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Comparison of Environmental Impact of Plastic, Paper and Cloth Bags

This Briefing Note looks at the environmental impact of different types of carrier bags- cloth, paper and plastic. Their impact is compared based on four categories: decomposition, the manufacturing process, their reusability and their recyclability.

1. Decomposition

Paper Bags

Research demonstrates that paper in landfills does not degrade or break down at a substantially faster rate than plastic does. In fact, nothing completely degrades in modern landfills because of the lack of water, light, oxygen and other important elements that are necessary for the degradation process to be completed. A paper bag takes up more space than a plastic bag in a landfill, but because paper is recycled at a higher rate, saving space in landfills is less of an issue.¹

¹ <http://www.davidkrohn.net/what-are-the-impacts-of-plastic-paper-and-jute-bags-and-which-is-the-most-environmentally-friendly/>

Plastic Bags

It can take between 400 and 1000 years for plastic bags to decompose. A number of UK retailers have recently introduced degradable carrier bags. These bags are made from plastic which degrades under certain conditions or after a predetermined length of time. There are two types of degradable plastic: bio-degradable plastics, which contain a small percentage of non oil-based material, such as corn starch; and photodegradable plastics, which will break down when exposed to sunlight.

There are a number of concerns over the use of degradable plastics. First, these plastics will only degrade if disposed of in appropriate conditions. For example, a photodegradable plastic product will not degrade if it is buried in a landfill site where there is no light. Second, they may cause an increase in emissions of the greenhouse gas methane, as methane is released when materials biodegrade anaerobically.²

2. Manufacturing Process

Paper Bags

It takes more than four times as much energy to manufacture a paper bag as it does to manufacture a plastic bag. For paper bag production, forests must be cut down (trees are absorbers of greenhouse gases) and then the subsequent manufacturing of bags produces greenhouse gases. The majority of paper bags are made by heating wood chips under pressure at high temperatures in a chemical solution. The use of these toxic chemicals contributes to both air pollution, such as acid rain, and water pollution. These chemicals can pollute waterways; the toxicity of the chemicals is long-term and settles into the sediments, working its way through the food chain. Further toxicity is generated as both plastic and paper bags degrade. Paper bags generate 70% more air and 50 times more water pollutants than plastic bags.³

It would take approximately seven lorries to transport the same number of paper bags as can be transported by a single lorry full of plastic bags.⁴

Plastic Bags

Plastics are produced from the waste products of oil refining. An analysis of the life cycle of plastic bags includes consideration of the environmental impacts associated with the

² <http://www.wasteonline.org.uk/resources/information sheets/plastics.htm>

³ <http://www.reuseit.com/learn-more/myth-busting/why-paper-is-no-better-than-plastic>

⁴ <http://www.enviroliteracy.org/article.php/1268.html>

extraction of oil, the separation of products in the refining process, and the manufacturing of plastics. The total environmental impact depends upon the efficiency of operations at each stage and the effectiveness of their environmental protection measures.⁵

Their manufacture can add many tons of carbon and other toxic chemicals into the atmosphere⁶ It takes around 2 billion barrels of oil to service the plastic bag industry alone.⁷ However, plastics are currently made from a by-product of oil or natural gas. It could be argued that this by-product arises because the world needs fuels, and would arise whether or not the by-product were used to make plastic goods. Until other fuels have been developed, it makes good environmental sense to use the by-product, instead of using scarce agricultural resources and water to make paper or cloth bags or vegetable-based plastic.⁸

Cloth Bags

Cloth Bags are much thicker and more expensive. 30,000 cotton bags can be packed into a 20-foot container, but the same container will accommodate 2.5 million plastic carrier-bags. Therefore, to transport the same number of jute or cotton bags 80x more ships and lorries would be required than for plastic bags, using 80x more fuel, using 80x more road space and emitting 80x more CO₂.⁹

3. Reusability

Plastic Bags

Plastic Bags can be made very thin, and are still strong enough to carry a full load of heavy shopping. A plastic bag can carry 2,500 times its own weight and stay strong when wet. The bags can also be re-used many times over for shopping, and are compact enough to be put in a pocket or handbag. They are also put to many other uses in the home, and for other uses such as clearing dog-waste from the streets, and most of them will eventually serve as a bin-liner to safely collect and dispose of household waste.¹⁰

Reusable plastic bags (the so-called 'bags for life') are more sustainable than all types of lightweight plastic carrier bags if used four times or more. They give the greatest

⁵ <http://www.enviroliteracy.org/article.php/1268.html>

⁶ <http://www.davidkrohn.net/what-are-the-impacts-of-plastic-paper-and-jute-bags-and-which-is-the-most-environmentally-friendly>

⁷ <http://www.ecocarrierbag.co.uk/eco/faq.asp>

⁸ <http://www.biodeg.org/position-papers/plastic-bag-bans/>

⁹ <http://www.biodeg.org/position-papers/plastic-bag-bans/>

¹⁰ <http://www.biodeg.org/position-papers/plastic-bag-bans>

environmental benefits over the full lifecycle.¹¹ Tesco reward customers with one 'Green' Clubcard point for every bag re-used, even if it isn't one of their bags.¹²

According to the Welsh Assembly Government, The Environment Agency completed a study into the environmental impacts of types of carrier bags. The study concluded that for a paper bag to have the same impact on the environment as a plastic bag it would need to be used at least 4 times; however, most paper bags would not be durable enough to be used 4 times.¹³

Cloth Bags

Cloth Bags can be reused many times. However, cloth bags are not hygienic, like plastic bags. Research by Guelph Chemical Laboratories in Canada in 2008 Microbiological Study of Reusable Grocery Bags⁴ has shown that "re-usable grocery bags can become an active microbial habitat and a breeding-ground for bacteria, yeast, mould, and coli forms."¹⁴

4. Recyclability

Paper Bags

It takes 91% less energy to recycle a pound of plastic than it takes to recycle a pound of paper.¹⁵

A report on the production of carrier bags made from recycled rather than virgin polythene concluded that the use of recycled plastic resulted in the following environmental benefits:

- reduction of energy consumption by two-thirds
- production of only a third of the sulphur dioxide and half of the nitrous oxide
- reduction of water usage by nearly 90%
- reduction of carbon dioxide generation by two-and-a-half times

A different study concluded that 1.8 tonnes of oil are saved for every tonne of recycled polythene produced.¹⁶

Cloth Bags

Cloth Bags can be recycled like most textiles. Textile recovery:

¹¹ Environment Group Research Report (2005) 'Proposed Plastic Bag Levy- Extended Impact Assessment'
<http://www.scotland.gov.uk/Resource/Doc/57346/0016899.pdf>

¹² <http://www.rbkc.gov.uk/environmentandtransport/domesticrecyclingandrubbish/recycling/plasticbagrecycling.aspx>

¹³ Welsh Assembly Government
http://wales.gov.uk/topics/environmentcountryside/epq/waste_recycling/substance/carrierbags/chargeqanda/types/?lang=en [accessed 23/02/11]

¹⁴ <http://www.biodeg.org/position-papers/plastic-bag-bans>

¹⁵ <http://www.reuseit.com/learn-more/myth-busting/why-paper-is-no-better-than-plastic>

¹⁶ <http://www.wasteonline.org.uk/resources/information sheets/plastics.htm>

- Reduces the need for landfill space. Textiles present particular problems in landfill as synthetic (man-made fibres) products will not decompose, while woollen garments do decompose and produce methane, which contributes to global warming.
- Reduces pressure on virgin resources.
- Aids the balance of payments as we import fewer materials for our needs.
- Results in less pollution and energy savings, as fibres do not have to be transported from abroad.¹⁷

Plastic Bags

Some supermarkets offer recycling banks instore.¹⁸ They can be recycled into many different products or can be reprocessed into small pellets, or post consumer resin, which can become feed stock for a variety of products such as new bags, pallets, containers, crates, and pipe.¹⁹

5. Environmental Impact of Plastic vs. Paper Bags

In 2005, the Scottish Government issued a full environment impact assessment report on the effects of a proposed plastic bag fee²⁰. The Report contains the comparison between plastic and paper bags, outlined in the table below. The lightweight plastic bag was given a score of 1 in all categories as a reference point. A score greater than 1 indicates that a paper bag makes more contribution to the environmental problem than a lightweight plastic bag when normalised against the volume of shopping carried. The indicators take account of emissions which occur over the whole lifecycle.

INDICATOR OF ENVIRONMENTAL IMPACT	Plastic bag HDPE lightweight	Paper bag
Consumption of nonrenewable primary energy	1.0	1.1
Consumption of water	1.0	4.0
Climate change (emission of greenhouse gases)	1.0	3.3
Acid rain (atmospheric acidification)	1.0	1.9
Air quality (ground level ozone formation)	1.0	1.3
Eutrophication of water bodies	1.0	14.0
Solid waste production	1.0	2.7
Risk of litter	1.0	0.2

¹⁷ <http://www.wasteonline.org.uk/resources/information sheets/textiles.htm>

¹⁸ http://www.recyclenow.com/what_can_i_do_today/can_it_be_recycled/plastic/carrier_bags.html

¹⁹ http://www.plasticbagrecycling.org/plasticbag/s01_consumers.html

²⁰ Environment Group Research Report (2005) 'Proposed Plastic Bag Levy- Extended Impact Assessment'
<http://www.scotland.gov.uk/Resource/Doc/57346/0016899.pdf>

A recent article by The Independent on the 20th February 2011 (Annex A), states that unpublished Environment Agency research shows that ordinary high density polythene (HDPE) bags may be less harmful than supposedly low impact choices such as cotton or paper. The unpublished report titled '*Life Cycle Assessment of Supermarket Carrier Bags*', by Dr Chris Edwards and Jonna Mehoff Fry found that:

- An HDPE plastic bag would have a baseline global warming potential of 1.57 kg Co2 equivalent, falling to 1.4 kg Co2e if re-used once, the same as a paper bag used four times (1.38 kg Co2e).
- A cotton bag would have to be re-used 171 times to emit a similar level, 1.57 kg Co2e.
- The HDPE bag had the lowest environmental impacts of the single use options in nine of the 10 impact categories. The bag performed well because it was the lightest single use bag considered.

The article states that the 96 page report comes amid an ongoing controversy over plastic bags and plans by Wales to introduce a 5p plastic bag tax in October. According to the Environment Agency, despite the long peer review, the date for publication is not known, except that it will be soon.

Annex A

Plastic fantastic! Carrier bags 'not eco-villains after all'

Unpublished Environment Agency research shows polythene may be less harmful than cotton or paper

By Martin Hickman, Consumer Affairs Correspondent

Sunday, 20 February 2011

Unpublished Government research suggests the plastic carrier may not be an eco villain after all – but, whisper it, an unsung hero. Hated by environmentalists and shunned by shoppers, the disposable plastic bag is piling up in a shame-filled corner of retail history. But a draft report by the Environment Agency, obtained by the *Independent on Sunday*, has found that ordinary high density polythene (HDPE) bags used by shops are actually greener than supposedly low impact choices.

HDPE bags are, for each use, almost 200 times less damaging to the climate than cotton hold-alls favoured by environmentalists, and have less than one third of the Co2 emissions than paper bags which are given out by retailers such as Primark.

The findings suggest that, in order to balance out the tiny impact of each lightweight plastic bag, consumers would have to use the same cotton bag every working day for a year, or use paper bags at least thrice rather than sticking them in the bin or recycling.

Most paper bags are used only once and one study assumed cotton bags were used only 51 times before being discarded, making them – according to this new report – worse than single-use plastic bags.

However, despite being commissioned in 2005 and scheduled for publication in 2007, the research has not been released to the public.

Officially, the Environment Agency says the report, Life Cycle Assessment of Supermarket Carrier Bags, by Dr Chris Edwards and Jonna Meyhoff Fry, is still being peer reviewed. However it was submitted to the peer review process “more than a year ago”. Despite the long peer review the Environment Agency does not have a date for its publication, except to say that it will be soon.

The report set out to find out which of seven types of bags have the lowest environmental impact by assessing pollution caused by extraction of raw materials, production, transportation and disposal.

It found that an HDPE plastic bag would have a baseline global warming potential of 1.57 kg Co2 equivalent, falling to 1.4 kg Co2e if re-used once, the same as a paper bag used four times (1.38 kg Co2e).

A cotton bag would have to be re-used 171 times to emit a similar level, 1.57 kg Co2e.

The researchers concluded: “The HDPE bag had the lowest environmental impacts of the single use options in nine of the 10 impact categories. The bag performed well because it was the lightest single use bag considered.”

The 96-page report comes amid an ongoing controversy over plastic bags and plans by Wales to introduce a 5p plastic bag tax in October.

Six billion plastic bags are used across the UK annually and there is no doubt that they cause environmental problems such as litter and marine pollution as well as using up oil, and limiting their use and re-using them reduces their harm.

However the new report suggests that if shoppers to switch to alternatives, they have to use those time and time again to be greener.

Barry Turner, chief executive of the Packaging and Films Association, which represents plastic bag manufacturers, suggested the report had been “suppressed.” “They [the Environment Agency] have kept it fairly quiet and tried to suppress things,” he said.

“This [report] has dragged on and on. It was a report that could have been done relatively quickly, probably within 12 months but it has gone on for years.

“If these are the conclusions that have arrived at it wouldn’t really surprise me. It was buried because it didn’t give the right answers. It doesn’t support the political thrust at the moment.”

He added: “People at CEO level [in retailers] have been consistently telling Wrap [the publicly-funded Waste and Resources Action Programme] and Defra [Department for the Environment, Food and Rural Affairs] that they have been missing the point. They have had very closed ears on this and I have never have been able to understand why they have been so rigid in their approach.”

The Environment Agency denied the report had been suppressed. “No. The initial draft went to the review panel just over a year ago but they have not been constantly engaged in the review,” he said.

“We amended the report after the comments from the first review and then the revised report was resubmitted to them last summer but, because it was a panel and because of their other commitments, it has taken them some time to complete. We expect this to be completed shortly.”

Asked whether the draft findings had been seriously challenged, he said the reviewers had “questioned some aspects of the original draft, although much was about emphasis and balance.”

The report brings to mind another life-cycle assessment carried out by the Environment Agency, into disposable nappies, which suggested that reusable "eco" nappies were typically more damaging to the environment than disposables such as Pampers because washing uses so much carbon-emitting electricity.

Following publication of that report, the Government dropped its advice for parents to use eco nappies. The Womens Environmental Network also dropped its campaign.

So which bag should you use?

All bags have an impact. The best solution would be to use a cotton bag several hundred times, probably using it constantly for years. If you are not going to do that, a plastic bag – re-used as a bin liner – is the next best option, better than paper. Avoid accepting a plastic bag unless you need one, though.²¹

²¹ To view the article visit: <http://www.independent.co.uk/environment/green-living/plastic-fantastic-carrier-bags-not-ecovillains-after-all-2220129.html>