

The Complete Book on Biodegradable Plastics and Polymers (Recent Developments, Properties, Analysis, Materials & Processes)

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Biodegradable plastics made with plant based materials have been available for many years. The term biodegradable means that a substance is able to be broken down into simpler substances by the activities of living organisms, and therefore is unlikely to persist in the environment. There are many different standards used to measure biodegradability, with each country having its own. The requirements range from 90 per cent to 60 per cent decomposition of the product within 60 to 180 days of being placed in a standard composting environment. They may be composed of either bio plastics, which are plastics whose components are derived from renewable raw materials, or petroleum based plastics which contain additives.

Biodegradability of plastics is dependent on the chemical structure of the material and on constitution of the final product, not just on the raw materials used for its production. Polyesters play a predominant role as biodegradable plastics due to their potentially hydrolysable ester bonds. Bio based polymers are divided into three categories based on their origin and production; polymer directly extracted from biomass, polymers produced by classical chemical synthesis using renewable biomass monomer and polymers produced by microorganisms or genetically modified bacteria. In response to public concern about the effects of plastics on the environment and in particular the damaging effects of sea litter on animals and birds, legislation is being enacted or is pending in many countries to ban non degradable packing, finishing nets etc.

This book basically deals with biodegradable plastics developments and environmental impacts, hydro biodegradable and photo biodegradable, starch synthetic aliphatic polyester blends, difference between standards for biodegradation, polybutylene succinate (pbs) and polybutylene, recent developments in the biopolymer industry, recent advances in synthesis of biopolymers by traditional methodologies, polymers, environmentally degradable synthetic biodegradable polymers as medical devices, polymers produced from classical chemical synthesis from bio based monomers, potential bio based packaging materials, conventional packaging materials, environmental impact of bio based materials: biodegradability and compostability, etc.

Environmentally acceptable degradable polymers have been defined as polymers that degrade in the environment by several mechanisms and culminate in complete biodegradation so that no residue remains in the environment. The present book gives thorough information to biodegradable plastic and polymers. This is an excellent book for scientists engineers, students and industrial researchers in the field of bio based materials.

BIODEGRADABLE PLASTICS – DEVELOPMENTS AND ENVIRONMENTAL IMPACTS

Biodegradable

The ASTM defines “biodegradable” as

Compostable

“Compostable” is defined by the ASTM as

Hydro-biodegradable and Photo-biodegradable

Bio-erodable

Thermoplastic Starch Products

Degradation Mechanisms and Properties

Starch Synthetic Aliphatic Polyester Blends

Degradation Mechanisms and Properties

Starch and PBS/PBSA Polyester Blends

Degradation Mechanisms and Properties

Starch-PVOH Blends

Degradation Mechanisms and Properties

PHA (Naturally Produced) Polyesters

Degradation Mechanisms and Properties

PHBH (Naturally Produced) Polyesters

Degradation Mechanisms and Properties

PLA (Renewable Resource) Polyesters

Degradation Mechanisms and Properties

PCL (Synthetic Aliphatic) Polyesters

Degradation Mechanisms and Properties

PBS (Synthetic Aliphatic) Polyesters

Degradation Mechanisms and Properties

AAC Copolyesters

Degradation Mechanisms and Properties

Modified PET

Degradation Mechanisms and Properties

Water Soluble Polymers

Polyvinyl Alcohol (PVOH)

Degradation Mechanisms and Properties

Ethylene Vinyl Alcohol (EVOH)

Photo-biodegradable Plastics

Degradation Mechanisms and Properties

Controlled Degradation Additive Masterbatches

Degradation Mechanisms and Properties

Coated Paper

Agricultural Mulch Film

Shopping Bags

Food Waste Film and Bags

Consumer Packaging Materials

Landfill Cover Film

Other Applications

Biodegradation Standards and Tests

American Society for Testing and Materials

ASTM D5338-93 (Composting)

ASTMD5209-91 (Aerobic, Sewer Sludge)

ASTM D5210-92 (Anaerobic, Sewage Sludge)

ASTM D5511-94 (High-solids Anaerobic Digestion)

ASTM Tests for Specific Disposal Environments

International Standards Research
International Standards Organisation
European Committee for Normalisation
â€™OK Compostâ€™™ Certification and Logo
Compost Toxicity Tests
Plant Phytotoxicity Testing
Animal Toxicity Test
Difference Between Standards for Biodegradation
Development of Australian Standards
Composting Facilities and Soil Burial
Key Factors Defining Compostability
Physical Persistence
Chemical Persistence
Toxicity
Effect on Quality of Compost
Anaerobic Digestion
Waste Water Treatment Plants
Reprocessing Facilities
Landfills
Marine and Freshwater Environments
Litter
Key Issues
Recyclable Plastics Sorting Considerations
Reprocessing Considerations
Polyolefin Reprocessing
Polyethylene Reprocessing
Composting
Landfill Degradation
Energy Use
Greenhouse Gas Emissions
Pollution of Aquatic Environments
Increased Aquatic BOD
Water Transportable Degradation Products
Risk to Marine Species
Litter
Compost Toxicity
Recalcitrant Residues
Aromatic Compounds
Additives and Modifiers
Isocyanate Coupling Agents
Plasticisers
Fillers
Catalyst Residues
Prodegradants and Other Additives
Source of Raw Materials
Development of Australian Standards and Testing
Life-Cycle Assessment
Minimisation of Impact on Reprocessing
Determination of Appropriate Disposal Environments
Education
Identify standards and test methods for biodegradable
plastics in Australia
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Activated Sludge
Aerobic degradation
Aliphatic-aromatic Copolyesters (AAC)
Aliphatic polyesters (e.g. PCL)
Amylose
Anaerobic degradation
ASTM
Bioassimilation
Biodegradable
Bioerodable
Biomass
Compostable
Compostable Plastics
Composting
Copolyesters
Decomposer organism
Degradability
Degradable PET
Ecotoxicity
Foamed starch
Functional Group
Humus
Hydrolysis
LCA
Masterbatch
Mineralisation
Modified PET
Monomer
Organic Recycling
Photo-biodegradation
Photodegradable
Phytotoxicity
Plastified Starch
Polybutylene succinate (PBS) and polybutylene
succinate adipate (PBSA)
Polycaprolactone (PCL)
Polyesters
Polyhydroxyalkanoates (PHA)
Polyhydroxybutyrate (PHB)
Polylactic Acid (PLA)
Polylactic acid aliphatic copolymer (CPLA)
Polymer
Polyvinyl Alcohol (PVOH)
Prodegradant
Recalcitrant Residues
Thermoplastic Polymers
Thermosetting Polymers
Thermoplastic Starch

2. RECENT DEVELOPMENTS IN THE BIOPOLYMER INDUSTRY

INTRODUCTION

FIBRE-REINFORCED COMPOSITES

STARCH BASED MATERIALS

PLANT PRODUCED POLYMERS

MICROBIALY PRODUCED POLYMERS

BIOLOGICALLY-BASED RESINS, ADHESIVES,
AND COATINGS

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A Modification of Polysaccharides

Modification of Polypeptides

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Test Methods

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Starch and derivatives

Cellulose and derivatives

Chitin/Chitosan

Proteins

Casein

Gluten

Soy protein

Keratin

Collagen

Whey

Zein

Polymers produced from classical chemical synthesis

from biobased monomers
Polylactic acid (PLA)
Biobased monomers
Polymers produced directly by natural or genetically
modified organisms
Poly(hydroxyalkanoates) (PHAs)
Bacterial cellulose
Material properties
Gas barrier properties
Gas barriers and humidity
Water vapour transmittance
Thermal and mechanical properties
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Blown (barrier) films
Thermoformed containers
Foamed products
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Additional developments
Conclusions and perspectives

FOOD BIOPACKAGING

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Modified atmosphere packaging
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Food packaging requirements
Replacing conventional food packaging materials
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Conventional packaging materials
Potential biobased materials
Ready meals
Conventional packaging materials
Potential biobased packaging materials

Dairy products
Conventional packaging materials
Potential biobased packaging materials
Beverages
Conventional packaging materials
Potential biobased packaging materials
Fruits and vegetables
Conventional packaging materials
Potential biobased materials
Snacks
Conventional packaging materials
Potential biobased packaging materials

Frozen products

Conventional packaging materials

Potential biobased packaging materials

Dry products

Conventional packaging materials

Potential biobased packaging materials

Conclusions and perspectives

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Biobased materials

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The CEN activity

The compostable packaging

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Environmental impact of bio-based products

The Buwal study on starch-based plastics

The case of hemp-based materials: LCA does not allow generic statements

Compostoâ€™s study on bags for the collection of organic waste

The Ecobilanâ€™s study. The LCA of paper sacks
The Ifeu-IBIFA-study The LCA of loose-fill-packaging

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Today

Tomorrow

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Food applications

Safety and legislation on materials in contact with food

The environment

The market of biobased packaging materials

Perspective

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BEGIN INSERT

PLASTICS FROM POTATO WASTE

STARCH TO GLUCOSE TO LACTIC ACID

LACTIC ACID INTO PLASTIC

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Biodegradation by *Pseudomonas* sp.

Weight loss data

Materials

Test microorganisms

Testing of the samples

Weight loss data

APPENDIX 1

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The forward draw (FWD)

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MATERIALS
APPLICATIONS
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