

The Global Outlook for Biodegradable Packaging

Key trends and developments driving the global biodegradable packaging market

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Table of Contents

Ian Barnett	2
Disclaimer	2
Executive summary	8
Introduction	8
Legislation and regulation	9
Biodegradable packaging – technology, sectors and applications	10
Biodegradability and the packaging industry	11
Future outlook	12
Chapter 1 Introduction	13
Summary	13
What is biodegradable packaging?	14
Sustainability the main driver	16
Biodegradable packaging and composting	16
Increasing costs of hydrocarbons	17
Concerns over the price of biodegradable packaging	19
Lack of recyclability	21
Consumer attitudes to bioplastics	21
Consumer packaging market	22
The biodegradable plastics market	24
Chapter 2 Legislation and regulation	25
Summary	25
Introduction	26
Packaging legislation in the European Union	26
Regulatory overview	27
Before 1994	27
Directive 94/62/EC	27
Directive 2004/12/EC	27
Directive 2005/20/EC	28

Current EU regional picture	29
UK	29
Belgium	30
France	30
Italy	31
Slovakia	31
Germany	31
Bioplastics/biodegradable legislation in the EU	32
Certification and labeling	32
EU Directives	33
Lead Markets Initiative	34
Funding	35
Future outlook	35
Packaging legislation in the United States	36
US regulatory overview	36
The FDA	36
NEPA	37
EPA	37
US bioplastics/biodegradable legislation	38
Certification and labeling	39
US non-government organizations	40
The Bioplastics Recycling Consortium (BRC)	40
The Biodegradable Products Institute (BPI)	40
The Sustainable Packaging Coalition (SPC)	41
Walmart	41
Packaging regulations in Asia-Pacific	41
China	42
Japan	43
Singapore	44
Thailand	45
Indonesia	46
Global trends	47
Biodegradable drivers	49
Chapter 3 Technology, sectors, and applications	51
Summary	51
Introduction	52
Technology	53
Biopolymers	53
Fermentation	54
GM plants	55
Agro-polymers	55

Cellulose biopolymers	56
Starch biopolymers	56
Starch blends	57
Starch composites	58
Starch multi-layers	58
Agro-resources-based polymers	59
Biopolymers from lactic acid	59
Biopolymers from micro-organisms	60
Petroleum-based polyesters	60
New polymer materials	61
Smart materials	61
Nanocomposites	62
Biodegradable barrier materials	63
Self-regulating, self-monitoring packaging	64
Regulating the internal packaging environment	64
Enzyme immobilization systems	64
Self-healing composites	64
Sensor technologies	65
Biosensors	65
Sectors and applications for biodegradable packaging	66
The steady rise of plastics	66
Biodegradables are a vital target for investment	66
Bioplastics led by PLA	67
Oxo-biodegradable plastic – the new alternative	68
Recent commercial applications of biodegradable plastic packaging	70
Bioplastics market overview	71
Paper and board packaging	73
Biodegradable linings	75
Nanotechnology	76
Chapter 4 The biodegradability packaging industry	78
Summary	78
Major packaging companies with interests in biodegradable	79
Innovia	79
NatureWorks	80
Cereplast	81
Cardia	82
Novamont	83
Manufacturers moving biodegradables into the mainstream	83
Amcor	83
BASF	84
Biodegradable materials and brand names	85
Nature Flex	85
Ingeo	87
Mater-Bio	88
Nature Plus	89
Ecoflex	89
Retailer and manufacturer initiatives	90

Retailers	90
Sainsbury's	90
Tesco	91
Walmart	93
Manufacturers	94
The Coca-Cola Company	94
PepsiCo	95
Niche players	97
Chapter 5 Future outlook	99
Summary	99
Introduction	100
Market outlook	101
Outlook for Suppliers	103
Production	103
Research and development	105
Economies of scale	105
How viable is biodegradable packaging?	105
Who is driving the market?	106
Price drivers	106
Policy drivers	106
Consumer demand	107
Who is paying for the development and growth of biodegradable packaging?	107
Appendix	108
Scope	108
Methodology	108
Glossary/Abbreviations	108
Bibliography/References	109

Table of figures

Figure 1: Share of global bioplastics market by production volume (%) 2009	15
Figure 2: Coca-Cola's PlantBottle	19
Figure 3: Global consumer packaging market (\$bn),2006–2010	22
Figure 4: Share of consumer packaging market by region (% value), 2009/2010	23
Figure 5: Share of value of consumer packaging market 2010 by material (%)	24
Figure 6: Seedling logo and OK Compost logo	32
Figure 7: Key drivers of the development and use of biodegradable packaging	50
Figure 8: Schematic of competing starch blends	58
Figure 9: SWOT analysis of paper packaging	74
Figure 10: NatureFlex NK film	86
Figure 11: Ingeo Biobottle from Sant'Anna	87
Figure 12: Ecoflex biodegradable film	90
Figure 13: Tesco principles to reduce packaging	92
Figure 14: Share of worldwide capacity of bio-based plastics (%) by region in 2020	101
Figure 15: Global production capacity of compostable bioplastic (metric tons), 2009-2012	102
Figure 16: Major cost barriers for suppliers of biodegradable packaging	103
Figure 17: Which stakeholders are driving the growth in biodegradable plastics?	106

Table of tables

Table 1: PLA uses in packaging industry	14
Table 2: Plastics price comparison	20
Table 3: Regional biodegradable packaging policies in the EU	29
Table 4: Comparison of compostable and oxo-biodegradable plastics	69
Table 5: Major suppliers of starch-based biopolymers	72
Table 6: Leading players in paper and board market	75
Table 7: Leading biodegradable materials used in the packaging industry	85

The Packaging (Essential Requirements) Regulations 2003, as amended by the Packaging (Essential Requirements Amendment) Regulations 2006

These regulations require companies to ensure that their packaging is 'fit for purpose' and is the minimum weight and volume needed for safety, hygiene, and consumer acceptability.

Packaging may be reusable (optional) but all packaging, including reusable packaging, must fulfill at least one of the following criteria:

- Packaging recoverable through material recycling.
- Packaging recoverable through energy recovery.
- Packaging recoverable through composting, in particular, "Packaging waste processed for the purpose of composting shall be of such a nature that it should not hinder the separate collection and the composting process or activity into which it is introduced".
- Biodegradable packaging: in particular, "Biodegradable packaging waste shall be of such a nature that it is capable of undergoing physical, chemical, thermal or biological decomposition such that most of the finished compost ultimately decomposes into carbon dioxide, biomass and water".

Belgium

The Belgian government primarily approaches the problem of packaging waste with taxation. The government attempted to introduce a carbon-based tax on all packaging materials, but this failed due to opposition from a coalition of environmentalists, industry, and consumers which viewed the plans for a general tax on packaging as a stealth tax that could not be justified on environmental grounds. From July 2007 a tax on selected types of packaging became effective, including EUR 3 per kg (approximately \$4.30 per kg) on plastic carrier bags and EUR 2.70 per kg 0028 (approximately \$3.80 per kg) on plastic films.

France

France is one of the leaders of biodegradable packaging regulation in Europe. A 2005 Law on Agricultural Policy outlined the country's obligation to promote biodegradable plastics, and in 2007 France submitted a proposal to the European Commission to require plastic used to produce small rubbish bags and cotton buds to contain a minimum of 40% material from vegetable origin (by weight). This proposal came into effect in 2009.

There are four main sources of biopolymer:

- *Biomass*: e.g. agro-polymers from agro-resources including starch and cellulose.
- *Microbial production*: e.g. polyhydroxyalkanoates.
- *Conventional chemical synthesis*, with base molecules derived from agro/renewable resources: e.g. polylactic acid.
- Polymers whose monomers and polymers are obtained conventionally *from petrochemicals through chemical synthesis*.

Biopolymers can be created using a number of methods, including the creation of a polymer structure from an original natural molecule using a process of chemical polymerization; and the chemical modification of a naturally occurring polymer. Chemical modification, however, can sometimes affect the biodegradability of the end product. As each biopolymer has its own unique set of properties (such as oxygen permeability), a compromise is often necessary between material properties and biodegradability.

There are currently two main production processes for the creation of biopolymers: fermentation and GM plants.

Fermentation

Fermentation is the use of micro-organisms to break down organic substances without the use of oxygen. Polymers created using fermentation usually use genetically engineered micro-organisms specifically designed for the appropriate substance.

There are two main methods of fermentation:

- *Bacterial polyester fermentation*: using bacteria called *Ralstonia eutropha*. These bacteria use the sugar of feed stocks such as corn to fuel their cellular processes, the by-product of which is a bacterial biopolymer which can then be separated from the bacterial cells.
- *Lactic acid fermentation*: using lactic acid fermented from sugar. In this process, the end-product is lactic acid, therefore an additional step is required to convert the lactic acid to polylactic acid (polymerization).

Table 4: Comparison of compostable and oxo-biodegradable plastics

Compostable plastic	Oxo-biodegradable plastic
Can be recycled as part of a normal plastic waste stream	Damages recycle stream unless extracted from feedstock
Can be made from recycled plastic	Cannot be made from recycle
Emits CO ₂ slowly while degrading and forms biomass Inert deep in landfill	Emits CO ₂ rapidly while degrading
Can use same machinery as for conventional plastic	Needs special machinery
Can be compostable	Degrades only in high-microbial environment
Four or five times more expensive than conventional plastic	Little or no on-cost
Same strength as conventional plastic	Weaker than conventional plastic
Same weight as conventional plastic Leak-proof Degrades anywhere on land or sea	Weaker than conventional plastic
No PCB's, organo-chlorines, or "heavy metals"	Can be incinerated, but lower calorific value
Can be incinerated with high energy-recovery	
Production uses no fertilizers, pesticides or water	Production uses fertilizers, pesticides and water
Safe for food contact	Safe for food contact

Source: Business Insights

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Market outlook

The global production capacity for bioplastics reached 400,000 tons in 2009, according to a study from the University of Utrecht, and is forecast to reach 3.5m tons by 2020, representing a Compound Annual Growth Rate (CAGR) of 21.8%. Europe currently leads the field in regulation and infrastructure for biodegradable packaging, and accounted for over 50% of world tonnage for bioplastic packaging consumption in 2010.

The US still dominates in terms of production capacity, but even here it is gradually losing its dominance. In 2003 the US accounted for 84% of global bioplastics production, compared to just 15% in Europe. However, by 2007 Europe had almost doubled its capacity to 33%, while the US share fell to 36%, and Asia accounted for 29% - a dramatic increase from just 1% in 2003. According to the European Bioplastics association, by 2020 Europe and the US are likely to each account for around a quarter of production capacity, while Asia, South America, and new players will provide the rest.

