycling**

“Mass production of plastics uses high-throughput machines for injection or blow-moulding, sheet formation, extrusion and other processes, which require fine-tuning of the plastic feedstock’s properties to each machine’s operation. This demands a high-quality standard for any plastic that is recycled, since different distributions of molecular mass in the basic resin and unknown levels of contamination by additives from previous use may be incompatible with these processing machines.” This is why it is not worthwhile in economic or environmental terms to recycle low value contaminated packaging whose provenance is not known.

“Multiple recycling is limited by the scission of the polymer chains through heating and loss of properties relative to virgin material.” This is why a piece of plastic cannot be recycled indefinitely.

“Outside highly selective and well-separated container recycle streams (e.g. PET bottles), mixed packaging plastics are difficult to recycle, involve costs that are often higher than the price of virgin materials, and face quality challenges that are difficult to overcome. This is a fundamental problem arising from the inherent complexity of the different plastic uses which involve very sophisticated manipulation of the molecular structure of the resin combined with choice and refinement of additives.

“For instance, even LDPE films (without additives) will have different molecular structures adjusted to give the required thickness, strength and processability. Recycling even such simplified materials to make a material capable of being reused as feedstock for the same plastic film (closed loop) is thus only achievable with waste plastics with a similar composition: in other words, by separating according to each producer’s specific product.”

With general mixed plastics containing different resins, colours and a wide range of additives which are unknown and inseparable, it may become technically impossible to produce a recyclate of any value. This is why downcycling is the norm for any plastics other than PET and HDPE containers, and why waste handlers have depended on low-cost disposal routes through exports. The ideal circular model, in which most plastics can be recycled in a closed loop to new plastic products, can only work so far owing to the inherent technical shortcomings and limitations of the recycling process.”

“It is important to recognise that there is a balance to be struck between the energy costs of some separation and cleaning processes and the benefits of increased recycling. The value of mixed packaging plastics is so low that intensifying the separation of plastic household waste for recycling under currently available technologies may not be justified from a welfare perspective (Verrips et al., 2019b). For example, Gradus et al. (2017) found that the costs of avoided carbon dioxide from improved collection, sorting and recycling were high (€178 per tonne of carbon dioxide in the Netherlands).

“There will inevitably remain a substantial fraction of mixed plastics where the best (or least bad) solution will be to recover simpler chemical products or energy through chemical treatment, pyrolysis or ultimately incineration with energy recovery.

- **Microplastics**

“Macroplastics break down (primarily through exposure to ultraviolet light and physical abrasion) into fragments of various shapes and sizes, which are regarded as microplastics when they are smaller than 5 mm.”

“It is still unclear how far small plastic particles have different effects than naturally occurring sediments or organic particles of similar size in the seas, or in soils. This is in contrast to the many studies which have demonstrated the adverse effects of macroplastics especially on marine life. Consequently, the established adverse effects of macroplastics and their importance as a source of microplastics would support regulatory action continuing to focus on macroplastics.”

- **Oxo-Biodegradable Plastic**

“Polyethylene containing pro-oxidants disintegrates on exposure to heat, light, and oxygen into small fragments, thereby reducing their visibility, but the fragments do not further biodegrade into nutrients that can be used in natural processes.”

That assertion is not supported by either the 2011 or the 2012 literature reviews which are cited. They merely state that, at the time they were written, there was no clarity as to how long complete biodegradation could take.

The authors have misunderstood the whole point of oxo-biodegradability. “The degradation process is not only a fragmentation, but is an entire change of the material from a high molecular weight polymer, to monomeric and oligomeric fragments, and from hydrocarbon molecules to oxygen-containing molecules which can be bioassimilated.”

A report was published in 2017 by the Ellen MacArthur Foundation and endorsed by some of the world’s largest producers of the very plastic packaging which is polluting the oceans. The Report claimed that “oxo-degradable” plastics simply fragmented into tiny pieces of plastic – but having engaged with OPA scientists they no longer say that.

They now accept in their May 2019 report that “oxo-degradable” (they mean oxo-biodegradable) plastics are manufactured so that they can degrade faster than conventional plastics and that they do become biodegradable, but they say that “it is not yet possible accurately to predict the duration of the biodegradation for such plastics.”

Accurate prediction is impossible, because the speed of abiotic and biotic degradation is influenced by many extrinsic factors which vary from place to place and from time to time and for that reason a broad indication only can be given as to timescale. It is however possible to say with certainty that at any given time and place in the open environment an oxo-biodegradable plastic item will become biodegradable significantly more quickly than an ordinary plastic item. Sunlight and heat are not essential, but they will accelerate the process.

It is not important how long a particular piece of plastic in a particular place will take to biodegrade – the importance of oxo-biodegradable technology is that it will gradually reduce the overall burden of plastic in the environment.

EASAC say “Moreover the additives will have deleterious effects on recyclate quality if included with other plastics.” However, whilst almost all pre-consumer waste (eg factory offcuts) is recycled or reused, almost all post-consumer waste plastic is not. There are reasons for this, one of which is that a great deal of water is needed to wash post-consumer waste to make it useable, so the amount of waste-water generated is enormous. Moreover, this process leaves prodigious quantities of dirty solid waste, including biological waste that is hazardous and highly undesirable.

The recycling charity RECOUP says (“Recyclability by Design”) that “where plastic products are particularly lightweight and contaminated with other materials, the energy and resources used in a recycling process

may be more than those required for producing new plastics. In such cases recycling may not be the most environmentally sound option." It is too costly in financial and environmental terms to collect it, transport it, sort it, bail it, store it, and then reprocess it.

EASAC itself notes the limitations on recycling plastic, and says that "many plastics cannot be repeatedly recycled. Thermoset plastics (such as fiberglass and foams), which are made of polymers that become irreversibly rigid when they are heated, cannot be remelted or reshaped. This makes thermoset plastics difficult to recycle; often they can only be recycled into lower value products, which usually cannot be recycled themselves."

Recycling is sometimes used as an objection to biodegradable plastic, on the basis that it would contaminate a post-consumer waste stream, but this is clearly inapplicable if the relevant waste plastic is not going to be mechanically recycled anyway.

Although oxo-biodegradable plastic is used for low-value items which are not worth recycling, experts in Austria and South Africa have found it suitable for recycling with ordinary plastic if anyone still wanted to recycle it. See **article**

They also found that bio-based plastics are not recyclable.

- **Reusable Bags**

"An update (EIA, 2019b) showed that plastics use was still increasing overall, and that consumer behaviour has started to adapt to the availability of low-cost reusable 'bags-for-life'. Sales of these had risen to 1.5 billlion in 2019 (75% of the number of single-use bags given away in 2016), suggesting that many consumers are treating them in the same way as single-use bags. Since reusable bags must be used over four times to deliver a net environment benefit, the initial resource and GHG savings following the single-use charge have now been more than offset, leading to calls for much higher charges."

Not only must reusable bags be used over four times to deliver a net environment benefit, but the Coronavirus epidemic has focussed attention on their ability to spread disease. See above.

- **Bans and Restrictions**

"Media coverage of photogenic images may oversimplify the issues as well as seek to apportion blame which can lead policy-makers to seek simple short-term actions (a 'quick fix') rather than address the underlying problem. Elements of this have already been seen in measures to restrict plastic straws rather than address the primary use of difficult-to-recycle beverage containers and the limited recycle infrastructure."

"The European Commission reported to the Parliament that oxo-degradable plastics are not a solution to the environment problems of plastic leakage and that they are not suitable for long-term use, recycling or composting and has consequently included a ban on all oxo-degradable plastics in its SUP Directive."

This is partly correct for oxo-degradable plastic, but not for oxo-biodegradable plastic, which (a) does mitigate the environment problems of plastic leakage, by becoming biodegradable much more quickly than ordinary plastic (b) is not designed or marketed for long-term use, (c) can be recycled if anyone wants to recycle them (c) are not designed or marketed for composting, which is not in any event a suitable use for plastic, because "compostable" plastic converts into CO2, not compost.

The European Union has no scientific justification from its own scientific experts (ECHA) for any restriction of oxo-biodegradable plastic. See article

The Commission's concern was about the formation of microplastics, but ten months into the study ECHA advised that they were not convinced that microplastics were formed and requested more time. Instead the Commission closed the study and proceeded straight to legislation to impose a ban. This kind of behaviour has no place in a civilised legal system, and has brought the EU into disrepute.

Michael Stephen

Michael Stephen is a lawyer and was a member of the United Kingdom Parliament, where he served on the Environment Select Committee.

When he left Parliament Symphony Environmental Technologies Plc. attracted his attention because of his interest in the environment.

He is now Deputy Chairman of Symphony, which is listed on the AIM market of the London Stock Exchange, and is the founder and Chairman of the Oxo-biodegradable Plastics Association.

Earlier Postings in this Column

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- 14/1/20 – Plastiphobia and Bioplastics Definitions
- 21/1/20 – Composting, the European Union and Unemployment
- 30/1/20 – Plastiphobia, Malaysia and a Case Against Compostables and Paper
- 7/02/20 – Coronavirus, MPs Letter, Montreal, Australia and the Dominican Republic
- 14/02/20 – Oman, MacArthur Foundation, Stifling Innovation, South Africa and Compostable Plastics
- 24/02/20 – Serbia, India, Pakistan and European Bioplastics
- 03/03/20 – Plastic To Protect Health and Common Sense on Plastic
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- 17/03/20 – Greening our Way to Infection, Defra Warns Against Bioplastics and Montreal

- 24/03/20 – Ditch the Plastic Bag Ban and Inn-Probio

Interview with Michael Stephen

- Questions and Answers on OXO-Biodegradability

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