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School of Biological and Chemical Sciences

Mr. Mark Blainey,
European Chemicals Agency,
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Mark.BLAINEY@echa.europa.eu
May 3rd, 2018

Dear Mr Blainey,

Re: Response to the EU report on oxo-plastics, January 2018

I am writing to you as I am deeply concerned with the conclusions of the EU Commission's report[1] (16/01/18) and the subsequent proposal to ban oxo-plastics in the EU. I request that the proposal to ban oxo-plastic be retracted due to conclusions drawn from my own research outlined below.

Scientific Research at QMUL

I am a research scientist at Queen Mary, University of London, a member of the Russell Group of Universities and I have over 20 years' experience in the fields of biochemistry and microbiology. Over the last three years, together with a team of chemists and geobiologists, we have conducted a range of microbiological and biochemical tests to investigate the molecular mechanisms of plastic and polymer biodegradation.

Firstly, we have discovered that many of the testing methods used to date are insufficient to fully assess biodegradation and bio-toxicity[2,3]. Consequently, any previous conclusions reached on the bioavailability of any form of plastic do not give the full picture regarding the efficacy, environmental and biological impact of any part of the degradation process.

Importantly, we have applied our methods and compared the biodegradation of LDPE and oxo-LDPE in a fully defined and sealed environment by a bacterial species typical of a marine or a soil environment. Under these conditions we have observed significantly higher rates of carbon assimilation as a result of microbial activity once oxo-LDPE has undergone some degree of ageing[2]. Abiotic degradation of plastic causes a significant drop in the molecular weight of the oxo-polymer that is not observed for conventional LDPE. The oxidation of the polymer also makes the molecule more readily accessible for microbial mediated enzyme activity. 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[4]

[1] EU: *The impact of the use of oxo-degradable plastic, including oxo-degradable plastic carrier bags, on the environment* (2018).
[2] This work is currently undergoing peer review prior to publication in a scientific journal.
[3] Castro-Aguirre, E. *et al*. 2017. Insights on the aerobic biodegradation of polymers by analysis of evolved carbon dioxide in simulated composting conditions. *Polym. Degrad. Stab.* **137**, 251-71
[4] We have just begun testing plastic with environmental cultures and expect this work to be completed by the end of the year.

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[5], and not, as we have tested, a single species. Nonetheless, we clearly observed higher rates of oxo-plastic consumption compared to LDPE.

Further to my own research, I herewith include my direct response to several major features raised in the EU report that I urge be re-evaluated.

Addressing EU report

1. Research and science

The EU report states that experiments on oxo-LDPE are carried out "over too short a time span" and "give no conclusive evidence". This data will be forthcoming, as I have presented here, but rigorous, responsible, cross-disciplinary research of <u>any</u> type of plastic be it bio-based, biopolymer, oxo- or LDPE is costly and slow. To date, tests on oxo-plastic only compare against LDPE, where oxo-LDPE fares better. There are very few independent studies that subject all forms of plastic to the same conditions simultaneously. Until this has been carried out, there is no conclusive evidence to present any type of plastic as having a greater environmental impact.

I am troubled by the apparent desire of the EU Commission to discredit a single type of modified plastic; it does not send the positive innovative message that is needed. Further, the EU report heavily cites a single author that is dismissive of primary scientific sources[6]. Academic publications are subjected to severe scrutiny during the peer review process; provision of plastic from a company must be stated but does not force the scientist to present only data supporting a particular industry.

2. Fragmentation of plastic

Micro and nanoparticles exist in the open environment. They are a product of the breakdown process of LDPE released over the last 50 years. There is no technology available to remove it, though there is evidence of certain bacteria that have evolved to consume it[7]. These tiny pieces of plastic are part of a transitory phase during the disintegration of the polymer prior to inclusion in the carbon cycle. The EU report clearly acknowledges that oxo-plastic undergoes an accelerated rate of fragmentation, which could reduce entanglement and catastrophic ingestion by higher organisms. However, what has been omitted is that the oxo-plastic additive catalyses the depolymerisation of the primary carbon chain that makes a plastic bag. Not only is the physical plastic bag breaking down, but the long polymer hydrocarbon chain is oxidised and reduced in size, termed abiotic degradation. The lower molecular weight organic compounds are more readily assimilated by microorganisms as the molecules start to resemble naturally occurring compounds such as fatty acids[8]. I explained this directly to Commission officials in Brussels on 30th November 2017 as I wanted them to understand this fundamental point. I am concerned by the omission of this evidence from the Commission's report.

There is no evidence that standard LDPE undergoes any oxidation. Indeed only macroscopic and not molecular degeneration is observed. It is noteworthy that bio-based LDPE differs from LDPE only in the source of the carbon that comprises the backbone (coming from sugar cane rather than oil).

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[5] Dussud, C. *et al.* 2018. Evidence of niche partitioning among bacteria living on plastics, organic particles and surrounding seawaters. *Environmental Pollution.* **236,** 807-816

[6] Ellen MacArthur Foundation. 2017. Oxo-degradable plastic packaging is not a solution to plastic pollution and does not fit in a circular economy. Endnote 6. Less than 10% of references are peer reviewed scientific studies.

[7] Yang, J. *et al.* 2014. Evidence of Polyethylene Biodegradation by Bacterial Strains from the guts of Plastic-Eating Waxworms. *Environmental Science and Technology.* **48** (23). 13776-13784

[8] Kawai, F. *et al.* 2004. Comparative study on biodegradability of polyethylene wax by bacteria and fungi. *Polym. Degrad. Stab.* **86,** 105–114

Consequently, bio-based LDPE degrades in the exact same manner as LDPE *i.e.* slowly. Thus bio-based LDPE is not a better alternative than LDPE or oxo-LDPE. However, it is not included in the reference to ECHA.

3. Biodegradation in the marine environment

Previous reports[9] have attested to the lack of evidence for biodegradation of oxo-LDPE in the marine environment. There are no standards for any type of plastic under these conditions. We are working hard to address the lack of rigorous and non-polluting testing methods and have demonstrated, in the laboratory, that oxo-LDPE can be assimilated by bacteria commonly found in the oceans. I would find it irresponsible to impose powerful legislation with the little scientific data currently available.

4. Plastic in the food chain

The report rightly raises concern regarding incorporation of plastic into the food chain. However, there is no evidence to suggest that this is unique to oxo-plastic and rather that such assimilation will occur for all forms of plastic, be it bio-based, a true biopolymer, oxo- or LDPE. This is not a reason to ban a single form of plastic. Further, no toxic effects of the degradation of the specific oxo-LDPE additive have been shown either in our experiments or when subjected to standard testing methods.

Conclusions

There is no doubt that the current rate of plastic accumulation is unacceptable and new policies to restrict our reliance on plastic are needed. However, we still have very little understanding of the biological and chemical mechanisms of plastic breakdown. Importantly, we have no evidence at this point that any current commercially available form of plastic has greater toxicity during the degradation process. Indeed, oxo-plastic has been shown to have a higher rate of degradation compared to conventional LDPE, which is the main cause of accumulated plastic waste and microplastics.

To this end, I am surprised that the EU are proposing to ban a product that is certainly no worse than the unmodified LDPE that is not subject to the same action. Legislating against a single form of plastic is not the way to resolve the accumulation of many forms of poly-hydrocarbon but actively goes against EU policies that call for redesign and innovation.

I implore ECHA not to propose a restriction and allow more independent, scientific research to be carried out.

Yours sincerely,

Dr Ruth Rose

School of Biological and Chemical Sciences, Queen Mary University of London

[9] EU commission, Eunomia. (2016).The impact of the use of oxo-degradable plastic on the environment.

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Mr. Mark Blainey

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Finland

Pisa, 9th May 2018

Mark.BLAINEY@echa.europe.eu

Respectful Mr. Blainey,

I had recently discovered that the European Commission has made reference to European Chemicals Agency (ECHA) under Article 69 (1) of REACH, alleging that Oxo - Biodegradable Plastics constitute a risk to human health and environment.

By looking at that question from my more than half century involvement in R&D activities in Polymer Science & Technology at Academic & Industrial level, let me say that I think it would be a serious mistake if Oxo-biodegradable Polymeric Materials & Relevant Plastic Items(OBPs) would be banned or restricted in the EU. It is not correct to say that OBP technology produces just fragments of plastic, and I cannot agree with the January 2018 Report of the Commission that there is any case for banning or restricting them.

In OBP, very small amounts of pro-oxidant/pro-degradant additives (1-2% by weight) are added to conventional formulations of PE and PP during their processing to make relatively short service-life packaging items or mulching films. This causes oxidative degradation much more quickly than in conventional plastics, and converts the plastic into oxygen-containing which are known to be biodegraded by microorganisms present in the terrestrial and aquatic environmental compartments. All this happens under normal conditions, and no special conditions are necessary. Light and heat will accelerate the oxidation process of OBP but they are not essential, and nor is moisture essential for this process.

The biodegradation produces H_2O, CO_2 and Cell Biomass, but under anaerobiosis, instead of CO_2 there is production of methane so it is not desirable for anything to biodegrade deep in Landfill.

Recently in the scientific literature it has been reported that the PE oxidized material can be converted by specific microorganisms like *Ralstonia Eutropha* to poly(hydroxy alkanoate)s as reserve materials.

The use of pro-oxidant/pro-degradant additives based on fatty acid salts of transition metals like Fe, Co, Mn, Ni is safe and the very small amount used in OBPs is justified by their tandem role in the regeneration of the "redox" action.

The OBPs, once they have experienced oxidative degradation by spontaneous or induced environmental ageing, are not going to accumulate in the various environmental compartments, thus ruling out any addition to the environmental burden of "microplastics".

Also, I want to stress that contrary to the allegation that OBPs can cause problems in the recycling of PE & PP plastic items at the end of their service life, I have never heard any reports of any such problems. There are in addition scientific publications including two authoritative Reports (see attachments of the first pages of the Reports available on request) stating their compatibility with mechanical recycling.

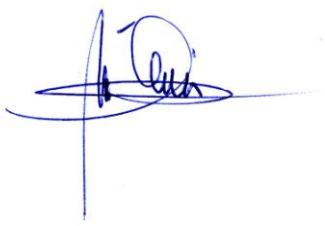
As a conclusion let me say that OBPs must continue to be available in the European Union because they are much better for the environment than conventional plastic and do not present any risks to human health or the environment. Their position in commodity packaging is placing no demands on resources from feed & food chains, and they can be made by existing plastic factories without any problems.

The above considerations are validated by the research activities performed over many years by the Research Group I was directing (see attachment) as well as from the contributions given by international research groups from all over the world. (see attachment)

I am attaching quite a few docs including my CV that I hope might be useful to you for understanding my position in favour of OBPs. If you need some other inputs and clarifying elements on the points that I have raised in the present letter and relevant attached files I would be more than pleased to satisfy your requests.

As you most likely are aware, OBPs are being accepted in Developed as well as in Developing Countries and Countries in transition, and in some countries there is legislation which makes them mandatory. They are not dependent on land and freshwater resources needed for the ever growing demand for food and feed applications as the World population is expected to reach from the present 7Bn something like 10 Bn in year 2050.

Yours-Sincerely.



Emo-Chiellini.

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Comments on the request to the European Chemical Agency to prepare a restriction to oxo-biodegradable plastics

We have taken note of the request from the European Commission on the restriction proposal on oxo-biodegradable plastics (OBP). As motivation, three main reasons are given by the commission:

1. OBP may not degrade under all relevant environmental conditions
2. OBP could negatively impact on the quality of plastic recyclates
3. OBP constitutes a potential risk to the environment because of their potential to generate microplastics

In our opinion, as it stands, this request provides no scientific based reasons for the proposed restriction on used of oxo-biodegradable plastics.

Plastics derive their mechanical properties from their long chains. Thus, biodegradation of all types of polymers (both synthetic and natural) requires an abiotic chemical process to cleave the chains to molecules small enough to penetrate the cell membrane to be metabolized. Consequently, the rate of degradation of polymers depends on the type of polymer and environment (temperature, oxygen, moisture, etc.). OBP are identical to conventional plastics but containing small amounts of prodegradant additives.

Comment to reason 1 – The term "biodegradable" is only meaningful if the environment and the period is specified. For this reason there are various standard test methods to verify biodegradability under specific conditions e.g. ISO 14855 - ultimate biodegradability under controlled composting conditions, ISO 17556 - ultimate biodegradability in soil, EN 14987 - disposability in waste water treatment plants, ISO 14853 - ultimate anaerobic biodegradation in an aqueous system, etc. Consequently, the first argument applies to all biodegradable materials not only to OBP.

Comment to reason 2 – OBP have the same properties as the corresponding conventional plastics. They are also designed to have a certain service life using stabilizers before they start to degrade. It has been proven in several studies that OBP can be recycled together with corresponding conventional materials without negative impact on quality of recyclates. Furthermore, consumption of the OBP materials is negligible compared to the total demand for plastics. In this context, the presence of small amounts of OBP will not have any significance for the quality and long term properties of the recylates. This has been proven in an experimental work, reported in the scientific paper (*Polymer Degradation and Stability 97 (2012) p. 316-321*).

Comment to reason 3 – As mentioned above, polymer based materials derive their mechanical properties from their long chains. However, hydrocarbon polymers contain structural elements that are susceptible to oxidative degradation reactions. Therefore, they always contain stabilizers that are used to protect the polymer during melt processing and to protect the finished article upon exposure to light and air. During use, the stabilizers are continuously consumed and when they are gone the degradation process begins. It can be emphasized that the mechanism of oxidation is essentially the same with or without prodegradants but the prodegradants significantly accelerate the oxidation. Microplastics are always formed as intermediate in the degradation process regardless of whether it is regular plastic or OBP but the period between the beginning of degradation and bioassimilation is much shorter for OBP. Consequently, OBP should constitute less risk if any to the environment regarding microplastics formation.

Finally

OBD materials are not a general solution to the environmental problems but they provide benefits for the environment in some specific applications in the same way as other biodegradable materials do.

RISE Research Institutes of Sweden AB
Energy and circular economy

Ignacy Jakubowicz
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Comments on Oxo-Biodegradable Plastics

Graham Swift, Ph.D., Polymer Consultants, 10378 Eastchurch, Chapel Hill, NC 27517, USA.

Before commenting on the novel and unique chemistry of oxo-biodegradable plastics I would like to introduce myself to the reader by outlining and summarizing my substantial experience in plastics so that it is clearly understood that what I am writing has a sound and unbiased foundation.

- I am a graduate of the University of London with B.Sc. (1961) and Ph.D. (1964) degrees.

- I worked in the polymer and plastics industry in the USA for over 30 years and hold more than 100 US Patent in those fields and I have published widely and lectured internationally as an invited speaker.

- I have developed biodegradable water-soluble polymers and also plastics for a variety of applications.

- On retiring from Industry, I was invited to consult with many international corporations and formed by own consulting company as indicated above. In this capacity, I have helped to develop or advised on progress in all aspects of the biodegradable plastics industry, including the one under consideration: OXO-BIODEGRADABLE PLASTICS.

- I have been a member of the ASTM D20.96, the committee charged with developing standards for testing biodegradable plastics, since its inception and I currently serve as vice chairman. During this time, I have written and or commented on every standard developed and now in existence and used worldwide.

- I am totally committed to a maintaining a sustainable and healthy environment on this planet.

My comments, in response to the Report of the European Commission, should be considered seriously before action by the European Parliament and the Council.

Comments:

You have correctly outlined the major issues facing ALL biodegradable plastics:

- biodegradability in various environments,
- environmental impacts in regards to litter,
- the potential for recycle.

What I do find, though, is your hypotheses and assumptions on oxo-biodegradable plastics are somewhat shortsighted or hyperinflated based on an obvious biased and limited appreciation for their role in the key areas which we agree are very important for all of us.

Biodegradation is a common process in nature for the recycle of all organic materials through enzymatic degradation, assimilation and utilization by living organisms. The products of this process which can occur in the presence or absence of oxygen, aerobic or anaerobic respectively, are gases, water, and biomass. In nature, many mechanisms are operative and different time scales are apparent for materials with different composition and different applications or roles they function in; for example, hydrophilic materials such as celluloses are "fast biodegraders" and hydrophobic materials such as lignin are extremely "slow biodegraders". Slow biodegraders, like lignin, may take years to biodegrade in two stages, the first is abiotic degradation promoted by enzymes such as laccases and peroxidases to produce low molecular weight organic compounds that are then biodegraded and assimilated by appropriate micro-organisms. Such oxo-biodegradation processes may take many years.

The organic material under consideration, oxo-biodegradable plastics, are based on polyolefins which are recognized as slow to biodegrade due to several well-known similar factors as exhibited by lignins, including their hydrophobicity, as established by many researchers, notably Professors Ann-Christine Albertsson and Gerald Scott. In an effort to make these hydrophobic staples of the plastics industry, inexpensive and convenient properties for many applications, much research has been conducted to enhance their biodegradation rate. Oxo-biodegradable plastics are a result of this continuing research based on mimicking natural enzymatic oxidation processes which breakdown natural hydrophobic materials, such as lignin. Small amounts of transition metal catalyst termed pro-degradants enhance the oxidative degradation of high molecular weight and hydrophobic polyolefins to lower molecular weight oxygenated, common organic compounds, materials which are readily biodegraded by micro-organisms. The rate and degree of the oxidation phase leading to low molecular weight biodegradable organic compounds has certainly not been optimized at this stage of development, even though there are viable and useful commercial products. Hence, it is a highly irregular intervention in science to even consider restricting the use of oxo-biodegradable plastics, rather than indicating their short comings to be addressed (which producers are aware of) and to focus their future development in applications and disposal sites where they offer value to everyone, producer, consumer and the government.

Application Opportunities and Disposal Options for Oxo-Biodegradable Plastics

As the name implies, oxo-biodegradable plastics were developed primarily for their use in areas and applications where their disposal will be in the presence of air such that on disposal abiotic oxidation is followed by aerobic biodegradation.

Hydrophobic Plastic + O2 >> Oxidized Organic Chemicals + Microbial Activity >> CO2 +Biomass

Little is known of their behavior in anaerobic environments, though research is beginning to shed light on the potential for biodegradation under such conditions, as will be discussed briefly.

Compost(Aerobic):

At present, it is not possible to compost oxo-biodegradable plastics to achieve the degree of biodegradation that is mandated for plastics designed for that disposal medium. The time constraints are just not possible to meet given the stage of their development of this technology.

Soil(Aerobic):

Mulch film is a great application for oxo-biodegradable plastics where it has indeed found wide acceptance. It offers film properties with controlled short-term degradation and biodegradation after the task is complete obviating the need for tedious and expensive clean-up. Interestingly there is evidence in this longtime application that refutes some of the criticism levelled at oxo-biodegradable plastics. Notably, the oft claimed long-term accumulation of plastic because of slow biodegradation and long-term toxicity of the soil environment because of metals accumulation. Neither has been substantiated with no evidence of soil deterioration or crop quality.

Landfill(anaerobic):

As the Report from the Commissioners indicates, landfills are complex disposal sites that have changing environments, initially aerobic and later anaerobic. I have written several reviews of this disposal medium and also done field and laboratory experiments with oxo-biodegradable plastics introduced into such environments. Contrary, to some opinions, landfills are generally not tombs for organic material. They are active microbial environments that can result in the degradation and biodegradation of organic materials under either of the environmental conditions mentioned. I have published work from research on oxo-biodegradable plastic in a UK landfill where molecular weight (Mw) of the plastic decreased from well over 100,000 to <5000, clearly in a range where biodegradation could occur. More recently (yet to be published), a similar plastic evaluated under anaerobic landfill conditions in an ASTM test

method (D5511) biodegraded over 50 % in about 700 days indicating a life time of <<100's of years.

Given that off-gases from landfill biodegradation can be and are being captured for energy generation, this is an obvious opportunity for the recycle of oxo-biodegradable plastics which can be optimized and accelerated by utilizing anaerobic bioreactors.

Litter(aerobic):

This phenomenon is not controlled and certainly a societal and environmental problem as the Report spells out for both land and sea pollution. However, it is hardly fair to lay the blame on any one plastic, let alone oxo-biodegradable plastics. Of all plastics in common use, oxo-biodegradable plastics are but a minor fraction and contribute very little to the eye-sores on land and the floating debris at sea. Additionally, the breakdown mechanism of oxo-biodegradable plastics to hydrophilic organic intermediates, hardly is consistent with the formation of hydrophobic nanoparticles that threaten the environment. Rather, the intermediates are likely water soluble or swellable.

Indeed, in the wide spread problem of litter, humans are the issue as in all (plastic) littering, that is where the problem should be attacked NOT by limiting valuable plastics which have contributed mightily to human comfort. Is this not avoiding the solution?

Recycle:

There are always concerns in any materials handling industry when new materials are introduced. Oxo-biodegradable plastics are no different. They do require identification and recognition that they contain prodegradant additives, but in many studies, there have been positive results with successful blending and re-use with other materials. This is an issue for the recyclers to address and implement changes given that oxo-biodegradable plastics are useful and have a place and need in their respective markets.

Testing Protocols:

Testing Protocols, including guides, methods, specifications for biodegradable plastics are widely accepted for evaluating plastics for disposal areas such as compost, water treatment plants, anaerobic digestors, and landfills. Most of these are focused on materials that biodegrade over a short time period and are useful for plastics specifically designed for such disposal. This has clearly encouraged the development of biodegradable plastics that have short lives and measurement is amenable to laboratory testing. There is an obvious omission of testing protocols for longer term biodegradation, such as is needed for oxo-biodegradable plastics. This is a critical omission in the testing arsenal and one that needs addressing, since plastics such as oxo biodegradables are not being fairly evaluated and false or premature conclusions are being drawn.

Conclusions:

I conclude from my experience that:

- There are real needs and opportunities at this moment for oxo-biodegradable plastics, including mulch films, gas production from anaerobic digestors and landfills where applicable, and recycle. In the future, as the technology advances and degradation control are more easily exerted, they will challenge other biodegradable plastics in short term applications.

- No government restrictions are needed on oxo-biodegradable plastics which are still in the infancy stage, based on natural processes, and likely to be of much broader utility than we now witness.

- New biodegradation tests need to be developed or current ones extended to include better environmental fate protocols for longer term biodegradable plastics such as oxo-biodegradable

- There is need for limitations on advertising of all biodegradable plastics, especially regarding claims beyond what is proven.

- Litter issues should also be address where the problem resides, with people irresponsible people.

Graham Swift

May 10, 2018

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Please allow me to introduce myself in a quick way. I am a professor of Environmental Sciences at the Federal Institute of Education, Science and Technology of Porto Alegre, RS, Brazil. I have a doctorate in materials science (conventional plastics) concluded in 1996 and another doctorate in soil science (biodegradable plastics) concluded in 2008. I ended up focusing more on oxobio materials, because they showed greater potential in the Brazilian plastics market and also in many other countries. Since then, I have been following articles on these materials, published in high-profile journals, and I have participated in many events to discuss materials with a lower environmental impact in many countries of the world. I worked for many years with several conventional plastic materials in a Brazilian petrochemical industry.

I have read the report of the European Commission on oxo-biodegradable plastic materials and clearly noticed some antipathy and a great lack of familiarity with these materials. I am very much in agreement with the urgent need for action to contain the growing plastic pollution throughout the Earth environment. However, in order to be fair and help to show the other side of the subject, I would like to share my experience with these oxo-biodegradable materials.

When I started my doctorate in biodegradable plastics, I was also very skeptical of these materials at their three test levels: oxidative degradation, biodegradation, and toxicity. I ended up changing my opinion, as the results showed that the

materials were actually biodegradable and showed no signs of toxicity (I did also plant-ecotoxicity tests after the thesis). I have got very significant information from a book by Professor Gerald Scott (1927-2013): “Polymers and the Environment” (RSC Paperbacks, 1999), where Scott describes natural and artificial polymers, and explains that oxobiodegradability is a natural phenomenon , that creates a very important component of soils: humus.

To date, I have not read an article published in a journal reporting any kind of toxicity of oxobio residues in the environment, and there is a growing number of papers describing measured biodegradability in different environments. I know some works that failed to measure biodegradability because, in my view, they were conducted in an inadequate manner or because they used an inadequate technique to evaluate the low rates of biodegradation (comparable to the biodegradation rates of humus). In my doctoral work, I used a very sensitive biodegradation detection technique developed by Chiellini in Italy, and modified according to the technique used in the Faculty of Agronomy of the Federal University of Rio Grande do Sul - Porto Alegre.

I would like to comment that I have carefully studied the structure and characteristics of the fragments formed with the oxidative degradation of oxobio plastics, because some people said that those fragments were nothing else than plastics of a reduced size and would only aggravate environmental pollution, because they could not be collected for recycling. This is a fundamental error which the Commission has made. In reality, I found that those fragments could not even be considered as plastics, because their structure and properties had become completely different. They are oligomers containing high concentrations of oxygen (especially as carbonyls), hydrophilic - useless as plastics, but useful as carbon and energy sources by environmental microorganisms.

In fact, I observed the formation of biofilm (of epiphytic organisms) on the surface of polyethylene films exposed to outdoor weathering for one year under 100% relative humidity. These fragments are formed even under adverse conditions. Often, I watch samples of oxobio film samples break up in my office in the dark. These fragments are biodegradable and certainly will not form a layer of plastic

on the surface of the oceans because they will be used by organisms present in the soil, air and in the aquatic bodies as a source of nutrients.

The biodegradation of oxobio plastic materials in aquatic environments was tested by Chielllini, among other researchers, and also by me. We noticed that it occurs quite clearly. The aquatic environment is particularly favorable to the degradation of these materials, because the types of plastic in which oxo technology is commonly used will float on the surface, where there is an abundance of oxygen and ultraviolet radiation, where the temperature is relatively high and where there is the continuous movement of the waves, introducing mechanical effort, which also helps to break the plastic molecules. Biodegradation is also accelerated by the presence of the organisms that make up the plankton.

I can understand the idea of circular economy, much advocated by the Ellen MacArthur Foundation, where end-of-life products are reused as raw materials for other products. However, in my way of thinking, this concept is unsuitable for plastics, since they are composed of organic matter, and as such are easily degraded by the action of the environment (heat, oxygen, UV radiation, etc.), but mainly of mechanical stresses and temperature during reprocessing. This makes the idea of 100% recyclability of plastics (maintaining the original properties) become utopian.

Furthermore, it is extremely difficult and costly to collect small pieces of plastic scattered in the environment and then clean, classify and reprocess them. Nevertheless, oxobio products are recyclable, because their service life can be adjusted through the antioxidant/pro-oxidant balance.

I would like to comment that natural polymers (inherently biodegradable) and hydrobiodegradable plastics are fantastic materials and deserve their place in the market. Some are made with very creative and admirable technologies. In order to evaluate which materials are most recommended - from the environmental point of view, the most current tool is the life cycle assessment, considering all the environmental impacts, from obtaining the raw materials and energy, to the

disposal or recycling at the end of their useful life. In this regard, in addition to the economic and processing difficulties, many hydrobio materials do not perform as satisfactorily as one would expect. In particular, the production of plastics from plants seems to me a reprehensible practice, since it presents among its consequences: deforestation and loss of biodiversity, soil degradation (nutrient export, erosion and compaction), water consumption, eutrophication, acidification, global warming, depletion of fossil fuels and minerals, etc.

We can not ignore the fact that biodegradable plastics made from plants, although they can be readily biodegradable under composting conditions, may be more impactful to the environment than conventional plastics made from petroleum.

In conclusion, I do not believe that oxobio products are a risk to humans or the environment. I do not think it is a good solution to ban them from the plastics market. But I believe that something must be done urgently to avoid the immense environmental pollution of conventional plastics, whose manufacturers insist on the utopia of recycling 100%. Oxobio may not be the ideal solution for the planet, but they are an excellent solution for the present and real world. In summary, I am in favour of the oxobio materials for our current world. Please do not let any type of biodegradable plastic be banned.

I will also upload this letter to section IV of: https://comments.echa.europa.eu/comments_cms/CallForEvidence.aspx?RObjectId=0b0236e18244dc70.

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Jiutepec, Morelos; May 4th 2018

Dear Mr Mark Blainey – ECHA-Heisinki

PRESENT

Whoever hereby subscribes, in my capacity as Technical Research and Development Manager and, moreover, as a member of the National System of Researchers, in the most attentive manner, I am writing to you, to express the following: The global accumulation of non-degradable products is one of the most important environmental concerns today. The use of degradable materials is an option to mitigate the environment or impact generated by the consumption of plastics. One of the technologies used for the manufacture and use of degradable plastics is the use of pro-degrading additives that are incorporated in conventional plastics to promote its degradation under certain conditions.

Based on scientific studies carried out by the Research Center in Applied Chemistry in 2011 under the direction of Dr. Mario H. Gutiérrez, it was demonstrated that polymers additivated with prodegradantes agents are susceptible to a molecular weight reduction close to 5000 Daltons, same reduction that occurred as a result of a thermal degradation followed by the protocol that marks ASTM D 5510-94 (2001). This result reaffirms that the generation of waste from thermal degradation is biologically ready to be consumed by microorganisms and non-microplastics that have high molecular weight.

On the other hand, experiments carried out with the Autonomous Metropolitan University, were carried out with the purpose of evaluating the oxidation, biodegradation and potential ecotoxicity process of the polyethylene films with the inclusion of an oxo-degradable additive, in accordance with ASTM D -6954. After 180 days of laboratory controlled composting, the samples reached the following percentages of biodegradation: polylactic acid, 41%; printed oxo-degradable polyethylene, 32.24%; oxo-degradable polyethylene, 25.84%; printed polyethylene, 18.23% and polyethylene, 13.48%. The cellulose used as a control sample was mineralized in 58.45%. The ecotoxicity evaluation showed that the biodegradation products of the analyzed samples did not generate a negative effect on the germination or development of the plant species studied.

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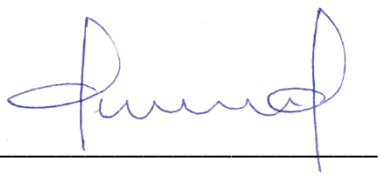
Under the proper management of waste conditions, these plastics can be used as an option to reduce the environmental impact of plastic films and / or packaging for food or various products. Since the inclusion of this technology suggests with scientific support based on ASTM 6954 the plastics analyzed show that there is fragmentation in the molecular chains of the polymer, in addition to the degradation products; under the conditions of analysis, they showed that none of the samples released toxic byproducts to the substrate at levels higher than those contained in the soil. In addition, the biodegradation of these plastics in a controlled system of compost did not generate toxic metabolites that affect the germination rate of the plants of the different species studied. These results indicate that oxodegradable plastics can be used safely, provided that the conditions for their correct biodegradation are met since they do not exhibit toxic effects for plant species and, according to the definition, no microplastics are produced.



PhD Adriana Reyes-Mayer
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Member of the National System of Researchers,

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Zagreb – Croatia

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To Mr. Mark Blainey,

ECHA,

Helsinki

Mark.BLAINEY@echa.europa.eu

9th May 2018

Dear Sir,

OXO-BIODEGRADABLE PLASTIC

I understand that ECHA has been requested by the EU Commission to advise whether OBP poses a risk to human health or the environment. I am quite sure that it does not, and I wish to make a contribution to your study of oxo-biodegradable plastic.

My basic education is chemical engineering in plastics processing and application. My scientific activity is in the field of photodegradation, gamma irradiation in plastic modification and stability. I was working for more than 30 years in petrochemical industry dealing with development of polyolefins in agricultural application as well as packaging. I have been working with oxo-biodegradable technology for the past seven years in Serbia, Croatia, Slovenia, Kosovo and Macedonia. It is very easy to use, and manufacturers and end-users are satisfied with it. I have heard of no problems with recycling.

I was very surprised that the EU Commission had made this reference to ECHA, and having read their report dated 16th January 2018 I think they are fundamentally mistaken. The purpose of incorporating a prodegradant masterbatch in a plastic product is not just to cause fragmentation, but to catalyse oxidation so that the molecular weight of the polymer reduces rapidly at the end of the useful life of the product and converts it into biodegradable materials.

A conventional plastic will perform in much the same way but it will persist in the environment for a much longer period. It will fragment under the influence of uv light but the fragments will have a molecular weight for several decades which is too high to enable biodegradation.

The time that the abiotic process takes is the rate-determining step, for once the material becomes biodegradable it will be assimilated by the micro-organisms in much the same timescale as they would assimilate any other biodegradable material.

It is well understood that the abiotic process will be accelerated by light and heat, but they are not essential in the case of OBP, which will degrade much more quickly than conventional plastic under any given conditions in the environment so long as oxygen is present. Moisture is not necessary for the abiotic process.

Landfill is not relevant to OBP because it will not degrade (and will not therefore become biodegradable) in anaerobic conditions. This is an advantage, not a disadvantage, because biodegradation in anaerobic conditions generates methane, which is a dangerous greenhouse gas. Composting is not relevant either, as OBP is not designed to comply with the standards currently used for compostable plastic in the EU and is not marketed for that purpose.

Oxo-biodegradable technology is the only way we can deal with plastic which has escaped into the environment, and the governments of Slovenia, Serbia, Kosovo, Montenegro, Macedonia, and Albania have passed legislation in favour of it. Future generations in the Balkan countries will not thank ECHA if you try to deprive us of this technology.

Marica Mlinac Misak

Zagreb, May 9th 2018

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Mexico-City, May 20th 2018

To: European Chemicals Agency

Concerning the "Report from the Commission to the European Parliament and the Council" of 16th January 2018 on "the impact of the use of oxo–degradable plastic carrier bags, on the environment".

INAINE is a NGO that has more than 30 years supporting society in environmental management, technical issues and communication in order to favor sustainability in benefit of the planet.

We herewith want to express to the ECHA the experience on oxo-degradable plastics that we have had for the last five years in Mexico:

1. We could determine without doubt, that the resulting particles after the whole process of oxo–biodegradation are not plastic in nature anymore, but the components of it like aldehyde, esters and ketones.
2. We observed that the resulting particles of oxo–biodegradation are colonized by bacteria and that these bacteria feed form the resulting particles.
3. BIMBO, the biggest bakery in the world, with Head Office in Mexico, has been using successfully oxo–biodegradable additives in their bread bags for the last five years.
4. We have scrutinized scientific papers that demonstrate that the resulting particles from oxo–biodegradation are non toxic for plants and marine organisms.

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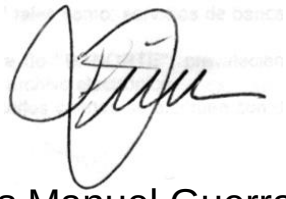
We are convinced that the addition of oxo–biodegradable additives is part of an integral solution to the pollution caused by microplastics, and we wish to continue using them in Mexico to protect our environment from the long–term accumulation of plastic waste and plastic particles.



Luis Manuel Guerra
President

Pablo Hurtado
Scientific Director