World Skill Development Institute

Biodegradable Plastics and Polymers

Course Duration – 1 Year.

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 course 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 course gives thorough information to biodegradable plastic and polymers. This is an excellent course 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

Compostableis 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

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

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

Co polyesters

Decomposer organism

Degradability

Degradable PET

Eco toxicity

Foamed starch

Functional Group

Humus

Hydrolysis

LCA

Master batch

Mineralisation

Modified PET

Monomer

Organic Recycling

Photo-biodegradation

Photodegradable

Phytotoxicity

Plastified Starch

Polybutylene succinate (PBS) and polybutylene

suucinate adipate (PBSA)

Polycaprolactone (PCL)

Polyesters

Food packaging requirements

Replacing conventional food packaging materials with bio based materials - a challenge

Bio based packaging - food quality demands

State-of-the-art in bio packaging 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

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 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

Calculations (representative)

For sucrose linked to poly(styrene maleic anhydride)

13.GLUCOSE AND GLUCOSE DERIVATIVES WITH POLY(STYRENE MALEIC ANHYDRIDE)

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)

Thermo gravimetry

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

Rotary table machines : Jomar, Uniloy and similar

TOOLING

PROCREA

MATERIALS

APPLICATIONS

Machine and process capabilities