

The Need to Clarify Disposal Options for Plastics

By DrRossH

Introduction

The options for making degradable plastics seems to be changing quickly these days, or more importantly, more attention is being given to the concept. More companies are offering a degradable plastic carry bag or a degradable drink bottle for their goods. However in an attempt to present their company as green, there is considerable confusion arising on the consumer side as to what the degradable statement on the product really means. Some of this may be intentional by the sellers to over promote their image. However it also appears the sellers themselves do not always understand what they are using and are relying on their supplier of the degradable item to tell them the item is degradable. The sellers are then just passing on the degradable item thinking it is green but not knowing the true definition or process by which degradation can actually occur.

Summary

Informing consumers on making educated decisions about disposal of their plastic waste would minimise the plastic trash that is collecting and lasting for hundreds of years in our landfills. To achieve this, a second symbol imprinted on the item, just like the recycling number is currently, could be used to show the designated disposal method for that plastic item. Consumers could then make the 'best choice' on where to dispose of the item. This too would bring to the surface the pros and cons of the more common degradable options being pushed by industry today.

The Situation Today

Some examples of common day to day items and their confusing labelling are listed below.

- 1) Plastic bag label 'Dog Waste Bag. We care for our environment.' Claim: 'This bag will totally degrade* after disposal. * ASTM D6954-04' Conclusion: This is an ASTM standard for composting. This bag will only degrade in a compost pile not simply after disposal.
- 2) Plastic bag from 7-Eleven. Claim: 'This bag will degrade* in a landfill. * According to standard ASTM D6954:04' Conclusion: An oxodegradable additive was used in this bag as there was the d2W symbol on it. This is the symbol of Symphony Environmental Technologies. There are several things not correct with this claim. The claim of degrading in a landfill is only partially correct. It has to be in an area where oxygen is present (first meter or less of the fill) or it will not degrade. It says it will degrade according to a standard D6954.

D6954 is not a standard but only a guide for comparing materials. From the ASTM definitions of this guide(1), ASTM write these comments; *'The guide will permit the comparison and ranking of the overall rate of environmental degradation of plastics that require thermal or photo-oxidation to initiate degradation.'* Then it goes on to say; *'The correlation of results from this guide to actual disposal environments (for example, agricultural mulch films, composting, or landfill applications) has not been determined, and as such, the results should be used only for comparative and ranking purposes'*.



3) Plastic bag from Whitcoulls. Claim: 'This environmentally friendly bag is 100% degradable' The company was contacted on this twice and they replied they had forwarded the question on to the appropriate department. No further reply was received. Conclusion: May be an oxodegradable additive was used. No disposal information provided on the bag.

4) Plastic bag label 'Pharmacy Caring for our Environment.' Claim: '100% Degradable bag. This bag will degrade in a landfill site leaving no harmful residues'. Company did not reply to multiple email requests which asked exactly what this statement means. Conclusion: An additive has been used to induce biological degradation. No validation test method cited.



5) Plastic cutlery spoon from 'Taterware.' Claim: the word 'Biodegradable' is printed on the spoon. Their website states these items will only degrade in a compost facility. Conclusion: This spoon will only degrade in a compost pile it will not biodegrade anywhere else.

6) Disposable Water bottles made from PLA. Claim: 'PLA water bottles environmentally friendly Biodegradable materials. (2)' Conclusion: PLA will only biodegrade under certain conditions where temperature and oxygen are required to break it down. Without those conditions, PLA does not break down (3). This makes claims about PLA being environmentally friendly both confusing and misleading.

- 7) Plastic bag label 'We care for our environment. Envirogreen degradable bag. Please Reuse this Recyclable Bag'. Claim: 'Activated by heat & Sunlight'. Company name of EPI on bag. Conclusion: EPI website presents oxodegradable additives.

From the above examples, it can be seen how the average consumer, who doesn't understand any of the technicalities of this field, would not know what to do and could be misled into thinking what degradable means. The normal method of disposal of our trash is through curb side collections and dumping to a landfill. Some municipalities include recycling in their pickups, however plastic bags are not allowed in that collection. Of the collected recycled material, some of it is still dumped, depending on what a sampling of the load for recycling compliance yields. People who get a drink while away from home, perhaps when driving, or walking in a park or along a beach, most often dispose of the plastic bottle and the plastic bag by dumping them in a trash bin (sometimes due to lack of recycle containers). Those items then go to a landfill. Therefore, a good percentage of recyclable plastic is still going directly to landfills. In Australia 65% of bottles go to landfills (4). Since plastic bags are not recyclable, then almost all bags go to landfills. The same happens with plastic cutlery, plastic lids and plastic straws; they all go to landfill or end up as litter.

The Main Current Options for Degradation

A 2002 report written for the Environment Australia titled Biodegradable Plastics –Developments and Environmental Impacts (5) presents a comprehensive but general description of the state of the degradable industry at that time. In addition to other pertinent factors, it presents a fairly wide covering of degradability options including some that are not commonly used.

The three main ones referred to either directly printed on the packaging or implied to with the mention of a standards test, are:

- 1) **Compostable**. Those items that only degrade in a commercial composting facility will not degrade outside of a compost facility. Outside of a facility, they will remain in existence just as long as a non biodegradable item does, hundreds of years or more. How would a consumer know this?
- 2) **Oxo-degradable**. These plastic items require sunlight or oxygen and heat to degrade. This implies they need to 'lie' around in the environment to decompose. Case in point, the EPI additive supplier, listed in one of the examples above, mentions (6) a test they did to illustrate the degradation of plastic bags with their additive. For the test they 'hung the bags on a fence' in the sunlight! In trying to control plastic debris we do not want to have plastics that require to be left on the ground or in the ocean where they can get sunlight and oxygen. This would cause them to break down to smaller and smaller pieces, not to mention

the litter aspect of this process. Also for the case with oxodegradable plastics, this is degradation based on time. So it precludes a plastic item that has been treated with an oxodegradable additive from being recycled, as the new product would start degrading whether the user wanted it to or not. The most common method of disposal for one-off use plastic items, is for them to be dumped to a landfill and oxo-additives suppliers themselves admit the additive does not work in that setting. For the smaller fraction of plastics that do end up as litter and become caught in a tree or stuck in a waterway, the idea of having that plastic item break down into many smaller pieces seems a worse effect than just leaving the original plastic item in one piece. The biodegradable claim on these small pieces is in question from many sources (7). Also the plastic item cannot be put back in the recycle stream. It is difficult to comprehend how a plastic item that disintegrates into smaller and small pieces of plastic is good for the environment. These pieces can become so small and will blow around in the wind, or flow in moving water. Wildlife are particularly vulnerable to ingesting these particles. There are numerous reports of birds, fish, turtles and the other species that have multiple pieces of plastic in their stomachs. The plastic is not broken down by their digestive systems, and can accumulate in their bodies. In cases such as turtles, the plastic makes them more buoyant and they can no longer dive underwater to find food. They get trapped on the surface and starve. Researchers have estimated that for every 1 kilogram (2.2 pounds) of plankton in the Great Pacific Garbage Patch in the Pacific Ocean, there is 6 kilograms (13.2 pounds) of plastic. (8)

It is easy to comprehend why most consumers who have no knowledge of the ins and outs of these treated plastics become confused. Prior to the time non degradable plastic bags started to become banned in various locations, there were few options available to produce a degradable bag. This is the time the entry of oxo-degradable additives seems to have found their place. South Australia is a case in point. They allow oxo-degradable bags but not non degradable bags. Considering the above comments, it is not clear what benefit South Australia has picked up at all from allowing oxo-degradable additives. From (9) *'Surely a ban on oxo-degradable plastic would be more appropriate and the issue of non-biodegradable plastic tackled through recycling incentives and/or a switch to truly biodegradable or compostable plastic?'*

From the OxoAlliance (10) themselves, when replying to the question; "Oxo products biodegrade, but do they in the landfill?"

Answer: This is a tricky issue. Are we talking about a dry landfill? What about a wet landfill? Cold? Hot? What about a regularly turned landfill? Deep inside a landfill nothing

biodegrades. It is like a tomb. No air and no UV light, which are the triggers to start the oxobiodegradation process.

The goal of Oxo is for the biodegradation to take place out in the open environment where we find unsightly trash, and on the top levels of landfills or in regularly turned landfills.

Oxobiodegradable plastic does not biodegrade deep in a landfill because there is no oxygen.

The Oxoalliance does not support companies who claim oxo biodegrades in a landfill.

- 3) **Landfill Biodegradable.** If the biodegradation time is not unrealistic by scientific terms, and it can be done in a landfill, then this seems to be a better solution to degrade our plastic waste. No special conditions are required such as composting, the consumer does not have to be concerned about finding one of those few and far between composting facilities. They simply dispose the item into their trash. 2008 was a landmark year in the field of plastic biodegradation. This was the year a commercial additive was made available (11). This additive could be added to a plastic at the time of extrusion in order to make that plastic into a biodegradable product which has normal (discard to trash) consumer disposal methods. Adding one of these biodegradable additives still allows the plastic item to be put back into the recycling stream as well. Actually it is preferable as that would then give the recycled new product the ability to biodegrade when it was eventually disposed to a landfill.

Proper Disposal Method Identification Required

There needs to be a standard disposal method identifier on every plastic item that is manufactured. Simply putting the claim degradable or biodegradable on a plastic item is misleading. It can falsely lead consumers to make assumptions about the product's disposal that can do more environmental damage even though they are trying to do the right thing.

It would be fairly safe to assume that most consumers would not be in support of a degradable plastic that had undesirable benefits on the environment and on wildlife, if they were provided the proper information in a simple to understand manner.

AS14021 (12) touches on the topic of how a consumer should be informed with what the labelling on a plastic item can declare. It states:

5.7 Specific requirements

Self-declared environmental claims and any explanatory statements are subject to all requirements in 5.7. Such claims, including any explanatory statement, shall be presented in a manner that clearly indicates that the environmental claim and explanatory statement should be read together. The

explanatory statement shall be of reasonable size and in reasonable proximity to the environmental claim it accompanies

This is both valid and necessary information needed to educate the consumer, but it fails to tell the consumer how to dispose of the item. This standard is now 11 years old and from the examples provided at the beginning of this article, it can be seen that this standard is not being followed by those manufacturers.

Current Definitions for Methods of Degradation are Confusing

There are numerous definitions available which helps leads to confusion for the manufacturers on how to label their products. Appendix 1 lists two such definitions. Compostability and biodegradation are the definitions that seem to get the most attention. Some manufacturers try to label their products with a definition that is based on actual test data, yet regulatory agencies coming up with their own definitions can make it difficult to produce a label that makes any sense. In most cases the regulatory agencies are guided by independent boards. However, when a deeper look is taken, some of them are not so independent. Consider California late in 2010 for example. A bill was being pushed through that was touted as putting a stop to false environmentally green claims by manufacturers, which were confusing the consumers.

State Bill [SB 1454](#) (13) will require all products and packaging that want to use the term biodegradable to pass legitimate verifiable end-of-life tests known as ASTM standard specifications (specifically ASTM D6400 and D6868). These standards are already in use today to certify that products are compostable and that they will breakdown in a commercial composting environment within a 180 day period

ASTM D6400 and D6868 are standards for compostability and this bill was being pushed by the composting lobby to gain business. It would have been such a setback for the disposal of plastic products had it passed. Any item which was degradable by any other method, other than compostable, would have been disallowed to have any biodegradability claim on its packaging. Fortunately it was vetoed in the last few days of becoming law.

In Australia, the standard AS4736-2006 (14) titled, *Australian Standard Biodegradable Plastics— Biodegradable Plastics suitable for Composting and other Microbial Treatment*, has this statement in its' opening pages;

This Standard provides a basis to allow labelling of materials or products made from plastics as 'compostable', for use in such facilities as municipal or industrial composters. This Standard applies to the processing of plastics in controlled waste treatment plants

Again we see a strong bias to composting as the only way to achieve biodegradability.

If a manufacturer produced a biodegradable product that biodegrades in a landfill, it would not satisfy this standard.

In the USA the Federal Trade Commission (FTC) have asked the general public for their opinion on what the normal biodegradation time is understood to be and used that in their definition of biodegradation.⁽¹⁵⁾ This seems to be letting the public dictate what defines biodegradable and then requiring industry to follow this. It is similar to asking the general public how many miles per gallon (mpg) they think a fuel efficient car ought to get. If the public said 60mpg, then any cars that got less than 60 mpg would not be allowed to be sold as an efficient car. The general public currently expect to get about 30 mpg out of a compact car and less from a larger vehicle. Why do they have that belief? It's because that's what the vehicle industry can engineer at the moment and has done for the last 50 or so years. Hence, over time the public have learned what industry can do and that is where they base their expectations. They know if they buy a larger SUV they are not going to get 30 mpg from it.

However, in a relatively new field, such as landfill biodegradability, there can be no engineering based expectations by the general public as there is no historical data in this field. All the public knows is that a discarded item, such as a banana peel, will decay in a year or less. The FTC is saying plastics labelled as biodegradable must act according to current perception of biodegradation which is within one year. If we had 20 years of experience behind us and the public knew that it took about 7 years for a disposable plastic water bottle to biodegrade, then the FTC may be then happy to say these bottles should degrade in about 7 years.

What we need to appreciate is the time it takes for an item to biodegrade in a landfill. Do we really care if it takes 1 year, 5 years or 10 years for an item to biodegrade? No would dispute that a fallen tree in a forest was biodegrading away even if it took 30 years. Compare that with the hundreds or more years for the same non biodegradable plastic item. With landfill biodegradable plastics, we are way ahead. One way to consider this is we would like for products to biodegrade away within our generation so that we are not carrying trash forward to future generations. That is approximately 20 years. So if a water bottle or other plastic item biodegraded in 20 years, we should still be happy. It is a lot better situation than what we have currently.

This school of thought makes a winning situation to bring landfill biodegradability as a legitimate method to the forefront of eliminating plastic waste.

The industry and policy makers seem to have gotten too hung up on the definitions of each of these processes and lost sight of the desired end result, which is to get rid of plastic trash in a safe manner and in a shorter time.

- Compostable requires degradation at a certain minimum temperature, decay has to be within a certain number of days, and the item cannot be identifiable in the compost mix afterwards, etc.
- Biodegradable requires degradation in less than 1 year, and so on.

As mentioned above do we care if it is 60 days or 600 days? Whatever method achieves the result is a successful method and should be promoted as one of the options to use. The average consumer surely does not understand a commercial composting facility and most would not know how to find one. Even if they knew a location they probably would not drive across town to dump a few plastic bags. Their plastic waste just ends up in the trash headed for a landfill. Unless the composters want to take the trash themselves and sort it by pulling out the materials they could use, then composting currently has only a small role to play in waste management. Landfill biodegradation as defined above would have the largest role to play as it allows the consumer to discard their trash in their normal way. We, as a society, then reach our goal of not having plastic trash last for future generations to deal with.

What Consumers Need to Know

The industry has taught consumers over the recent years to look for a recycle number on the bottom of a plastic item. That tells the consumer only one thing: is this item recyclable or not? If they see a number within the triangle, then it is recyclable. What is really needed for consumers to know is how to dispose of a plastic item that is not shown to be recyclable or cannot be taken to a recycle bin. This is the only way to control this plastic trash we have now and which is growing worse. The current recycle number is really a note to the recycle companies how to deal with the item.

Consumers don't care if an item is PET or PE, etc. They just want to know how to dispose of the item the 'best' way. Compostable plastics need their own recycle number to differentiate them from other plastics. Compostable plastics need to be separated out of other plastic waste at the recycling centre, to not contaminate the plastic waste stream. This would also at least give a chance for compostable plastics to be collected and taken in bulk to a composting facility to biodegrade them away.

Therefore there needs to be an additional disposal symbol so the consumer can know what to do with a plastic item once they have finished using it. This concept is supported in the Key Recommendations of Reference (5) partially stated below;

For the successful introduction of degradable plastics into Australia it is essential that for any new application that the following are clearly identified:

- *disposal route;*
- *testing against nationally agreed standards to ensure that the disposal route is appropriate and is environmentally sustainable.*

For this to be achieved it will be necessary to establish a national framework for standards and testing.

Disposal Option Symbols Needed for Consumers

As mentioned above, what if, just as the recycle numbers are now, there was a second set of symbols moulded into or printed onto the plastic item? This would be a simple set of options to tell the average consumer what the designated disposal method is to be. Explanations of these symbols would be advertised in the various media along with how recycle numbers we now receive are advertised. For this article, the disposal symbols used are basic text in a box with a preferred disposal option format.

Recycle. Disposal path - Recycle If it can be recycled (evidenced by the triangle recycle symbol with a number in it), then it should be recycled. This applies to all common petroleum based plastics. Otherwise dispose to trash. All recyclable items with the recycle symbols on them would have this disposal option symbol on them too. As each recycling facility operates under different constraints, the recycling facility then makes the decision as to the final fate of the plastic item, i.e. sent off for recycling or landfilled.

Compostable plastics, : If compostable plastics do get their own unique recycling number, then they would be disposed of in with the Recycle group above. (The consumer does not need to know any special requirements of them). If compostable plastics do not have their own unique recycle number on them but are designated the number 7 ('other plastics') as they are now, then they need labelling as

Disposal path - Biodegradable in a Compost facility only or non Biodegradable in Rubbish

Designated disposal method is through a commercial compost facility. If none is available, dispose to trash. Consumers cannot be expected to drive a long way to take a plastic bag to a compost facility. Since there are few of these currently around, composting is really not a good way for plastics to be presented as degradable or biodegradable. If the item is not able to be composted then it is to be disposed to the trash then on to a landfill. There it will not degrade but last just like a non degradable plastic. This is very important for consumers to know.

Oxo-degradable.

Will fragment in air. Dispose to Waste. Do not Recycle

Designated disposal method is to trash. For this consumers ought to know that the only way this

plastic item will break down is by leaving it on the ground as litter for many months or years. These are not recyclable either so this creates another problem. The only valid disposal option for this is to go to a landfill where the item will not degrade. Again it is important for consumers to know this.

Landfill Biodegradable.

Landfill biodegradable only, Dispose to Waste

Designated disposal method is to dispose to trash. The item is biodegradable in a landfill or a compost pile (i.e. anaerobic or aerobic conditions) Consumers would know that they can dispose of the plastic item in their trash knowing it will degrade harmlessly away with a known time expectation. These products need to be tested to ASTM (or equivalent) standards of D5511 and D5988 and meet some minimum biodegradation amount in 120 days for this claim to be made. The test is to be carried out on a piece of the actual item or a piece with a minimum thickness of 1.5 mm whichever is thinner. No grinding to artificially increase the surface area and biodegradation rate of the sample is allowable. The plastics manufacturer has to make this information publically available on their website for consumers and regulatory agencies to review.

Not Biodegradable.

Non Biodegradable, Dispose to Waste

Designated disposal option is to trash. These items will not degrade and will persist for anywhere from hundreds to thousands of years possibly. Manufacturers ought to be responsible to pay a penalty for producing this type of plastic that has no environmental considerations. In Germany, non biodegradable plastics have a special tax on them to discourage their use.

This simple5 option disposal method guide is vitally important for the control of plastic waste as we go forward. There are too many 'green' pushers out there with big claims about their degradable plastics but who are actually confusing the consumer on degradability and doing the environment harm. Consumers are being kept in the dark about the real implications of these claims. From reading the above Disposal Option list it is obvious that the disposal to trash is by far the most prevalent path that would be used other than recycling. It strongly suggests that a landfill biodegradable additive be put in all consumer plastic whether they are going to be recycled or not, as that is the only way to ensure plastics will degrade away in a relatively short time. Other methods fail in this goal.

With the public educated on how to dispose of their plastic waste, many of them will see the shortcomings of some of the above mentioned disposal methods and more pressure will be put on manufacturers to produce degradable plastics that have preferred disposal methods. Rather than the industry lobbying policy makers dictating what methods are best (and best for whom?), the industry will be answering to the public on why their green claims are not so green.

Conclusion

The amount of plastic that has been manufactured in the last 50 years and dumped to landfills is substantial. Almost all of it is still there. More plastic has been discarded in the last ten years than the previous ten years. We are not able to sustain ourselves continuing down this path. A disposal methodology is urgently required to put an end to this and to get our plastic trash problem under

control. It's not meant to be left as a legacy for future generations to deal with. Manufacturers need to adjust their processes so they produce products that will biodegrade plus label them with a suitable disposal method for consumers to follow. Consumers need to adhere to these symbols and discard their plastic trash accordingly. A simple landfill biodegradation method is now available which allows plastics, when disposed as trash and sent to a landfill, to biodegrade away, producing humus or plant fertiliser. This is a back stop method only, and all attempts to reuse and recycle should be performed first to reuse those resources, only after those 2 Rs are exhausted, the plastic is to be sent to a landfill where it will biodegrade away. This destines a natural end for a product in a reasonably short period of time that would otherwise last for centuries.

References

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- 2) http://www.allproducts.com/plastic/youcheng/pla_bottles500.html
- 3) http://www.commandpackaging.com/Env_PLA.asp
- 4) <http://www.aquamaker.com.au/content/news.php>
- 5) Environment Australia 'Biodegradable Plastics –Developments and Environmental Impacts', Written by Nolan-ITU, Oct 2003
- 6) <http://www.epi-global.com/en/how-it-works.php>
- 7) EV0422 Accessing the Environmental Impacts of Oxo-degradable Plastics Across their Lifecycle, Loughborough University, Jan 2010
- 8) <http://www.seeturtles.org/1128/ocean-plastic.html>
- 9) <http://www.facebook.com/topic.php?uid=131191950225835&topic=299>
- 10) http://www.oxoalliance.org/FAQs_and_Misconceptions.html
- 11) Bio-Tec Environmental, LLC, www.goecopure.com
- 12) AS/NZS ISO 14021:2000 Australian/New Zealand Standard™ Environmental labels and declarations—Self-declared environmental claims (Type II environmental labelling)
- 13) <http://www.triplepundit.com/2010/09/californias-truthful-environmental-advertising-in-plastics-bill-awaiting-action/>
- 14) AS 4736—2006 Australian Standard® Biodegradable plastics—Biodegradable plastics suitable for composting and other microbial treatment
- 15) Federal Trade Commission Green Guide Summary
- 16) <http://www.worldcentric.org/biocompostables/bioplastics>
- 17) <http://www.mirelplastics.com/environmental/default.aspx?ID=673#biodegradable>

Appendix 1

Definitions of Degradation Types from Reference (16)

Biodegradability & Compostability

Bioplastics can take different length of times to totally compost, based on the material and are meant to be composted in a commercial composting facility, where higher composting temperatures can be reached and is between 90-180 days. Most existing international standards require biodegradation of 60% within 180 days along with certain other criteria for the resin or product to be called compostable. It is important to make the distinction between degradable, biodegradable and compostable. These terms are often (incorrectly) used interchangeably.

Compostable Plastic is plastic which is "capable of undergoing biological decomposition in a compost site as part of an available program, such that the plastic is not visually distinguishable and breaks down to carbon dioxide, water, inorganic compounds, and biomass, at a rate consistent with known compostable materials (e.g. cellulose). and leaves no toxic residue." American Society for Testing & Materials (ASTM). In order for a plastic to be called compostable, three criteria need to be met:

- 1. Biodegrade - break down into carbon dioxide, water, biomass at the same rate as cellulose (paper).*
- 2. Disintegrate - the material is indistinguishable in the compost, that it is not visible and needs to be screened out*
- 3. Eco-toxicity - the biodegradation does not produce any toxic material and the compost can support plant growth.*

Biodegradable Plastic is plastic which will degrade from the action of naturally occurring microorganism, such as bacteria, fungi etc. over a period of time. Note, that there is no requirement for leaving "no toxic residue", and as well as no requirement for the time it needs to take to biodegrade.

Degradable Plastic is plastic which will undergo a significant change in its chemical structure under specific environmental conditions resulting in a loss of some properties. Please note that there is no requirement that the plastic has to degrade from the action of "naturally occurring microorganism" or any of the other criteria required for compostable plastics.

Definitions from the USA FTC (17)

Compostable: Claims of Compostability should be qualified to the extent necessary to avoid consumer deception. An unqualified claim may be deceptive if: (1) the package cannot be safely composted in a home compost pile or device; or (2) the claim misleads consumers about the environmental benefit provided when the product is disposed of in a landfill. A claim that a product is compostable in a municipal or institutional composting facility may need to be qualified to the extent necessary to avoid deception about the limited availability of such composting facilities.
Source: USA Federal Trade Commission Environmental Marketing Claims (16 CFR Part 260)

Biodegradable: Claims of degradability, biodegradability, or photodegradability should be qualified to the extent necessary to avoid consumer deception about: (1) the product or package's ability to degrade in the environment where it is customarily disposed; and (2) the rate and extent of degradation.

Source: USA Federal Trade Commission Environmental Marketing Claims (16 CFR Part 260)

Appendix 2

The findings below are from reference (7) and are included as they make a pertinent summary of oxo-degradable additives and their shortcomings.

1. Key findings

The overall conclusion of this review is that incorporation of additives into petroleum-based plastics that cause those plastics to undergo accelerated degradation does not improve their environmental impact and potentially gives rise to certain negative effects.

Degradation and biodegradation

- (a) The length of time to degradation of oxo-degradable plastic cannot be predicted accurately because it depends so much on the environmental conditions. It is suggested that oxo-degradable plastics left in the open environment in the UK degrade to small fragments within 2 to 5 years.
- (b) Oxo-degradable plastics are not compostable, according to established international standards EN13432 and ASTM 6400. Oxo-degradable plastics should not be included in waste going for composting, because the plastic fragments remaining after the composting process might adversely affect the quality and saleability of the compost.
- (c) It is thought that labelling the oxo-degradable plastics as biodegradable can lead to confusion on the part of consumers, who may assume that 'biodegradable plastics' are compostable. This may lead to contamination of the composting waste-stream with oxo-degradable plastics.
- (d) Biodegradation of oxo-degradable plastics can only occur after they have fragmented and then proceeds very slowly, for example, at a rate many times slower than that of a compostable plastic.
- (e) The fact that the term —biodegradable can be applied to materials with extremely widely differing rates of biodegradation demonstrates that the term is virtually meaningless unless the rates of biodegradation and conditions under which it is measured are specified, preferably with reference to a widely recognised standard.

Bio-accumulation of plastic fragments in the environment

The fate of plastic fragments that remain in the soil is an area of uncertainty. Although these are regarded as beneficial by the producers, concerns have been raised that these particles of plastic may be ingested by invertebrates, birds, animals and fish. No evidence was found in this study that oxo-degradable fragments have a harmful bio-accumulative effect but neither was there evidence that they do not.

Re-use

The fact that they are degradable limits the re-use of oxo-degradable bags. They are unsuitable for storing items for an extended length of time.

Recycling

Oxo-degradable plastics are not suitable for recycling with main-stream plastics. The recycle will contain oxo-degradable additives that will render the product more susceptible to degradation. Although the additive producers suggest that stabilisers can be added to protect against the oxo-degradable additives, it would be problematic for recyclers to determine how much stabiliser needs to be added and to what extent the oxo-degradable plastic has already degraded. On this basis it seems unreasonable to claim recyclability of oxo-degradable plastics in existing recycling streams.

Disposal – Incineration and Landfill

The potential for problems to be caused by incorrect disposal of oxo-degradable plastics means that any packaging should be clearly labelled with the appropriate means of disposal. Life cycle analysis suggests that the best means of disposal for oxo-degradable plastics is incineration. If incineration is not available then landfill is the next best option.

There is a lack of evidence about what actually happens to oxo-degradable plastics in landfill. It is possible that they will degrade in landfill sites if sufficient oxygen is present but the more likely scenario is that they remain un-degraded.

Litter

Some oxo-degradable producers maintain that their products are a solution to the litter problem because oxo-degradable packaging will eventually degrade and then biodegrade. However, as the plastics will not degrade for approximately 2-5 years, they will still remain visible as litter before they start to degrade.