



## **COURSE OVERVIEW PE0164**

### **PEG (Polyethylene Glycol) Manufacturing & Process Troubleshooting**

#### **Course Title**

PEG (Polyethylene Glycol) Manufacturing & Process Troubleshooting

#### **Course Date/Venue**

September 07-11, 2025/TBA Meeting Room, The H Dubai Hotel, Sheikh Zayed Rd - Trade Centre, Dubai, UAE

#### **Course Reference**

PE0164

#### **Course Duration/Credits**

Five days/3.0 CEUs/30 PDHs



#### **Course Description**



***This practical and highly-interactive course includes various practical sessions and exercises. Theory learnt will be applied using our state-of-the-art simulators.***



This course is designed to provide participants with a detailed and up-to-date overview of PEG (Polyethylene Glycol) Manufacturing & Process Troubleshooting. It covers the applications of PEG in pharmaceuticals, cosmetics and industrial uses; the ethylene oxide (EO) and ethylene glycol (EG) chemistry catalysts use in PEG synthesis, reaction mechanisms and by-products and side reactions; the difference between batch versus continuous PEG production; the reactor types and configurations, process flow diagrams (PFDs) for PEG synthesis and key process parameters affecting PEG quality; and the equipment used in PEG manufacturing, safety considerations in PEG manufacturing and quality control and analytical techniques.



Further, the course will also discuss the ethoxylation reaction mechanism, catalyst selection and optimization, reaction conditions and process control; the automation and instrumentation purification, separation techniques and yield optimization strategies; the common production issues in PEG manufacturing, troubleshooting ethoxylation reactions and the temperature and pressure-related issues; the equipment malfunctions and preventive maintenance; and the quality control failures, troubleshooting, waste management and environmental compliance.



During this interactive course, participants will learn the process optimization techniques and scale-up challenges in PEG manufacturing; the advanced catalysis for improved efficiency, energy efficiency and sustainability; the role of IoT in process monitoring, predictive maintenance using AI, smart sensors for inline quality control and digital twins for PEG process simulation; the hazard identification in PEG plants, HAZOP and FMEA studies, fire and explosion risk mitigation and emergency shutdown procedures; the FDA, EU and REACH guidelines for PEG; the good manufacturing practices (GMP) for pharmaceutical PEG; and the environmental workplace safety regulations.

### **Course Objectives**

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

- Apply and gain a good working knowledge on PEG (polyethylene glycol) manufacturing and process troubleshooting
- Discuss the applications of PEG in pharmaceuticals, cosmetics and industrial uses
- Interpret ethylene oxide (EO) and ethylene glycol (EG) chemistry, catalysts use in PEG synthesis, reaction mechanisms and by-products and side reactions
- Differentiate batch versus continuous PEG production and identify reactor types and configurations, process flow diagrams (PFDs) for PEG synthesis and key process parameters affecting PEG quality
- Identify the equipment used in PEG manufacturing, safety considerations in PEG manufacturing and quality control and analytical techniques
- Discuss ethoxylation reaction mechanism and apply catalyst selection and optimization, reaction conditions and process control
- Identify process automation and instrumentation and apply purification and separation techniques and yield optimization strategies
- Recognize common production issues in PEG manufacturing, troubleshoot ethoxylation reactions and identify temperature and pressure-related issues
- Identify equipment malfunctions and apply preventive maintenance, quality control failures and troubleshooting, waste management and environmental compliance
- Employ process optimization techniques and discuss scale-up challenges in PEG manufacturing
- Carryout advanced catalysis for improved efficiency, energy efficiency and sustainability
- Discuss the role of IoT in process monitoring, predictive maintenance using AI, smart sensors for inline quality control and digital twins for PEG process simulation



- Apply hazard identification in PEG plants, conduct HAZOP and FMEA studies, and carryout fire and explosion risk mitigation and emergency shutdown procedures
- Assess FDA, EU, and REACH guidelines for PEG, good manufacturing practices (GMP) for pharmaceutical PEG, and environmental workplace safety regulations

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



*Participants of this course will receive the exclusive “Haward Smart Training Kit” (H-STK®). The H-STK® consists of a comprehensive set of technical content which includes **electronic version** of the course materials conveniently saved in a **Tablet PC**.*

### **Who Should Attend**

This course provides an overview of all significant aspects and considerations of PEG (polyethylene glycol) manufacturing & process troubleshooting for process engineers, production supervisors & operators, maintenance engineers/technicians, quality control and quality assurance teams, R&D (research & development) teams, project managers, health & safety personnel, consultants and trainers.

### **Accommodation**

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

### **Training Methodology**

All our Courses are including **Hands-on Practical Sessions** using equipment, State-of-the-Art Simulators, Drawings, Case Studies, Videos and Exercises. The courses include the following training methodologies as a percentage of the total tuition hours:-

- 30% Lectures
- 20% Practical Workshops & Work Presentations
- 30% Hands-on Practical Exercises & Case Studies
- 20% Simulators (Hardware & Software) & Videos

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

### **Course Fee**

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




### **Course Certificate(s)**


Internationally recognized certificates will be issued to all participants of the course who completed a minimum of 80% of the total tuition hours.

### **Certificate Accreditations**

Haward's certificates are accredited by the following international accreditation organizations: -

-  British Accreditation Council (BAC)

Haward Technology is accredited by the **British Accreditation Council** for **Independent Further and Higher Education** as an **International Centre**. Haward's certificates are internationally recognized and accredited by the British Accreditation Council (BAC). 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.

-  The International Accreditors for Continuing Education and Training (IACET - USA)

Haward Technology is an Authorized Training Provider by the International Accreditors for Continuing Education and Training (IACET), 2201 Cooperative Way, Suite 600, Herndon, VA 20171, USA. In obtaining this authority, Haward Technology has demonstrated that it complies with the **ANSI/IACET 2018-1 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 2018-1 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 Accreditors 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.





### 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:



**Dr. Fathy Samir**, PhD, MSc, BSc, is a **Senior Process Engineer** with over **20 years** of extensive experience within the **Oil & Gas, Refinery and Petroleum** industries. His expertise widely covers in the areas of **Polyethylene Glycol, Heat Exchangers, Catalyst Selection & Optimization, Process Automation & Instrumentation, Quality Control Failures & Troubleshooting, Crude Oil Analysis, Distillation of Crude Oil, Lube oil Analysis, Gas Chromatography, Crude Oil Sampling, Testing & Evaluation, Oil & Gas Laboratory Management, Energy Optimization of Oil Refineries, Carbon & Gas Storage, Desulfurization of Gasoline & Diesel**

**Fuels, Production, Treatment & Recycling of Lube Oils & Petroleum Waxes with Catalytic Conversion, Solvent Extraction & Polymer Membrane Separation, Debottlenecking & Facility Optimization, Chemical Demulsifiers, Dehydration Process & Equipment, Produced Water Handling & Treatment, Burner Operation & Flame Monitoring, Gas Compression System, Pipeline & Piping System, Oil & Gas Production Operation, Oil & Gas Processing, Emergency Shutdown System (ESD) on Oil & Gas Installations, Isotopes in Groundwater, Water Analysis & Quality Control, Water Quality Indices (WQI), Sewage & Industrial Wastewater Treatment, Electronic Waste Management, Water Treatment & Reverse Osmosis (RO) Operation, Water Treatment Technology, Potable Water Analysis, Hydrotreating & Hydrocracking Process, Crude Oil Sampling, Gas Chromatography, High Performance Liquid Chromatography (HPLC), Modern Laboratory Safety, Chemical Analysis Support Laboratory, Quality Management System (QMS), Chemical Handling & Storage, Good Laboratory Practice, ISO/IEC 17025, ISO 27001, Inductively Coupled Plasma (ICP), Atomic Emission, Mass Spectrometry (MS), Lab Toxicology & Risk Assessment, Laboratory Internal & External Audits, Laboratory Risk Control, Laboratory Supervision & Management, Oil & Gas Laboratory Management, Uncertainty Measurement, Data Validation, Method Validation & Statistical Process Control (SPC), Energy Optimization, Crude Oil Analysis, Lube Oil Analysis, Paraffin Waxes, Microcrystalline Waxes, Solvent Extraction, Polymer Separation, Catalytic Conversion, Nano Materials & Petroleum Desulfurization, Organic & Inorganic Chemistry, Thermal & Hydrogen Storage, Nano Fluids & Ionic Liquids and Metal Fabrication such as Kiron, Aluminium, Copper, Stainless Steel Alloys, and Ceramics.**

During his career life, Dr. Samir has gained his practical and field experience through his various significant positions and dedication as the **Laboratory Supervisor, Associate Research Professor, Lecturer, Researcher and Assistant Researcher** for various international companies, such as Egyptian Petroleum Research Institute (EPRI), Nano Technology Centre, Higher Institute of Applied Arts and Arab Academy for Science, Technology & Maritime Transport.

Dr. Samir has a **PhD** degree in **Physical Applied Chemistry** and a **Master's and Bachelor's** degree in **Applied Chemistry**. Further, he is a **Certified Instructor/Trainer** and an active member of the World Academy of Science, Engineering and Technology (WASET), Society of Petroleum Engineers (SPE), Chemical Consultant Network (CCN) and Asia-Pacific Chemical, Biological & Environmental Engineering Society (APCBEEs). He has also published numerous technical papers and books and has further delivered numerous trainings, seminars, courses, workshops and conferences internationally.



### **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, 07<sup>th</sup> of September 2025**

0730 – 0800	Registration & Coffee
0800 – 0815	Welcome & Introduction
0815 – 0830	<b>PRE-TEST</b>
0830 – 0900	<b>Introduction to Polyethylene Glycol (PEG)</b> Definition, History, and Significance of PEG • Applications in Pharmaceuticals, Cosmetics, and Industrial Uses • Molecular Weight Variations and their Impact on Properties • Regulatory Standards for PEG Production
0900 – 0930	<b>Raw Materials &amp; Chemistry of PEG Production</b> Ethylene Oxide (EO) and Ethylene Glycol (EG) Chemistry • Catalysts Used in PEG Synthesis (Alkaline & Acid-Based) • Reaction Mechanisms (Polymerization Process) • By-Products and Side Reactions
0930 – 0945	Break
0945 – 1100	<b>PEG Production Process Overview</b> Batch versus Continuous PEG Production • Reactor Types and Configurations • Process Flow Diagrams (PFDs) for PEG Synthesis • Key Process Parameters Affecting PEG Quality
1100 – 1230	<b>Equipment Used in PEG Manufacturing</b> Reactors (CSTR, Plug Flow, and Batch) • Heat Exchangers and Temperature Control Systems • Separation Units (Distillation, Filtration) • Storage and Handling of Raw Materials & Products
1230 – 1245	Break
1245 – 1320	<b>Safety Considerations in PEG Manufacturing</b> Hazardous Properties of Ethylene Oxide • Personal Protective Equipment (PPE) Requirements • Safety Protocols for Reactor Handling • Emergency Response Procedures
1320 – 1420	<b>Quality Control &amp; Analytical Techniques</b> Viscosity, Molecular Weight, and Purity Testing • Karl Fischer Titration for Water Content Analysis • Chromatographic Methods (GC, HPLC) • FTIR and NMR for Structural Analysis
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: Tuesday, 08<sup>th</sup> of September 2025**

0730 – 0830	<b>Ethoxylation Reaction Mechanism</b> Stepwise Ethoxylation Process • Factors Affecting Polymer Growth • Role of Catalyst in Reaction Kinetics • Impact of Reaction Temperature and Pressure
0830 – 0930	<b>Catalyst Selection &amp; Optimization</b> Acidic versus Basic Catalysts • Homogeneous versus Heterogeneous Catalysts • Catalyst Poisoning and Deactivation • Recovery and Regeneration of Catalysts
0930 – 0945	Break
0945 – 1100	<b>Reaction Conditions &amp; Process Control</b> Temperature and Pressure Optimization • Stirring and Mixing Efficiency • Influence of Reaction Time on Product Quality • Monitoring Polymer Chain Growth



1100 – 1230	<b>Process Automation &amp; Instrumentation</b> Process Control Loops for PEG Production • Online Monitoring of Reaction Parameters • SCADA and PLC Applications in PEG Plants • Sensor Technologies for Quality Assurance
1230 – 1245	Break
1245 – 1320	<b>Purification &amp; Separation Techniques</b> Removal of Unreacted Ethylene Oxide • Solvent Extraction and Drying • Filtration Techniques for Impurity Removal • Distillation Methods for PEG Fractionation
1320 – 1420	<b>Yield Optimization Strategies</b> Minimizing Side Reactions • Reactor Design Improvements • Impact of Feedstock Purity on Yield • Waste Minimization 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 Two

**Day 3: Wednesday, 09<sup>th</sup> of September 2025**

0730 – 0830	<b>Common Production Issues in PEG Manufacturing</b> Inconsistent Molecular Weight Distribution • Unwanted By-Products (Dioxane, Aldehydes) • Equipment Fouling and Clogging • Process Upsets Due to Catalyst Deactivation
0830 – 0930	<b>Troubleshooting Ethoxylation Reactions</b> Low Conversion Rates and Incomplete Reaction • Excessive Polymerization Leading to High Viscosity • Formation of Undesired Oligomers • Effect of Feedstock Variability
0930 – 0945	Break
0945 – 1100	<b>Temperature &amp; Pressure-Related Issues</b> Overheating and Thermal Degradation of PEG • Pressure Fluctuations Affecting Polymerization • Energy Inefficiencies and Heat Loss • Cooling System Malfunctions
1100 – 1230	<b>Equipment Malfunctions &amp; Preventive Maintenance</b> Reactor Scaling and Fouling Problems • Pump Failures and Flowrate Inconsistencies • Corrosion in Process Pipelines • Heat Exchanger Efficiency Losses
1230 – 1245	Break
1245 – 1320	<b>Quality Control Failures &amp; Troubleshooting</b> Batch Inconsistencies in PEG Viscosity • Impurities Affecting Pharmaceutical-Grade PEG • Inaccurate Analytical Results in Laboratory Testing • Cross-Contamination Issues in Storage and Transfer
1320 – 1420	<b>Waste Management &amp; Environmental Compliance</b> Handling PEG Production Waste • Treatment of Ethylene Oxide Emissions • Regulatory Compliance for Effluents • Sustainable Production Practices
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: Thursday, 10<sup>th</sup> of September 2025**

0730 – 0830	<b>Process Optimization Techniques</b> <i>Data-driven Process Improvements • Statistical Process Control (SPC) • Lean Manufacturing Principles for PEG Production • Use of AI and Machine Learning in Process Control</i>
0830 – 0930	<b>Scale-Up Challenges in PEG Manufacturing</b> <i>Differences Between Lab-Scale and Industrial-Scale Production • Process Intensification Techniques • Pilot Plant Design Considerations • Equipment Scaling and Cost Analysis</i>
0930 – 0945	Break
0945 – 1100	<b>Advanced Catalysis for Improved Efficiency</b> <i>Novel Catalyst Developments for PEG Synthesis • Nano-Catalysts and their Role in Polymerization • Catalyst Recycling Technologies • Case Studies of Industrial Catalyst Improvements</i>
1100 – 1230	<b>Energy Efficiency &amp; Sustainability</b> <i>Reducing Energy Consumption in PEG Reactors • Renewable Feedstock Alternatives • Carbon Footprint Reduction Strategies • Economic Analysis of Green Production Methods</i>
1230 – 1245	Break
1245 – 1320	<b>Digitalization &amp; Industry 4.0 in PEG Manufacturing</b> <i>Role of IoT in Process Monitoring • Predictive Maintenance Using AI • Smart Sensors for Inline Quality Control • Digital Twins for PEG Process Simulation</i>
1320 – 1420	<b>Case Studies &amp; Best Practices in PEG Industry</b> <i>Benchmarking Against Global Manufacturers • Lessons from PEG Production Failures • Successful Process Optimization Case Studies • Future Trends in PEG Manufacturing</i>
1420 – 1430	<b>Recap</b> <i>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</i>
1430	Lunch & End of Day Four

**Day 5: Friday, 11<sup>th</sup> of September 2025**

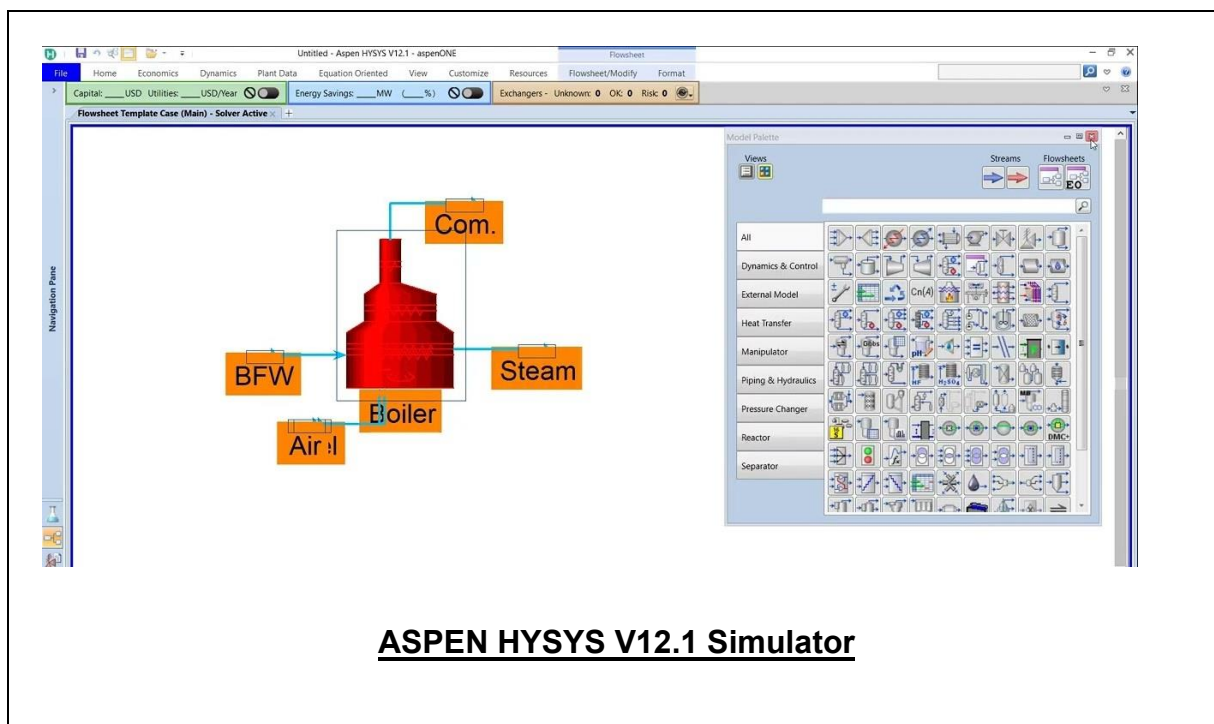
0730 – 0930	<b>Hands-On Troubleshooting Workshop</b> <i>Simulated Case Studies of Common PEG Process Failures • Group Discussions on Root Cause Analysis • Corrective Action Strategies • Implementing Troubleshooting Frameworks</i>
0930 – 0945	Break
0945 – 1045	<b>Risk Assessment &amp; Safety Drills</b> <i>Hazard Identification in PEG Plants • Conducting HAZOP and FMEA Studies • Fire and Explosion Risk Mitigation • Emergency Shutdown Procedures</i>
1045 – 1200	<b>Compliance with Global Regulations &amp; Standards</b> <i>FDA, EU, and REACH Guidelines for PEG • Good Manufacturing Practices (GMP) for Pharmaceutical PEG • Environmental and Workplace Safety Regulations • Documentation and Record-Keeping Requirements</i>



1200 – 1215	Break
1215 – 1345	<b>Final Project &amp; Process Optimization Proposals</b> <i>Developing a Process Improvement Plan • Identifying Key Performance Indicators (KPIs) • Presentation of Findings and Recommendations • Feedback and Evaluation</i>
1345 – 1400	<b>Course Conclusion</b> <i>Using this Course Overview, the Instructor(s) will Brief Participants about the Course Topics that were Covered During the Course</i>
1400 – 1415	<b>POST-TEST</b>
1415 – 1430	Presentation of Course Certificates
1430	Lunch & End of Course

### **Simulator (Hands-on Practical Sessions)**

Practical sessions will be organized during the course for delegates to practice the theory learnt. Delegates will be provided with an opportunity to carryout various exercises using our state-of-the-art “ASPEN HYSYS” simulator.



### **Course Coordinator**

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