5 The products relevant to the study

Before any assessment can be made of the potential impact of the proposed regulations, it is necessary to have a clear understanding of the current products being used in the retail industry, as well as possible substitute products. An important consideration is that the current products will change (dimensions, material composition etc.) under the proposed regulations, as part of the natural tendency of industries to optimise products over time. The products that will most likely be relevant under the proposed regulations are therefore also described.

5.1 Current plastic VCB

Although there are a number of "standard" VCB products produced, it must be pointed out from the outset that these products vary significantly in dimensions, weight, and material composition.

VCB's can be categorised from two perspectives as follows:

Categorisation according to the material characteristics:

- Clear VCB: The bag is see-through and can only be made from virgin polymer
- White VCB: The bag can only be made from virgin polymer and first generation white recycle, with a maximum first generation recycle content generally not exceeding 50% for 17ì bags
- Printed VCB: The bag is printed on and generally made from virgin polymer and a maximum of 20% first generation unprinted recycle
- Plain VCB: The bag is "plain" in colour and not printed on. It is of a lower quality than printed bags, primarily because it generally has a high (40% upward) recycle content. The recycled material can be printed as well as unprinted recycled material, and first generation as well as post consumer recyclate.

Categorisation by type of bag according to functionality:

Although there is a wide range of bags made in different dimensions, the research indicated that the following types are predominantly in use.

Type	**Length (mm)**	**Width (mm)**	**Thickness ì**	**Weighted avg. thickness**	**Weighted avg. weight per bag (g)**	**Research sample of 34365 tonnes**	
						Production (t)	% of total
Mini	440-460	320-330	9-15	11.8	3.11	2408	7%
Handi	460-480	360-380	14-17	14.02	4.35	5641	17%
Midi/Maxi	560-600	420-480	14-20	15.96	7.01	18491	55%
No data provided [8]				14.24	5.87	8025	21%

[8] The distribution of converters that did not supply detailed product data was very similar to those who did, namely a combination of large manufacturers that supply printed bags to the mass-retail industry and smaller manufacturers who supply plain or printed bags to smaller retailers. The weighted average of the available data is therefore used.

For purposes of the study the variations between dimensions is standardised by calculating the weighted (by production volumes) average weight per bag. This is then used as the basis for further calculations.

This analysis does not include the key characteristics of the current 70ì "bag for life". This is due to the very low numbers of bags in use (less than 1%). It is also worthwhile to point out that if the definition of what constitutes a "vest-type carrier bag" is strictly applied, the current 70ì "bag for life" should be excluded from the analysis. It is technically not possible to manufacture an 80ì VCB. An 80ì bag is normally a "side seal" bag or a "bottom seal" bag without side gussets. By virtue of not having side gussets, it requires a different handle configuration, namely either a separately attached "loop" handle, or a "kidney" or "banana" cut out handle.

5.2 Plastic VCB product changes under the proposed regulations

The following table presents the changes to the key product characteristics under the proposed regulations. Bag dimensions and raw material mix values are based on the values generally agreed by industry, with bag weight and cost calculated values.

	Current VCB	**30 ì bag** **Current dimensions**	**30 ì bag** **Adjusted dimensions**	**80 ì bag** **Adjusted dimensions**
Bag dimensions: • **Length (mm)** • **Width (mm)** • **Thickness (ì)** • **Carrying capacity (l)**	Various	Various	600 480 30 20	520 420 80 20
Weight of bag	5.87g	12.36g	16.6g	34.4
HDPE proportion	85%	75%	75%	0%
LLDPE proportion	10%	20%	20%	20%
LDPE proportion	0%	0%	0%	75%
Masterbatch proportion	5%	5%	5%	5%
Cost to retailer (R per 1000 bags)	71.45	167.87	225.46	467.30

The first data column represents the weighted average data for the variety of bags currently in use, as previously calculated.

The second column represents the data of the current VCB's in use, but with a thickness of 30ì. The assumption is therefore that the same type of bags is manufactured, and the product mix remains the same, but that the thickness increases to 30ì. By using weighted average mass calculation, based on weighted average thickness etc., a baseline is established from which the impact on the industry can be calculated.

The "30 ì adjusted dimensions" bag reflects the properties of the bag which is most likely to come into use should the regulations be enforced at 30ì. The dimensions and properties of the bag reflects the view of the manufacturers and retailers on what such a bag should be in order to maximise variables such as volume, carrying capacity, strength, cost, etc.

The data for the 80ì-adjusted bag, with the adjustment reflecting adjustment from the current 70 ì low volume, high specification and high cost "bag for life" to a high volume, lower specification and lowest cost 80ì bag.

It is important to consider that the current 70ì "bag for life", for which the consumer pays R 1 per bag, is a niche product, and can not be considered as an approximation for a potential mass-market 80ì carry bag. Unique features that contribute to the cost of the bag include the high quality of printing, layers of lamination to protect the printing from rubbing off, and a separately attached "loop" handle. The cost of the 80 ì bag which would probably come into use is therefore much lower that that of the current "bag for life". This cost was calculated and verified with converters as being the minimum possible cost potentially possible.

The "retailer cost per 1000 bags" figures also reflect the differences in cost of HDPE, LLDPE and LDPE The values are therefore throughout reflective of the minimum cost to the retailer, which together with the cost of disposal, constitutes the minimum cost to the economy

Please note

Potential changes in bag cost due to the potential increase in post consumer reprocessed material, as a source of polymer is not considered. This is because the increase of the extent of post consumer waste entering the raw material supply chain is dependent on many factors such as; availability of virgin raw material, economics of waste collection, technological factors in the manufacturing process, etc. Any adjustment to the current cost of bags would therefore pre-empt the impact assessment. The impact on availability and use of post consumer reprocessed polymer will be determined as part of the scenario building, and corresponding changes in product cost as well as changes in the value chain will be commented on, as part of the impact assessment.

5.3 Current paper carry bag products

There must be a distinction drawn between paper bags and paper sacks, which are seen as different products by the paper industry, as they require different technologies to manufacture.

- Self opening paper bags are used for commodities such as flour, sugar, maize meal and also as carrier bags
- Multi-walled paper sacks are used for commodities where greater strength is required, for example cement bags, and often have a polyethylene barrier ply in order to prevent moisture entering the sack and toxic contents from migrating to the outside of the sack.

Since this research focuses on the 17 ì Plastic VCB, the current situation with regards to paper bags is limited to the equivalent type of paper bags, namely "plain" paper carry bags used in the retail sector, and specifically the "shopper" type bag.

It is known that none of the large retail groups use paper bags, and research under a representative sample of the smaller retailers indicated the following:

- 4% of retailers sampled indicated that they use paper bags
- The average usage is 1828 paper bags per month.
- The total use of paper bags in the smaller retailer industry (88 000 retailers) is approximately 78 million bags per annum, which equates to 0.98% of the current VCB industry.

The characteristics of the current paper carry bag used for retail purposes, called the "shopper" bag in the paper industry, is as follows

Dimensions	"Shopper" bag
Length (mm)	420
Width (mm)	305 x 165
Thickness (g/sq m)	80
Weight (kg/1000)	32.6
Carry capacity (kg)	4
Cost (R/1000 bags)	340

A key characteristic of this bag is that it does not have carry handles. The addition of handles will increase the price significantly

5.4 Paper bag product change assumptions under proposed regulations

The bag will be the same at the current "shopper" bag, as described. As in the case of plastic bags, the potential impact of recycled paper being utilised for the manufacture is excluded from the price per bag. As in the case of plastic, it will be dealt with when the impact of the regulations are determined, and any price changes due to increase in recycled content will be highlighted, and the necessary backwards calculations made.

5.5 Current cloth bag products

In the context of bags, the terminology "cloth" bag relates to:

- Woven poly-propylene cloth bags
- Calico bags

Since a woven polypropylene bag is essentially a plastic bag, the research into a "cloth" bag as an alternative to a plastic bag, this part of the research focuses on the calico type bag, which is primarily cotton based.

The use for cloth bags within the retail industry is non-existent, except for a minimal amount (150 000) that was manufactured as a niche product in one large retail group. Industry sources are of the opinion that very few of the bags have actually been sold.

It is estimated that the cost of a cloth bag substitute to the current plastic VCB will cost about R 6.99 per bag. This makes it prohibitively expensive to be even considered as a substitute product, even considering its durability, and it is therefore excluded from the research

5.6 Bio-degradable plastic bags

During the past 25 years, plastic materials have gained widespread acceptance for use in numerous industries including packaging. Plastics offer a number of advantages over alternative materials since they are lightweight and durable. Plastics are based on petroleum-based compounds and are therefore resistant to biodegradation, which is the major disadvantage of plastics.

Degradable plastics can be categorized as either photodegradable or biodegradable. Photodegradable plastics have light sensitive groups directly incorporated into the polymer or as additives. Photo-degradation leads to breakdown of the polymer into non-degradable smaller fragments leading to loss of structural integrity of the material.

In the past 10 years, several plastics that were claimed to be biodegradable were introduced into the market. These products were composed of starch-based products (e.g. corn) combined with resins. The blend of organic and inorganic constituents could not be classified as biodegradable since only the inorganic constituents were degraded leaving fine powders of organic material intact. In addition biodegradable plastics containing starch are regarded as inefficient and increase the quantity of waste because more plastic is needed to provide the same strength.

There are many factors governing degradability timescales, therefore it is difficult to what the length of time should be before the product should biodegrade. It can take a few months to a few years and factors include the type of polymers used and the additives, fillers, weight of the product, bacterial environment, temperature and humidity.

In response to the need to place benchmark standards numerous international standards bodies have defined the term biodegradable. For example the German Standards (DIN 54900-1) defines a "plastic material as biodegradable if all organic components are subject to complete biological degradability", which is determined by standardized test procedures. The definition of the term therefore requires the complete biodegradation of organic constituents to CO_2, H_20, methane and biomass (other natural end products of biodegradation).

5.6.1 Categories of biodegradable plastics

Second generation biodegradable polymers can be categorized as follows:

- Polylactic acid copolymers: These materials have a broad spectrum of properties but are largely aimed at applications presently held by polyesters, including fibres and packaging, and polystyrene.

- Aliphatic/ aromatic polyesters and polyester amides: While a wide range of property combinations can be obtained, these materials are generally aimed at applications held by polyethylene and polypropylene.
- Starch copolymers and derivatives: These are generally polyethylene and polystyrene replacements.

The following products were found as examples of the categories above:

Polylactic acid copolymers

- Cargill Dow Polymers - NatureWorks.

Alphatic/ aromatic polyesters and polyester amides

- BASF – Ecoflex
- Eastman Chemical – EastarBio
- DuPont – BioMax
- Bayer – Bak

Starch copolymer and derivatives

- Novamat – MaterBi
- Biotec Natural Products - BioPlas

In a review of 170 international biodegradable polymer patents[9] it was noted that the second-generation polymers, however, have been estimated at approximately 20% higher price[10],[11] (Symphony/ EPI technology) than the commodity polymers typically used in packaging applications. The industry is currently working toward bringing down the cost of manufacturing biodegradable polymers by increasing production capacity, improving process technology, and using low-cost feedstock. In contrast, however, Bayer has withdrawn their BAK product range, believing there to be no economic justification for pursuing the costly development thereof[12].

Degradation timescales are difficult to predict as it depends on a range of factors including exposure to sunlight, humidity, temperature, etc. Testing protocols (such as those specified in DIN 54900-1) would need to be established within the South African environment to ensure compliance to local requirements.

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[9] Process Economics Report 115: Environmentally degradable polymers, October 1998

[10] Email communications with Tony Kingsbury (President of the International Biodegradable Products Institute), 27th August 2001.

[11] Biopolymers move into the mainstream, Alex Scott, Chemical Week, 13th September 2000, v162 i34 p73.

[12] Bayer Stops Production of BAK® Biodegradable Plastic, http://www.bayer.co.uk/news/bak_0401.html, 2nd April 2001.

5.6.2 Categories of photodegradable plastics

It is important to note that biodegradation and photo-degradation are two independent processes. The breakdown of photodegradable plastics depends on irregularities in the polymers. These irregularities cause all plastics to slowly degrade when exposed to ultraviolet (UV) light, typically sunlight. In photodegradable plastics, adding photosensitive substances called promoters increases the rate of degradation. Two common promoters are carbonyl groups and metal complexes:

- Carbonyl group: This is produced by adding a carbonyl group to polyethylene. The resulting copolymer degrades when the carbonyl group absorbs sunlight. This product, since it needs direct sunlight to initiate, is suitable to film products.
- Metal complexes: This involves the adding of metal salts to initiate the breakdown process. The main difference between plastics containing metal salts and other photodegradable materials is its ability to breakdown in the absence of light. Initiation however relies on adequate exposure to UV light.

The following products have been found as examples of photodegradable polymers:

- Ampacet Corp. – Poly-grade (masterbatch, II, III)
- Cabot Plastics International – Masterbatch
- Dow Chemical Company – Ecolyte
- Union Carbide

The degradation timescale of photodegradable polymers in the environment is also difficult to predict as it depends on exposure to UV light, among other initiators.

5.6.3 Applications of biodegradable and photodegradable products

The development of photo- and biodegradable polymers is relatively new and therefore modifications of polymers to all product types are still in progress. Material specification sheets maintain that the biodegradable products are suitable replacements for conventional polymers for all numerous production techniques. Testing undertaken at the CSIR has proven difficulties with extrusion on conventional machinery. Products tested by the CSIR have proven to have the following limitations[13]:

- Slower blowing rates
- Difficulty in maintaining required thickness
- Material strength is compromised

The CSIR is of the opinion that products are more suitable to injection and blow moulding than to Film blowing. It was noted that if blowing were to take place on machinery approximating that used in

[13] Interview with Dr. Eino Vuorinen, CSIR Pretoria, 21st August 2001

laboratory conditions then the limitations would not be as large. Machinery of this nature are not, yet, available for large production facilities.

Internationally examples do exist however of biodegradable polymers successfully used in numerous applications including blown film[14].

5.6.4 Conclusion

The South African plastics industry has a strong recycling component. The effect of the inclusion of degradable polymer in the recycling stream is not clearly understood. Manufacturers claim that the degradation process can be "switched off" during recycling however recyclers have voiced concerns that this is not the case. Clearly the inclusion of degradable polymers in product, made from recycled material, for which the desirable quality is longevity, is problematic.

Internationally biodegradable and photodegradable products are clearly differentiated from recycled products through two mechanisms[15]. Firstly, degradable products are typically used for products that are not prone to recycling (e.g. garbage bags, mulch films, etc). Secondly, the products are clearly identifiable as being made of degradable material so as not to be included in the waste-recycling stream.

Packaging waste destined for conventional landfill will not benefit from being biodegradable as degradation is unpredictable and long-term. Indeed, the packaging's stability can be a positive with the landfill.

Photo degradation as a result of exposure to sunlight can be helpful for products used in rural and marine environments where litter is less likely to be cleared, but it will not make urban litter disappear within an acceptable time span or remove the social problems of litter.

The likelihood of production of degradable polymers in South Africa seems low due to the fact that big players can't keep up with demand for traditional polymers. Big players are furthermore keen to stimulate a strong recycling industry.

[14] European Commission, "Success stories on composting and separate collection", http://europa.eu.int/comm/environment/waste/compost/compost_en.pdf

[15] Discussion with Sasol Polymers