

**COURSE OVERVIEW PE0025**  
**Polymers & Polymerization**

**Course Title**

Polymers & Polymerization

**Course Date/Venue**

October 06-10, 2019/Dhow 2 Meeting Room, Samaya Hotel, Dubai, UAE

**Course Reference**

PE0025

**Course Duration/Credits**

Five days/3.0 CEUs/30 PDHs



**Course Description**

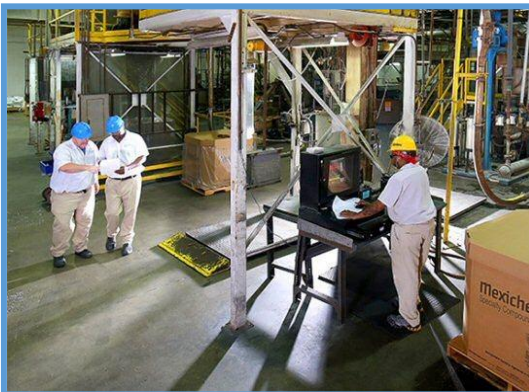


***This hands-on, highly-interactive course includes real-life case studies where participants will be engaged in a series of interactive small groups and class workshops.***

Polymers and composites are widely used for a range of applications in engineering and technology. Selecting the correct material which is fit for purpose is a critical decision faced by engineers and scientists who do not necessarily have an in-depth knowledge of the chemistry or physics of polymers.



Polymers are macromolecules built up by linking large numbers of smaller molecules. Due to their diverse physical properties, polymers have become central to a number of important industries, including plastics, rubber, adhesives, fiber, composites and paint industries.



This course is designed to provide a good introductory to polymer and polymerization. It includes polymer basic definitions and concepts, and an overview of the basis for the various classifications of polymers. It also examines the requirements for polymer formation from monomers and discusses polymer structure at three levels: primary, secondary and tertiary. The relationship between the structure of monomers and properties of the resulting polymer is highlighted.

Throughout the discussions, emphasis is on the structure-property relationship and several examples are used to illustrate the concept.

The course provides a practical insight into the factors which influence the performance of a polymer or composite allowing informed selections to be made. The course covers polymer synthesis, polymer micro-structure and morphology, properties of polymers, plastic materials, processing of plastics, applications of plastics and polymer composites.

### **Course Objectives**

Upon the successful completion of this course, each participant will be able to:

- Apply and gain an in-depth knowledge on polymers and polymerization technologies
- Identify the various types and classification of polymeric materials
- Recognize the importance of plastics, polyolefin and catalysts as well as identify the polymerization reactions, processes, stereo regularity and microstructural features
- Analyze polymer microstructure and morphology, molecular weight & its distributions and employ thermal analysis techniques
- Describe rheology, thermoplastics, thermosets and identify the mechanical properties of expanded plastics
- Discuss the coating systems and differentiate the process, application and classification between the polymer matrix composites and fibre reinforced polymer matrix composites
- Use and apply proper environmental practices in handling, sorting and separating the recycled plastics, biodegradable polymers and describe the short fibre reinforced PMCs

### **Exclusive Smart Training Kit - H-STK®**



Participants of this course will receive the exclusive “Howard Smart Training Kit” (H-STK®). The H-STK® consists of a comprehensive set of technical content which includes **electronic version** of the course materials, sample video clips of the instructor’s actual lectures & practical sessions during the course conveniently saved in a **Tablet PC**.

### **Who Should Attend**


This course provides an overview of all significant aspects and considerations of polymer and polymerization technology for researchers, chemists, engineers, physicists and those who work in or are beginning to work in this field. Further, managers in the polymer industry will greatly benefit from this in-depth course. No prior knowledge of polymer science is assumed.

### Course Certificate(s)

Internationally recognized certificates will be issued to all participants of the course.

### Certificate Accreditations

Certificates are accredited by the following international accreditation organizations: -

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USA International Association for Continuing Education and Training (IACET)

Haward Technology is an Authorized Training Provider by the International Association for Continuing Education and Training (IACET), 2201 Cooperative Way, Suite 600, Herndon, Virginia 20171, USA. In obtaining this authority, Haward Technology has demonstrated that it complies with the **ANSI/IACET 1-2013 Standard** which is widely recognized as the standard of good practice internationally. As a result of our Authorized Provider membership status, Haward Technology is authorized to offer IACET CEUs for its programs that qualify under the **ANSI/IACET 1-2013 Standard**.

Haward Technology's courses meet the professional certification and continuing education requirements for participants seeking **Continuing Education Units (CEUs)** in accordance with the rules & regulations of the International Association for Continuing Education & Training (IACET). IACET is an international authority that evaluates programs according to strict, research-based criteria and guidelines. The CEU is an internationally accepted uniform unit of measurement in qualified courses of continuing education.

Haward Technology Middle East will award **3.0 CEUs** (Continuing Education Units) or **30 PDHs** (Professional Development Hours) for participants who completed the total tuition hours of this program. One CEU is equivalent to ten Professional Development Hours (PDHs) or ten contact hours of the participation in and completion of Haward Technology programs. A permanent record of a participant's involvement and awarding of CEU will be maintained by Haward Technology. Haward Technology will provide a copy of the participant's CEU and PDH Transcript of Records upon request.

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British Accreditation Council (BAC)

Haward Technology is accredited by the **British Accreditation Council** for **Independent Further and Higher Education** as an **International Centre**. BAC is the British accrediting body responsible for setting standards within independent further and higher education sector in the UK and overseas. As a BAC-accredited international centre, Haward Technology meets all of the international higher education criteria and standards set by BAC.

### Accommodation

Accommodation is not included in the course fees. However, any accommodation required can be arranged at the time of booking.



### Course Instructor(s)

This course will be conducted by the following instructor(s). However, we have the right to change the course instructor(s) prior to the course date and inform participants accordingly:



**Mr. Henry Beer** is a **Senior Process Engineer** with **35 years** of in-depth industrial experience within the **Petrochemical, Oil & Gas** and **Refinery** industries. His wide expertise covers in the areas of **Process Systems Foundations, Gas Processing Plant Operations & Control, Gas Processing Monitoring & Troubleshooting, Chemical Engineering, Process Equipment Design & Troubleshooting, Polymers & Polymerization, Applied Process Engineering, Process Plant Optimization, Process Plant Troubleshooting & Engineering Problem Solving, Process Plant Performance & Efficiency, Flare Blowdown & Pressure Relief Systems, Polypropylene Manufacturing, Polyethylene & Process Troubleshooting, Process Operation Troubleshooting, Fluidized Bed Reactor, Oil Movement & Storage, Power Plant Chemistry, Catalyst Manufacturing Techniques, Fuel Systems Management, Process Design & Optimization, Aviation Fuel, Diesel Engine, Jet Fuel, Petrol, IP Octane, Cetane Control, Pipeline Distribution, Boiler Fundamental Preparation, Flocculation Sedimentation, Hotline Water Softening Processes, Desalination Processes, Reverse Osmosis, Molecular Sieves, Loop Water Management System, Sludge Removal, Cooling Water System, Tank Farms and Hydrocarbons**. Currently, he is the **Director** and **Senior Technical Consultant** wherein he is deeply involved in developing new industrial process and designing new process plants and equipment.

During his career life, Mr. Beer has gained his practical and field experience through his various significant positions and dedications as the **Global Commissioning Manager, Senior Business Analyst, Process Engineer, Chemical Engineer, Technical Sales Engineer, Senior Technician, Entrepreneur, Financial Consultant, Business Analyst, Business Financial Planner, Independent Financial Planner, Investment Independent Financial Advisor, Financial Broker, Trainer/Instructor** and **Technical Consultant** for various international companies such as the Sasol, TAG Solvents, Virgin Solvent Products, RFS Financial Services (Pty) Ltd, FNB and GHC Trading.

### Course Fee

US\$ 5,500 per Delegate + **5% VAT**. This rate includes H-STK® (Haward Smart Training Kit), buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

### Training Methodology

This interactive training course includes the following training methodologies as a percentage of the total tuition hours: -

- 30% Lectures
- 20% Workshops & Work Presentations
- 20% Case Studies & Practical Exercises
- 30% Videos, Software & Simulators

In an unlikely event, the course instructor may modify the above training methodology before or during the course for technical reasons.

### Course Program

The following program is planned for this course. However, the course instructor(s) may modify this program before or during the course for technical reasons with no prior notice to participants. Nevertheless, the course objectives will always be met:

#### **Day 1: Sunday, 06<sup>th</sup> of October 2019**

0730 – 0800	Registration and Coffee
0800 – 0815	Welcome & Introduction
0815 – 0830	<b>PRE-TEST</b>
0830 – 0930	<b>Introduction to Polymers</b> Polymers –Types • Part of The Ethylene Chain • Petrochemicals from Ethylene • Petrochemicals from Propylene • Petrochemicals from Butadiene • Petrochemicals from Xylenes • General Classes of Polymers • Vocabulary • Polymers-The Journey • Polymers- Finger Prints • A History of Development of Polymers • A Classification of Polymeric Materials • Introduction to Polymers
0930 – 0945	Break
0945 – 1100	<b>Plastics, Polyolefin &amp; Catalysts</b> Amorphous • Semi-crystalline • Co-Polymers • Additives • Types of Plastics • Thermoplastic vs. Thermoset • Technology S-curves for Polyolefin Production • Z-N Catalysts- Generations Catalyst
1100 – 1215	<b>Plastics, Polyolefin &amp; Catalysts (cont'd)</b> General Composition of Catalyst System • Evolution of Single Site Catalysts • PP- Stereochemistry Vs Properties • Polyethylene – Types Vs Properties • Polyethylene (HDPE) • Polymerization Process • Methods of Polymer Fabrication
1215 – 1230	Break
1230 – 1420	<b>Polymerization Reactions</b> Free Radical Polymerization – Ethylene • Polyethylene (LDPE) • Surface Structure of Chromium Based PE Catalysts • Conventional Ziegler-Natta Catalyst • Z-N Polymerization-Stereochemistry • PP Stereochemistry- Effect of Metal & Ligand • Polymerization of Propylene- Reaction Scheme
1420 – 1430	<b>Recap</b> Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow
1430	Lunch & End of Day One



**Day 2: Monday, 07<sup>th</sup> of October 2019**

0730 – 0900	<b>Polymerization Reactions (cont'd)</b> Polymerization of Propylene – Steps • PP- Stereochemistry Vs Properties • Condensation (step-growth) polymerization • A Comparison of Polymerisation Reactions • Step-Growth Polymerisation • Comparison of Step-Reaction and Chain-Reaction Polymerization • History of PE & PP
0900 – 0915	Break
0915 – 1100	<b>Polymerization Processes</b> Bulk Polymerization • Solution Polymerization • Precipitation Polymerization • Suspension Polymerization • Emulsion Polymerization • Comparison of Polymerization Methods
1100 – 1230	<b>Stereoregularity and Microstructural Features</b> Isotactic PP • Atactic PP • Syndiotactic PP • Morphology in Crystalline Thermoplastics • Network Molecules
1230 – 1245	Break
1245 – 1420	<b>Polymer Microstructure &amp; Morphology</b> Lamellar Thickness Measurement by SAXS • Determination of Crystallinity • Density Method • Infra-red (I.R.) Method • Thermal Analysis Method
1420 – 1430	<b>Recap</b> Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow
1430	Lunch & End of Day Two

**Day 3: Tuesday, 08<sup>th</sup> of October 2019**

0730 – 0930	<b>Polymer Microstructure &amp; Morphology (cont'd)</b> Determination of the Degree of Molecular Orientation in Polymers • Birefringence • Sonic Techniques • X-ray Diffraction • Infra-red Method
0930 – 0945	Break
0945 – 1100	<b>Molecular Weight &amp; Molecular Weight Distributions</b> Influence on Properties • Cohesive Energy Density • Solubility Parameter
1100 – 1215	<b>Thermal Analysis Techniques</b> Differential Scanning Calorimetry (DSC) • Thermogravimetric Analysis (TGA) • Dynamic Mechanical Thermal Analysis (DMTA or DMA) • Thermomechanical Analysis (TMA)
1215 – 1230	Break
1230 – 1420	<b>Rheology</b> Table: Typical Viscosity Values • Figure: Variation of Apparent Viscosity with Shear Rate • Figure: Newtonian and Non-Newtonian Behaviours
1420 – 1430	<b>Recap</b> Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow
1430	Lunch & End of Day Three





**Day 4: Wednesday, 09<sup>th</sup> of October 2019**

0730 – 0930	<b>Thermoplastics</b> Thermoplastic Types • Polyethylenes • Polypropylene • Polyvinylchloride (PVC) • Polystyrene (PS) • Nylons • Processing and Forming Methods for T/Ps • Vacuum Forming
0930 – 0945	Break
0945 – 1100	<b>Thermosets</b> Polyester Resins (Unsaturated) • Amino Resins • Phenol-Formaldehyde Plastics • Applications of PF • Processing Methods of Thermosetting Polymers
1100 – 1215	<b>Expanded Plastics</b> Polyurethane Foam (PU) • Raw Materials for Producing PU Foams • Processing • Mechanical Properties of Foams
1215 – 1230	Break
1230 – 1420	<b>Coating Systems</b> Drying and Hardening Processes • Coating Techniques
1420 – 1430	<b>Recap</b> Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow
1430	Lunch & End of Day Four

**Day 5: Thursday, 10<sup>th</sup> of October 2019**

0730 – 0930	<b>Polymer Matrix Composites</b> A Classification of Composites • Particulate Filled Polymers
0930 – 0945	Break
0945 – 1100	<b>Fibre Reinforced Polymer Matrix Composites</b> Thermal and Curing Stresses in Composites • Estimation of Mechanical Properties • Anisotropy in Tensile Strength of UD Composites
1100 – 1200	<b>Short Fibre Reinforced PMCs</b> Transfer of Stress from Matrix to Fibres and the Concept of Critical Fibre Length • Short-fibre Reinforced Thermoplastics • In-service Considerations for Composites
1200 – 1215	Break
1215 – 1345	<b>Recycling</b> Recycling of Plastics • Handling/Sorting/Separation • Recycling Codes for Common Thermoplastics • Biodegradable Polymers • Incentives for Companies to Apply Good Environmental Practices
1345 – 1400	<b>Course Conclusion</b> Using this Course Overview, the Instructor(s) will Brief Participants about the Course Topics that were Covered During the Course
1400 – 1415	<b>POST-TEST</b>
1415 – 1430	Presentation of Course Certificates
1430	Lunch & End of Course







**Practical Sessions**

This hands-on, highly-interactive course includes the real-life case studies and exercises:



**Course Coordinator**

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