

Chemical Engineering Principles and Practice

A Live Course on Essential Fundamentals of Theoretical and Practical Chemical Engineering –

Designed for Non-Chemical Engineers

Credit: 8 PDH's (7.5 PDH's for NYS Lic.) 1 Day; 0.8 CEU's, 1.6 Credits

Lead Instructor: Professor Gennaro “Jerry” Maffia, PhD, Dartmouth College; MBA, New York University

Course description

This online course is designed for new hires, technicians in the chemical industry and non-chemical engineers who work with or supervise chemical engineers. Additionally, analysts, administrators, legal and other professionals who interact with or manage chemical engineering work will find the content familiar and the presentation valuable. An overview the basics of chemical engineering calculations, analysis, operation and design will be presented in an intuitive fashion to maximize the learning. Discussions on chemical equipment, components, reactors, separators, and overall processing, controls and piping are included. Important concepts in chemical process design relative to safety are introduced. This course is also appropriate for energy professionals, engineering managers, technical professionals, facilities managers, analysts, media personnel, and other professionals who are not intimately familiar or current in areas such as chemical engineering principles and chemical processing.

Learning Objectives & Topics:

1. **After attending this course, you will know** the principles and concepts associated with chemical plant design, operation, and evaluation.
2. **You will know** the role of the refinery, petrochemical, chemical, and downstream operations.
3. **You will understand** how to develop a block flow diagram (BFD), a process flow diagram (PFD), and how to read a piping and instrumentation diagram (P&ID).
4. **You will be able to** apply important chemical system concepts, such as, reactor design and downstream separation. This will include heat management in a reactor circuit. The associated engineering computation, formulas, and simulation options will be covered.
5. **You will be able to** understand the industrial examples and case studies which are used throughout the training course to demonstrate how the fundamentals of chemical engineering are applied in the real world.

Learning Outcomes, upon completion of this course you will be able to:

1. Discuss the basic concepts of chemical engineering including mass and energy balances and the concept of unit operations.
2. Describe basic safety regulations and procedures and the basics of kinetics and reactive chemical analysis.
3. Explain the basics of fluid flow and pumps, the use of cooling towers, and the basics of tank and vessel design parameters.
4. Explain the basics of distillation, absorption, stripping, chromatography and drying processes and equipment choices for these unit operations.
5. Calculate basic stoichiometry and unit conversions.
6. Describe the basics of solids handling, characterization, transfer and storage.

Chemical unit operations and processing covered include:

- The chemical engineering profession and what it covers
- Safety and reactive chemical concepts, reaction stoichiometry
- Chemical stoichiometry and unit conversions
- Momentum, mass and energy balances
- Fluid flow and pumping equipment
- Heat transfer and heat exchangers, cooling towers
- Mass transfer concepts, distillation, absorption, stripping/desorption, chromatography, ion exchange, and extraction
- Evaporation, crystallization, filtration, and drying
- Solids handling, characterization, transfer, and storage
- Process control
- Polymers and plastics
- Tanks and process vessels

Schedule of Topics:

1 Day Class:

Morning:

- Chemical Engineering for Non-Chemical Engineers
- Safety in Chemical Engineering
- Basic Toxicology

- Economic analysis
- The Unit Operation Concept
- Stoichiometry and Reactions
- Mass balances and Process Flow Sheets
- Gas laws and Equations of State (EOS)
- Reaction Engineering, Thermodynamics and Kinetics
- Concepts and Principles for Reactive Chemicals
- Flow of Fluids, Heat Transfer, and Evaporation
- Pumps, Meters, and More

Afternoon:

- Heat Transfer and Heat Exchangers
- Radiative Heat Transfer and More
- Mass Transfer Fundamentals, Distillation and More
- Absorption and Stripping
- Solvent Extraction, Adsorption, Ion Exchange, and Membranes
- Cooling Towers, Humidification, and Dehumidification
- Liquid-Solids Separations, Solids Handling and Crystallization
- Filtration
- Drying of Solids
- Solids Handling
- Process Control
- Tanks and Process Vessels
- Chemical Engineering in Polymers

Why you shouldn't miss this course – How this course can benefit you, your organizations, and what is unique about this course:

1. Have you ever felt somewhat inadequate and ill-equipped in your **technical discussions with chemical engineers and chemists**? If so, then this course or seminar is a must.
2. Do you, as an engineer, manager, or technician, **feel that your knowledge and understanding of thermodynamics, material balances and heat transfer** is inadequate or insufficient, then you must not miss this seminar
3. How often do you get a chance to attend a workshop, course, or a seminar that is presented by the author of books, patents and articles on the subject matter - live? In this

seminar, you will have the opportunity to interact and learn from Dr. **Jerry Maffia, who has nearly 50 y of chemical engineering experience in academia and industry.**

4. As an engineer, technician or manager **have you ever found the understanding of reactors with heat management to be elusive** and hard to comprehend? Then, this seminar will present an excellent opportunity to remedy that.
5. **Imagine yourself, as an engineer or manager, at 2 o'clock in the morning, in a triage situation, leading a team, trying to get plant equipment up and running.** You and your team members have **PFD and P&ID drawings** of different types spread out, but, without the chemical engineering background, the symbol and nomenclature appear foreign to you. This seminar is an opportunity for you to bridge that gap.
6. How often do you get an **opportunity to understand abstract and complex chemical concepts through relatively simple examples, analogies and explanation?** This seminar will provide you that invaluable opportunity.
7. Some workshops and seminars end up being monotonous monologues from the presenter to the audience. Not this one. **In this seminar, you will get an opportunity to exercise the skills and concepts through classwork and engage the instructor in discussions.**
8. Do you manage or work with chemical engineers or technicians, and **are rusty in chemical engineering concepts, analytical techniques and design considerations, or are completely unfamiliar with them?** This seminar provides you the opportunity to brush up on those knowledge and skills, so that you can understand the challenges confronted by your subordinates and colleagues more clearly and can make informed decisions.
9. **Last, but not least** – If you are **not** a licensed Professional Engineer, but aspire to be one, and if you are rusty in the fundamentals of chemical engineering concepts and principles, then this course could serve as a **“warm-up”** on some of the chemical engineering principles, concepts and problem analyses techniques.

Who should attend:

- **Licensed Professional Engineers**, who need to meet the annual or biennial license renewal PDH (Professional Development Hour) or CEU (Continuing Education Units) requirements.
- **Engineers and Architects** who do not possess current working knowledge of chemical engineering.
- **Facility Managers, Engineering Managers, Program/Project Managers and other executives** or leaders who feel a lack of adequate chemical knowledge to hold meaningful discussions and to make informed decisions with interacting with their chemical subordinates or colleagues
- **Non-engineers**, including **technical writers** responsible for developing operations and maintenance manuals for chemically operated equipment

- **Procurement/purchasing professionals** who are responsible for acquisition of chemically operated equipment
- Candidates aspiring to take the **FE or PE exams**.
- **Energy Managers and Construction Managers**
- **Maintenance Engineers and Maintenance Managers**
- **Patent attorneys** and attorneys who specialize in construction, workplace safety workmanship litigation cases.
- **Other professionals** whose annual **PLP, Performance and Learning Program**, includes engineering/technical courses/seminars/workshops.

Dr. Jerry Maffia Short Biography

PhD, Dartmouth College, 1988

New York University, MBA, 1977

Manhattan College, M ChE, 1973

Manhattan College, B ChE, 1972

After twenty years as a process engineer and manager in the petrochemical industry, mostly with Atlantic Richfield, Inc., Gennaro (Jerry) Maffia joined Widener University in the fall of 1992 as Chairman of the Department of Chemical Engineering. In 2010, Prof. Maffia retired from Widener as Emeritus Professor joined his alma mater, Manhattan College, as Professor of Chemical Engineering. He served as Interim Department Chair at Manhattan from 2014 to 2016. In the fall of 2016, Prof. Maffia received grants for Process Intensification from the Department of Energy.

Prof. Maffia has broad research interests in environmental, energy, and biotechnology areas. One specific research topic is the development of technologies based on the water retention properties of unraveled bovine hide collagen (USP 6,660,829, USP 8,329,091). At Dartmouth in the 1980s, Prof. Maffia founded the Collagen Research Group which has involved more than 300 students, industrial and government researchers, and faculty colleagues over the years.

In academia, Prof. Maffia has authored ABET accreditation self-study reports in 1996, 2002, 2008, and 2014 (the latter with Dr. Liz Lennon at Manhattan), and has managed successful site visits. He has served on and chaired many academic committees over the years and participated on the Middle States accreditation team. The Widener University Budget Committee which Prof. Maffia chaired for 4 years was responsible for the review of institutional research data provided by the upper administration and board. Other academic interests include independent study and undergraduate/graduate research projects that involve government, industry and other universities. A particular focus has been the incorporation of modern topics into the traditional curriculum and the development of new courses. He has five publications in *Frontiers in Education* in 1997, 2000, 2002, 2004, and 2008 describing these activities. In addition to many recent seminars/webinars on natural gas mining and conversion, Prof. Maffia is currently working on a text for Wiley Publishers on this topic. Prof. Maffia has a teaching style that is best described as holistic. Having spent essentially half of his career in industry, he has the knowledge on how engineers work in industry as well as academia. Additionally, he believes strongly in project based learning with an emphasis on case studies. This represents a dramatic shift in pedagogy over the past few decades, as the assessment of students is now inclusive of

team and project work as they will experience upon graduation. ABET is cognizant of this paradigm shift as evidenced by the required Program Outcomes, commonly called a-k (now 1-7). These outcomes now consist of many items, global perspective, societal impact, team work, presentation skills, life-long learning and the like. Prof. Maffia's students at both Manhattan and Widener have always performed well on these items both on interviews and during his students' initial careers.

Prof. Maffia is an active consultant in chemical and bio-based processes, and is an associate of several consulting firms. He has offered short courses and training seminars on process engineering and related topics at sites around the world. A frequent volunteer for a variety of community and outreach activities, Prof. Maffia also served on Meals on Wheels in Newtown Square, PA for 20 years. In 2008, Prof. Maffia established a student chapter of Engineers Without Borders at Widener University and managed the initial stages of the first project which was a collaborative effort with the Peace Corps to supply lighting for a tribal village in Panama. He is now involved in service projects for potable water supply in Haiti, Mexico, Kenya, Puerto Rico, and the Philippines through Manhattan College. Recently, Prof. Maffia has established the Collagen Research group at Manhattan College and has initiated research projects with NASA, L'Oréal, ARK, DOE, and the USDA. He has also served as an adjunct professor at Drexel University since 1992.

PUBLICATIONS & PATENTS

Patents: USP 8329091 Porous Metallic Substrates
 USP 6660829 Collagen Processing and Applications
 USP 5162593 Tertiary Butyl Alcohol Preparation
 USP 4863856 Weighted Collagen Microspheres
 USP 4533780 Natural Gas Conversion

WO/2001/074929 Collagen-Based Dispersions and Macroporous Structures
WO/1985/004867 (EN) Natural Gas Conversion, (FR) Conversion De Gaz Naturel
16 IDRs (invention disclosure records) filled with DOE (2016-2017)

Principal Publications (recent):

Nicole Aylmer, Amanda Belluccio, Gennaro J. Maffia, "Effect of Collagen Nanofibrils on Turbid Water", IJERT, Vol. 7, Issue 1, January, 2018

Anne Gaffney, Olivia Mason, Gennaro J Maffia , "Use of the M1 Catalyst for the Conversion of Ethane to Ethylene", Catalysis Today, Volume 285, May1, 2017, page 159-165

Amanda Peterman, Jane Alawi, Gennaro J. Maffia; "Effect of Pore Size on the Density of Matrices Made from Collagen Nanofibrils", IJERT, Volume 6, Issue 8, August ,2017

Lucia Petkovic, Anne M Gaffney, Daniel M. Ginosar, Olivia M Mason, Gennaro J Maffia; "Odh-m For Ethane Conversion to Ethylene Using Excess Ethane, Limiting Oxygen and Membrane/distillation For Recovery (ODH-m with staged oxygen feed for higher conversion)", PCT application # PCT/US17/59844 filed Nov 3, 2017

Lucia Petkovic, Anne M Gaffney, Daniel M. Ginosar, Gennaro J Maffia "Heat Transfer Fluid (Energy utilization techniques for ODH process)", US Provisional Application No 62/555,727 filed Sept, 8, 2017

Anne M Gaffney, Gennaro J Maffia, "Hybrid Ethylene Separation and Recovery Systems For Use With Oxidative Dehydrogenation Reactors", Claims added to PCT application for BA-918, filed 8/28/2017

Control of Pore Size and Morphology in Artificial Tissue Made from Waste Corium, Gennaro Maffia, Manhattan College, Olivia Mason, Manhattan College, USA ICSW, March 21, 2017

Reuse of Waste Plastics, Gennaro Maffia, Manhattan College, Olivia Mason, Manhattan College, Marissa Kaplan, Manhattan College, USA ICSW, March 21, 2017

Use of Collagen Nanofibrils to Clarify Turbid Water, Gennaro Maffia, Manhattan College, Amanda Belluccio, Manhattan College, Nicole Aylmer, Manhattan College, USA, ICSW, March 21, 2017

Control of Pore Size and Morphology in Artificial Tissue Made from Waste Corium, Gennaro Maffia, Manhattan College, Olivia Mason, Manhattan College, USA ICSW, March 21, 2017

Reuse of Waste Plastics, Gennaro Maffia, Manhattan College, Olivia Mason, Manhattan College, Marissa Kaplan, Manhattan College, USA ICSW, March 21, 2017

TEA-LCA in Oxidative Dehydrogenation for the Conversion of Ethane to Ethylene Topics in Catalysis, ISSN 1022-5528, Issue 17-18/2016

RECENT MAJOR PROJECTS

Dr. Maffia has provided training and/or consulting services for the following projects/organizations over the last fifteen years:

1. Process and formulation improvements in the collagen gels for a major food manufacturer – consulting for a US client
2. Development of processing requirements for a collagen based implant in biomedical applications for a major clinical and research organization – university project sponsored by a US client
3. Invention and development of Lost Protein Technology for the manufacture of catalyst particles and oil field proppants - sponsored by Keystone Innovation Grant Program and resulting in US Patent 8,3209,091 issued in December, 2012
4. Process engineering training for major oil and petrochemical companies – 7 different, week long courses offered – 4 offered at Widener; 3 offered at the plant site
5. Engineering training via 20 different seminars offered multiple times, mostly for professional development hours (PDH) for professional engineers' license requirements in NY and NJ – offered through PERC, Inc.
6. Supervision of 250+ different senior plant designs for chemical engineering seniors – part of CHE 425, CHE 428 (Widener) and CHE 488 (Drexel) and CHML 405,406 739,740 (Manhattan College)
7. P&I review for a novel petroleum processing system – Asian client; petrochemical intermediates plant design for Asian client
8. Development of a charcoal production technology for a developing country – consulting for the UN project for the country of Haiti
9. Development of a biodiesel production process using lipids in meat and bone meal as substrate – project sponsored by the Fats and Protein Research Foundation
10. Development of a collagen based filtration process for the removal of turbidity and pathogens (bacteriophage), as well as other toxins from water – in addition to MS theses, implemented the apparatus in Kenya and the Philippines

11. Process development of a novel production method for light olefins for a major engineering contractor – consulting project
12. Supervised senior projects for the Metcalf & Eddy Design Competition – for Widener University (finished in the final four)
13. Supervised senior projects for the WERC Competition (Las Cruces, NM) – for Widener and Manhattan College
14. Development and presentation of a process design package for alternative processing of intermediates for Shenma in Pingdingshan, China
15. Supervising a team of students on a 3 year NASA project for waste reuse on space missions
16. Joint project with the School of Business on the development of a business for the production and marketing of a natural hair dye.
17. Joint project with non-profit ARK to collect and purify rainwater in a rural village in the Philippines.
18. Development of a technology for the supply of potable water for a mission in Cazeau, Haiti.
19. Extension of the recently issued USP 8.329.091 for tissue engineering and scaffolding; worked with a deaf student to develop an award winning technology. Shiran Zhavian won the domestic ISPE poster competition and finished second internationally.

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