AN ISO 9001 : 2015 CERTIFIED COMPANY

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

AN ISO 9001 : 2015 CERTIFIED COMPANY

Author: NIIR Board of Consultants & Engineers
Format: paperback
Code: NI165
Pages: 672
Price: Rs 1275 | US$ 125
Publisher: NIIR PROJECT CONSULTANCY SERVICES
Shipping: 5 days

About the Book

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 produces 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.

Contents

BIODEGRADABLE PLASTICS â€" DEVELOPMENTS AND ENVIRONMENTAL IMPACTS
Biodegradable
The ASTM defines â€˜biodegradableâ€™ as
Compostable
â€˜Compostableâ€™ 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
Addigtives 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
APPENDIX A
Abiotic disintegration
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
suucinate 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
MICROBIALLY PRODUCED POLYMERS
BIOLOGICALLY-BASED RESINS, ADHESIVES,
AND COATINGS
CONTINUING RESEARCH AND DEVELOPMENT
ON BIOPOLYMERS
CONCLUSION
3. RECENT ADVANCES IN SYNTHESIS OF BIOPOLYMERS BY â€œTRADITIONALâ€• METHODOLOGIES
INTRODUCTION
BIODEGRADABLE POLYMERS
POLYMER MODIFICATION
A Modification of Polysaccharides
Modification of Polypeptides
Summary
4. POLYMERS, ENVIRONMENTALLY DEGRADABLE
DEFINITIONS
OPPORTUNITIES FOR ENVIRONMENTALLY DEGRADABLE PLASTICS AND POLYMERS
TEST METHODS FOR ENVIRONMENTALLY DEGRADABLE POLYMERS
Test Methods
DEGRADATION MECHANISMS
Photodegradation
BIODEGRDATION
PRODUCTION OF ENVIRONMENTALLY DEGRADABLE POLYMERS
5. SYNTHETIC BIODEGRADABLE POLYMERS AS MEDICAL DEVICES
POLYMER CHEMISTRY
A Note on Nomenclature
PACKAGING AND STERILIZATION
PROCESSING
Factors That Accelerate Polymer Degradation
DEGRADATION
COMMERCIAL BIODEGRADABLE DEVICES
6. BIOBASED PACKAGING MATERIALS FOR THE FOOD INDUSTRY
INTRODUCTION
PROPERTIES OF BIOBASED PACKAGING
MATERIALS
Introduction
Food biobased materials - a definition
Origin and description of biobased polymers
Polymers directly extracted from bio-mass
Polysaccharides
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
Compostability
Possible products produced of biobased materials
Blown (barrier) films
Thermoformed containers
Foamed products
Coated paper
Additional developments
Conclusions and perspectives
FOOD BIOPACKAGING
Introduction
Food packaging definitions
Primary, secondary and tertiary packaging
Edible coatings and films
Active packaging
Modified atmosphere packaging
Combination materials
Food packaging requirements
Replacing conventional food packaging materials with biobased materials - a challenge
Biobased packaging - food quality demands
State-of-the-art in biopackaging of foods
Potential food applications
Fresh meat products
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
SAFETY AND FOOD CONTACT LEGISLATION
Introduction
Biobased materials and legislation on food contact materials
Common EU legislation
Biobased materials
Petitioner procedures
Standardized test methods
Implications of EU legislation for food and packaging industry
Assessment of potentially undesirable Interactions
Migration of compounds from biobased packages to contained food products
Microbiological contamination of biobased food packages
Penetration of microorganisms through biobased packaging materials
Penetration of insects and rodents into biobased food packages
Collapse due to absorbed moisture from the environment and the contained food product
Conclusions and perspectives
ENVIRONMENTAL IMPACT OF BIOBA-SED MATERIALS: BIODEGRADABILITY AND COMPOSTABILITY
Biodegradability
The composting of biobased packaging
The CEN activity
The compostable packaging
Characterization
Laboratory test of biodegradability
Disintegration under composting conditions and verification of the effects on the process
Compost quality: chemical and eco-toxicoiogical analysis
Natural materials
Biodegradability under other environmental conditions
ENVIRONMENTAL IMPACT OF BIOBA-SED MATERIALS: LIFECYCLE ANALYSIS OF AGRICULTURE
A sustainable production of biobased products
What is LCA?

Environmental impact of agriculture
Crops for biofuels
The ECN study
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 lfeu-IBIFA-study The LCA of loose-fill-packaging
Conclusions
THE MARKET OF BIOBASED PACKAGING
MATERIALS
Introduction
Market appeal
Market drivers
Marketing advantages
Functional advantage in the product chain
Cost advantage in the waste disposal system
Legislative demands
Consumers
The market
Today
Tomorrow
Price
Conclusions
CONCLUSION AND PERSPECTIVE
Performance of materials
Food applications
Safety and legislation on materials in contact with food
The environment
The market of biobased packaging materials
Perspective
7. PLASTICS FROM POTATO WASTE (SENATE â€“ JUNE 20, 1991)
BEGIN INSERT
PLASTICS FROM POTATO WASTE
STARCH TO GLUCOSE TO LACTIC ACID
LACTIC ACID INTO PLASTIC
POTENTIAL MARKETS
8. BIODEGRADABLE PLASTICS FROM RENEWABLE SOURCES
ANALYSIS
Plastics and the environment
The move to renewable sources
Extending the recycling loop
Biopolymers, conventional plastics and
biodegradable plastics
The plastics sector
Packaging
Plastic films
Structure of the business
Recent developments

Biodegradability and compostability
Challenges ahead
9. SYNTHETIC POLYMERS FUNCTIONALIZED BY CARBOHYDRATES
Polymerizations of the vinyl sugar monomers
to obtain poly(vinylsaccharide)s
Polymerization of anhydro sugars
Anhydro sugar polymerizations
Enzymatic and Enzyme mediated Polymerizations (Chemo-enzymatic methods)
Polymer analogous reactions
10. BIODEGRADABLE POLYOLEFINS
General procedure for grafting of sugars
onto poly(styrene maleic anhydride)
Determination of biodegradability of polymers
using aerobic microorganisms
Weight loss data
FTIR Spectral Data
Molecular weight decrease after biodegradation
by GPC
Appendix 1
Mechanism of reaction of poly(styrene maleic
anhydride) with the sugar
Appendix 2
Scanning electron micrographs of the polymers before
and after bacterial degradation
11. PROCESS FOR THE PREPARATION OF BIODEGRADABLE SYNTHETIC POLYMERS
FORMULA OF THE PRODUCT
INTRODUCTION
OBJECTIVE OF THE PRESENT INVENTION
Wherein
PREFERRED EMBODIMENTS
EXPERIMENTAL/ EXAMPLES
CLAIMS
CONCLUSION
12. FUNGAL DEGRADATION OF CARBOHYDRATE-LINKED POLYSTYRENES
Materials
Synthesis of sugar linked PS-MAH (General Procedure)
FTIR Spectra
Test microorganisms
Testing of the samples
APPENDIX 1
Reaction Mechanism
Calculations (representative)
For sucrose linked to poly(styrene maleic anhydride)
APPENDIX 2
13. GLUCOSE AND GLUCOSE DERIVATIVES WITH POLY(STYRENE MALEIC
ANHYDRIDE)
APPENDIX 1
1,2-5,6 Diisopropylidene D- glucose
Step 1: Tritylation and acetylation of D- glucose
Blank reaction of PSMAH in DMF solvent system
with 4-DMAP as the catalyst

Hydrolysis reaction of PSMAH using DMF as
the solvent and 4-DMAP as the catalyst
14. THERMAL ANALYSIS OF SUGAR- LINKED POLY(STYRENE MALEIC ANHYDRIDE)
Thermogravimetry
FTIR characterization of the thermally treated products
15. BIOMINERALIZATION OF THE SUGAR-LINKED POLY(STYRENE MALEIC
ANHYDRIDE)
Experimental set-up
Composition of minimal medium for 1 litre solution
Solutions for the titration are as follows
Preparation of the inoculum
16. BIODEGRADATION OF ACYLATED SUGAR-LINKED POLY(STYRENE
MALEIC ANHYDRIDE)
Procedure for Acylation of sugar- linked
poly(styrene maleic anhydride) polymers
FTIR spectroscopy of the acylated derivatives
of sugar-linked poly(styrene maleic anhydride)
Thermal studies of acylated derivatives of sugar-
linked poly(styrene maleic anhydride) polymers
Biodegradation by Serratia marscecens
Biodegradation by Pseudomonas sp.
Weight loss data
Materials
Test microorganisms
Testing of the samples
Weight loss data
APPENDIX 1
(Sugar-linked PSMAH and their acylated products degraded by Serratia marscecens and Pseudomonas sp.)
Preparation of Reagent A, B, C, and D
17. BIOTECHNOLOGY: AN ENABLING TECHNOLOGY
BIOTECHNOLOGY AND CO2 EMISSIONS
THE SOYA BEAN: AN IMPORTANT RENEWABLE RESOURCE
CHEMICALS FROM BIOLOGICAL FEEDSTOCKS
LIFE CYCLE ASSESSMENT OF PROTEASES
18. DEGRADABLE PLASTICS FOR COMPOSTING
CERTIFICATION AND STANDARDS
BIODEGRADABLE POLYMERS
DEGRADABLE PLASTICS
WHAT USERS WANT
QUESTIONS FOR THE FUTURE
19. STARCH BASED BIODEGRADABLE PLASTICS
INTRODUCTION
TECHNOLOGY COMMERCIALIZATION MODEL
APPLICATION OF TECHNOLOGY COMMERCIALIZATION MODEL
Starch-based Biodegradable Plastics â€“ Commercialization Case Studies
CONCLUSION
20. BIODEGRADABLE PLASTICS FROM WHEAT STARCH AND POLYLACTIC ACID (PLA)
INTRODUCTION AND BACKGROUND
RESULTS FROM PREVIOUS FUNDING
RATIONAL AND SIGNIFICANCE
PROCEDURES/METHODOLOGY

OTHER RELATED WORKS
21. MAKING PACKAGING GREENER â€" BIODEGRADABLE PLASTICS
PLASTICS THAT BREAK DOWN
PLASTICS CAN BE PRODUCED FROM STARCH
PLASTICS CAN ALSO BE PRODUCED BY
BACTERIA
WHATâ€™S THE COST?
BIODEGRADABLE AND AFFORDABLE
MULCH FILM FROM BIODEGRADABLE PLASTICS
POTS YOU CAN PLANT
DIFFERENT POLYMER BLENDS FOR DIFFERENT PRODUCTS
LANDFILL SITES ARENâ€™T COMPOST HEAPS
COMPOSTING THE PACKAGING WITH ITS CONTENTS
AN OLYMPIC EFFORT â€" RECYCLING 76
PER CENT OF WASTE
22. PET MATERIALS AND APPLICATIONS
INTRODUCTION
POLYMERISATION AND MANUFACTURING PROCESSES
Manufacturing plants
STRUCTURES, MORPHOLOGY AND ORIENTATION
Structure
Morphology
Orientation
Creep
PROPERTIES
Molecular weight and intrinsic viscosity
End group
Thermal properties
RHEOLOGY AND MELT VISCOSITY
Melt viscosity
Melt flow
Moulding shrinkage
MOISTURE UPTAKE AND POLYMER DRYING
Moisture level
Polymer drying
DEGRADATION REACTIONS
Thermal and thermal oxidative degradation
Environmental degradation
REHEAT CHARACTERISTICS
GAS BARRIER PROPERTIES
AMORPHOUS POLYESTERS
Homopolymers
Low copolymers
Medium copolymers
High copolymers
CRYSTALLINE POLYMERS
POLYMER BLENDS
APPLICATIONS
TRENDS
GLOBALS
23. PET FILM AND SHEET

Extrusion
Casting
The forward draw preheat (FWDPH)
The forward draw (FWD)
The sideways draw preheat (SWDPH)
The sideways draw (SWD)
24. INJECTION AND CO-INJECTION PREFORM TECHNOLOGIES
MULTILAYER CHARACTERISTICS
APPLICATIONS
Performance-driven applications
Economics - or legislative-driven applications
Combination applications
CLOSURE VS BOTTLE PERMEATION
CONTAINER PERFORMANCE
Barrier properties
Oxygen barrier
Carbon dioxide barrier
Scavenger property
WALL STRUCTURE
PREFORM AND BOTTLE DSESIGN
Permeation through finish, sidewall and base
Controlled fill
HEADSPACE OXYGEN ABSORPTION
OXYGEN DESORPTION FROM PET
BEER CONTAINERS
SMALL JUICE CONTAINERS
SMALL CSD CONTAINERS
CORE LAYER VOLUMES
RECYCLING
COMPARISON OF CO-INJECTION TECHNOLOGIES
CO-INJECTION MOLDING EQUIPMENT
25. INJECTION BLOW MOULDING
INTRODUCTION
BASIC PRINCIPLES
HISTORY
PROCESS IDENTIFICATION
COMMERCIAL PROCESSES
Rotary table machines : Jomar, Uniloy and similar
TOOLING
PROCREA
MATERIALS
APPLICATIONS
Machine and process capabilities

NIIR PROJECT CONSULTANCY SERVICES (NPCS) is a reliable name in the industrial world for offering integrated technical consultancy services. NPCS is manned by engineers, planners, specialists, financial experts, economic analysts and design specialists with extensive experience in the related industries.

Our various services are: Detailed Project Report, Business Plan for Manufacturing Plant, Start-up Ideas, Business Ideas for Entrepreneurs, Market Research, Manufacturing Process, Machinery, Raw Materials, Project Feasibility, Investment Opportunities, Technical Consultancy and Startup Help.

NPCS also publishes process technology books, technical books, startup books, directory, business database, detailed project reports and market research reports.

Our Detailed Project Report aims at providing all the critical data required by entrepreneurs for starting new business ventures.

NIIR PROJECT CONSULTANCY SERVICES
106-E, Kamla Nagar, New Delhi-110007, India

Email: npcs.india@gmail.com **Website:** https://www.niir.org/