POLYMERUPDATE ACADEMY

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INDUSTRIAL POLYMER TECHNOLOGY: MATERIALS & PROCESSING

Prepared & Conducted by

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Summary

This course provides a comprehensive overview of polymer fundamentals and industrial processing techniques, designed specifically for professionals in the polymer industry. Through a series of engaging lectures, participants will gain a deep understanding of the chemistry of polymers, material selection criteria, and various processing methods for both thermoplastics and thermosetting polymers.

The introductory module focuses on the fundamentals of polymers, covering the history of polymers, basic raw materials, and key concepts such as monomers, oligomers, and macromolecules. The participants will explore the basic chemistry of polymers, different polymerization techniques, and various classification systems for polymers. The session concludes with an examination of molecular weight and its significance in polymer science.

Module 2 delves into Polymeric Materials and Additives. In Lecture II, participants will gain insights into the wide range of polymer materials and their applications across different industries. The lecture covers major types of thermoplastics, thermosets, and rubbers, along with their properties and selection criteria.

Summary

In Lecture III, participants will explore the world of polymeric additives, understanding their functions and technical requirements. They will also learn about mixing devices, pigments, dyes, masterbatches, and color assessment. Additionally, the lecture provides an overview of various additives, such as nucleating agents, impact modifiers, foaming agents, flame retardants, coupling agents, antimicrobial agents, anti-fogging agents, and antistatic agents.

Module 3 is into Industrial Processing of Polymers, which is divided into three lectures. Lecture IV focuses on the processing of industrial thermoplastics, providing an overview of various techniques such as injection molding, blow molding, rotational molding, calendering, and thermoforming. Participants will gain in-depth knowledge of the process steps, machinery involved, critical parameters, and troubleshooting methods for each technique.

The lecture concludes by discussing the advantages and disadvantages of each processing method. Lecture V explores the processing of industrial thermoplastics in further detail, with a specific focus on extrusion. Participants will learn about extrusion processes, machinery, extruder zones, screw designs, die operations, troubleshooting techniques, and advancements in extrusion systems.

Summary

The lecture also covers 3D printing processes, including material extrusion, jetting, bed fusion, design considerations, and post-processing methods. The lecture concludes with a comprehensive analysis of the advantages and disadvantages associated with different processing techniques.

Lecture VI focuses on the processing of industrial thermosetting polymers. Participants will gain insights into compression molding, thermoforming, injection molding, extrusion of thermosets, sheet and bulk molding compounds, and conventional methods such as compression molding, transfer molding, hand lay-up, spray-up, resin transfer molding, filament winding, and pultrusion.

By the end of this course, participants will have a robust foundation in polymer science and a comprehensive understanding of various industrial processing techniques. They will be equipped with the knowledge and skills necessary to make informed decisions in materials selection, optimize processing parameters, troubleshoot common issues, and contribute to the advancement of polymer technology in their respective fields.

Who is this course for?

- Researchers and Development Professionals in the Polymer Industry: Those working in research and development departments of companies in the polymer industry can benefit greatly from this course. They will gain a deeper understanding of the fundamentals of polymers, their chemistry, and classification, molecular weight and structure-property relationship which can help in developing new products or improving existing ones.
- Quality Control Professionals: Quality control professionals responsible for ensuring that the final products meet the required quality standards will benefit from the polymer selection and properties for polymeric materials. They will learn about properties such as mechanical, thermal, electrical, chemical, and rheological properties and how to differentiate materials based on them.
- Production Managers and Engineers: Production managers and engineers involved in the manufacturing process of polymer products will benefit from the polymer processing session of the course. They will learn about the different processing techniques, their advantages, and disadvantages, and how to select the appropriate technique for a given product.

Who is this course for?

- Materials Engineers: Materials engineers responsible for selecting the appropriate polymer materials for different applications will benefit from the polymeric materials and additives session of the course. They will learn about the different types of polymer materials, their properties, and selection criteria. They will also learn about the different types of additives and how to design and optimize formulations for specific applications.
- Sales and Marketing Professionals: Sales and marketing professionals in the polymer industry will benefit from this course as well. They will gain a deeper understanding of the fundamentals of polymers, polymeric materials and additives, and polymer processing techniques. This knowledge will enable them to communicate more effectively with customers and understand their needs better.

Who is this course for?

- Traders, dealers, and distributors in the polymer business: They will benefit from this course by gaining in-depth knowledge of polymer fundamentals, materials, and processing techniques. This will enable them to offer informed recommendations to customers, make accurate material selections, communicate effectively, and stay up-to-date with industry trends. The course will their expertise, improves customer satisfaction, and strengthens their position in the competitive polymer market.
- Graduate Students and Researchers: Graduate students and researchers in the field of polymer science and engineering can also benefit from this course. It provides a comprehensive overview of the fundamentals of polymers, polymeric materials, and processing techniques, which can help in developing new ideas and research directions.

What will you learn?

- Understand the history, basic raw materials, and chemistry of polymers
- Describe various classification of polymers and their molecular weight
- Identify different types of polymer materials (thermoplastics, thermosets and elastomers) used in different industries and their properties (mechanical, thermal, electrical, etc.)
- Apply polymer selection criteria to choose the right polymer material for a specific application
- Explain the types of additives and their functions in polymer formulation design and optimization
- Learn about injection molding, including machinery, process optimization, and troubleshooting, for efficient production of thermoplastic parts.
- Learn about machinery, process parameters, and material considerations, for optimal results in thermoplastic processing methods such as injection molding, extrusion, blow molding, rotational molding, calendering, thermoforming, and 3D printing techniques, etc.
- Gain knowledge for thermosetting processing methods including, compression molding, injection molding, and other techniques for processing thermosetting polymers (transfer molding, hand lay-up, spray up, resin transfer molding, filament winding and pultrusion).
- Understand the processes along with advantages and disadvantages of different polymer processing techniques.

Lecture 1: Introduction to Industrial Polymers and its Chemistry

- History of polymers, a general overview, basic raw materials, concepts and definitions of monomers, oligomers, macromolecules, etc.
- Basic chemistry of polymers
- Polymerization techniques
- Various classification of polymers and impact of structure on polymer properties
- Molecular Weight

Lecture 2: Polymeric Materials and Selection

- Overview of polymer materials and their applications
- Types of polymer materials used in different industries such as
  - Thermoplastics: PE, PP, PVC, PS, PC, ABS, Nylon, PET, PBT, etc.
  - Thermosets: Unsaturated polyester, Vinyl ester, Epoxy, PF, MF, UF, etc.
  - Rubbers: Isoprene, Neoprene, Nitrile, silicon, fluoroelastomer etc.
- Properties of polymer materials
- Polymer selection criteria

Lecture 3: Polymeric Additives

- Types of additives such as stabilizers, process aids, etc. and their functions
- Technical requirements for usage of additives in polymers
- Mixing devices
- Pigments, dyes, masterbatches and color assessment
- Overview over additives such as Nucleating agents, Impact modifiers, Foaming agents, Flame retardants, Coupling agents, Antimicrobial agents, Anti-fogging agents, Antistatic agents.

Lecture 4: Processing of Industrial Thermoplastics - Part I

- Overview of polymer processing techniques
- Injection Molding: Process, machinery, pressure cycle, plasticisation methodology, screw design, mold, injection and clamping units, utilities and auxiliaries, troubleshooting, advanced injection molding methods such as GAIM, co-injection, overmolding, LIM, LPIM.
- Blow Molding: Process, multi mold production methodologies, machinery, IBM, EBM, ISBM, troubleshooting.
- Rotational Molding: Process, machinery, flow patterns during processing, rotation speeds, troubleshooting.
- Calendering: Process, Machinery, parameters, PVC processing, troubleshooting.

- Thermoforming: Process, various thermoforming processes, critical parameters, troubleshoot, etc.
- Advantages and disadvantages of different processing techniques

Lecture 5: Processing of Industrial Thermoplastics - Part II

- Extrusion: Process, machinery, extruder zones, single and twin screw extrusion, vented extruder, modular design, feeding concepts: volumetric and gravimetric, die design and operations, blown film extrusion, coextrusion, cast film/sheet extrusion, fiber extrusion, troubleshooting, advancements in extrusion systems such as feed enhancement technology, triple screw extruders: parallel and non-parallel configurations, quad and octa screw extruders with various screw positioning systems, continues mixers, ring extruder and roller extruder.
- 3D printing: Process, methods such as material extrusion, jetting, bed fusion, etc., materials for 3D printing, design considerations, post processing and finishing.
- Advantages and disadvantages of different processing techniques

Lecture 6: Processing of Industrial thermosetting Polymers

- Compression Molding of thermosets
- Injection molding and extrusion of thermosets
- Sheet and Bulk molding compounds
- Conventional methods for thermosets such as compression molding, transfer molding, hand lay-up, spray up, filament winding and pultrusion

Dr. Prashant Gupta

B Tech. M. E. PGD - CTM. Ph. D.

Born on June 6th, 1987, Dr. Gupta is a Polymer Technologist and has obtained his Masters, Post Graduate Diploma and Ph. D. from Institute of Chemical Technology, Mumbai. With virtue of his excellence in PGD-CTM course, Dr. Gupta has been awarded with a Gold Medal for securing top merit in the course.

Dr. Gupta has 5.5 years of academic experience (teaching/research) along with Industrial Research & Development experience in managerial positions for around 3.5 years in polymer compounding, testing, processing, and composites. Dr. Gupta has more than 20 publications to his credit in peer reviewed journals and books with high impact international (Elsevier, Wiley, Springer, Taylor & Francis etc.) publishers.

His areas of expertise and teaching include testing and quality control, polymer additives and compounding, polymer processing technology, polymer recycling and waste management, biodegradable and oxo-degradable plastics for packaging, use of information and communication technology for effective teaching learning, pedagogy related to teaching-learning, artificial intelligence in teaching learning, content creation for virtual laboratory, its development and applications.

Dr. Gupta has offered his expertise in the form of technical presentations at more than 20 international and prestigious national conferences/events across the globe some of which include EUROTEC-France, ANTEC-Mumbai, ICERP-Hyderabad, PPS-Mumbai, APM-Lucknow, APA-Chandigarh, Rangotsav-Mumbai, AMAI-Ahmedabad, etc. and won several awards for best paper, poster, project etc. Dr. Gupta has also been recognized as a certified developer, mentor, and reviewer for Virtual Labs, Mumbai an initiative of IIT M, IIT D and IIT K under MHRD, India.

Work Experience:

Organization Name: Maharashtra Institute of Technology
Tenure: 19th Sep 2016 onwards
Assistant Professor-Plastics and Polymer Engineering Dept. (UGC Approved) Junior Scientist, MIT-Center for Advanced Materials Research and Technology

Organization Name: Loxim Industries Ltd.
Tenure: 1st Sep 2015 – 16th Sep 2016
HOD and Manager: R & D/Quality Control
Management and Customer Representative-ISO-TS 16949

Organization Name : Crest Composites and Plastics Pvt. Ltd, Ahmedabad Tenure: 21st Apr 14 –31st Aug 15
Assistant Manager, (R & D) Application Development

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