Understanding the Global Petrochemical Industry
“Linking process technology, market needs and profitability drivers”

A 3-day in-depth training course

Petrochemical Industry Headlines Making You Dizzy?

Oil prices are collapsing and what is the short and long term impact?
Will shale gas still drive huge investments in North America?
Will China continue exploiting coal to chemicals?
Will some European players keep to their plan of importing ethane?
Will the Middle East’s commitment to building a downstream industry waver?
Can renewables to chemicals compete in the face of low energy prices?

How Can We Make Sense of all this Change?

During this time of growing market volatility and complexity it is critical you and your team have a thorough understanding of the fundamental industry dynamics driving growth and profitability. This course will provide attendees with the “big picture” and unravels and clarifies, in easy to understand terms, the many links along industry value chains. We will explore the relationships between feedstocks and olefins and aromatics, and how these key building blocks are converted to downstream intermediates and polymers in order to satisfy market needs. The course covers technology, supply/demand issues, inter-regional trade, economics, regional differences and more.

Who should take this course?

This three-day educational course is designed to be of interest and value to both technical and non-technical industry participants. Attendees represent a wide range of job functions and types of companies.

Job function
- Business managers
- Process engineers
- Financial analysts/accountants
- R&D chemists
- Licensing managers
- Strategic planners
- Purchasing agents
- Sales and marketing executives
- HR and legal managers

Company types
- Petrochemical companies
- Oil and gas companies
- Plastics Fabricators and Converters
- Compounds and formulators
- Specialty and performance chemical companies
- Biotech start-ups
- Industrial gas companies
- Technology licensing companies
- Commercial and investment banks
- Private equity and venture capital firms
- Law firms

Learn More and Register at ihs.com/chem-edu
Day 1 Morning Session

8:30 am  Introduction to Petrochemicals
“This is the most exciting time to be in the industry as there is so much change. And with change comes opportunity - if we have a good understanding of the industry dynamics driving this change” – Dr. Jeff

Regional Overview – “A Trip Around the World”
- North America – Shale gas reinvigorating the industry - learn why
- Western Europe – Good food, good wine, good beer – but no cheap feedstocks!
- Russia – lots of oil and gas but lacking infrastructure
- Middle East – A region in transition - going downstream to create jobs
- Asia – China the engine of growth – Using coal to invent and re-invent the future
- South America – Industry is reorganizing – Brazil leading the way in “green” chemicals

Understanding Petrochemical Feedstocks
- Natural gas – including an extensive discussion of shale gas. Learn about the concept of “stranded” gas and how this has created pockets of regional advantage in the olefins business
- Natural gas liquids (NGLs) – ethane, propane, butanes, condensates – each with their own uses and price drivers – learn how all of this impacts the petrochemical industry
- Oil – naphtha, middle distillates, heavy oil – extensive discussion about how refining intersects with petrochemicals and the benefits of refinery/petrochemical integration
- Coal – learn how China is leveraging cheap coal using old historical processes but also innovating new approaches as well
- Renewables – will bio-based routes to “petrochemicals” make an impact? Come find out about the opportunities and challenges

10:00 am  Coffee Break

10:20 am  Introduction to the Olefins Business
Introducing ethylene, propylene, and the C₄ olefins (butadiene, n-butenes, isobutylene) – chemical structures, physical form, sources, logistic issues, trade balances, key players, and value chains

Ethylene – The Largest of the Building Blocks
- Steam Cracking – a detailed look at the “heart and soul” of the petrochemical industry. Learn how Carbon Petroleum Dubbs put the “steam into steam cracking”
- Methanol to Olefins (MTO) – Finally commercial! Is this a game-changer? Will MTO grow outside of China?
- “Green” Ethylene from Bioethanol – A great example of Dr. Jeff’s theory of “Reverse Process Economics”

12:00 pm  Lunch

Day 1 Afternoon Session

1:00 pm  Propylene – The Second Largest Building Block, but the Fastest Growing Olefin
Unlike ethylene, three grades: polymer grade, chemical grade, and refinery grade
- Steam cracker co-product – the largest source, but shale gas causing a reduction – learn why
- Propylene from FCC units – refineries coming to the rescue
- On-purpose propylene – Mind the gap! – Propane dehydrogenation (PDH), olefin metathesis, enhanced FCC, olefin cracking, methanol to propylene (MTP), and “green” propylene

The C₄ Olefins – Butadiene, Butene-1, Butene-2, and Isobutylene
- C₄ disposition – recycle co-crack or separate for chemical use
- Separating the C₄’s – not straightforward, must use our “bag of tricks” – learn how and understand what raffinate-1 and raffinate-2 are all about
- Butadiene – steam cracker by-product, but once again shale gas is hurting this source. Will on-purpose butadiene technology proliferate?
- n-Butenes (butene-1/butene-2) and isobutylene – from both steam crackers and FCC units - competing with gasoline use

2:30 pm  Coffee Break

2:50 pm  Olefin Economics
Cost of production methodology – learn how costs are built-up in the petrochemical industry
- Capex versus opex
- Raw material costs
- Utility costs
- By-product credits
- Variable or incremental costs
- Fixed costs – labor, maintenance, etc.
- Selling, general & administrative costs
- Cash costs
- Cash margins
- ROI

Ethylene Economics – a case study comparing the costs of an ethane cracker versus a naphtha cracker. Regional costs are compared over the 20 years. Understand the huge Saudi advantage stemming from $0.75/MM Btu gas. The concept of cost curves is introduced and a global cost curve for ethylene production is presented and discussed.

Propylene and Butadiene Economics – Both propylene and butadiene are for the most part by-products. This feature complicates the methodologies used to assign costs to these two important olefins. Various approaches will be discussed and illustrated.

Overview of the Olefin Markets – To close out Day 1, an overview of the markets and value chains of the ethylene, propylene, and C₄ olefins will be presented. Detailed discussion of the individual olefin derivatives will be presented later in the course.
Day 2 Morning Session

8:30 am  Introducing Benzene, Toluene and the Xylenes – Taking the Complexity out of Aromatics Complexes
Chemical structures, physical form, logistic issues, trade balances, key players, and value chains. Simplifying aromatics complexes – separations techniques, and rebalancing supply/demand via isomerization and interconversions

Benzene – The Largest of the Aromatics
• Learn how benzene limits in gasoline around the world are impacting benzene supply
• Understand how cheap shale gas negatively impacts benzene supply
• Coal-based benzene becoming more and more important in China
• Secondary sources – hydrodealkylation (HDA) and toluene disproportionation (TDP) fill in supply gaps

Toluene – Learn about the Magic of Toluene Transformations – Fooling Mother Nature!

Xylenes – para-Xylene Rules!
• Highlighting the role of refineries in the aromatics business
• With flat gasoline demand around the world will there be enough xylenes made for chemical demand?
• Understand how the industry rebalances mixed xylenes distribution to match market demand

10:00 am  Coffee Break

For the remainder of the course, the derivatives of each of the seven building blocks will be discussed one by one. These discussions will include: historical origins, key players, trade, process technologies, and end-use applications. In many cases, end-use application discussions will be reinforced by many “colorful and interesting” graphics and “show and tell” demonstrations.

Exploring the Ethylene Value Chain – Dominated by Four Very Commoditized Businesses
• Polyethylene – LDPE, LLDPE, HDPE – Learn what polymers are and what the difference is between the three types of polyethylene. Tupperware and Hula Hoops start a new industry! “Green” polyethylene – what is it? What does “green” mean? Is it here to stay?
• PVC and the Vinyls Chain – Chlor/Alkali, EDC, VCM, PVC. Environmental, health & safety issues are always a consideration in this value chain. How can PVC be both rigid and flexible?
• Ethylene Oxide (EO) and Monoethylene Glycol (MEG) – Key to the polyester business, anti-freeze and a range of specialty uses. Learn why the Middle East players dominate trade in MEG?
• Styrene – Key monomer for polystyrene, ABS, SBR and UPR – this discussion will be held off until the discussion of the benzene value chain on Day 3.

12:00 pm  Lunch

Day 2 Afternoon Session

1:00 pm  Exploring the Propylene Value Chain – Bringing Good Things to Life
• Polypropylene – The most versatile and fastest growing of the polyolefins. Who invented PP? The most disputed story of invention in the entire industry!
• Cumene/Phenol/Acetone – “Tyranny of the Two for One Process”
• Bisphenol A (BPA) – Toxicity issues weighing on this industry segment.
• Polycarbonate – Strong, tough, glass-like clear – a wonderful plastic
• Epoxy resins – Super-tough thermoset

2:30 pm  Coffee Break

2:50 pm  • Phenol Formaldehyde (PF Resins) - The original thermoset molding resin
• Methyl Methacrylate (MMA)/PMMA – The other glass-like plastic, competing with polycarbonate
• Propylene Oxide (PO) – Understanding the alphabet soup of process routes to PO: CHPO, PO/MTBE, PO/SM and more recently HPPO. Impacts the polyurethane business.
• Oxo- Alcohols – n-Butanol and 2-Ethylhexanol. Biotech and regulatory issues impacting business
• Acrylic Acid – Key monomer for Super Adsorbent Polymers (SAPs). Diaper demo not to be missed! Also impacts the coatings business – water based paint and UV-cured coatings
• Acrylonitrile - By-product hydrogen cyanide a barrier to entry. Acrylic fiber – synthetic wool and world’s second synthetic fiber. Also polyacrylonitrile is precursor to carbon fibers

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Day 3 Morning Session

8:30 am  
Exploring the C4 Olefins Value Chains – Key to the Synthetic Rubber Industry

• Natural Rubber – Fascinating tale of discovery, but importantly led to the development of the synthetic rubber industry
• Polybutadiene Rubber (PBR) / Styrene Butadiene Rubber (SBR) – Key to the development of synthetic tires. WW II spurs innovation.
• Butyl Rubber (IIR) – How we keep the air in tires
• Other Specialty Elastomers
• Butene-1 – Comonomer for LLDPE and HDPE
• Butene-2 – Monomer for making methyl ether ketone (MEK)
• Isobutene – Butyl rubber, MMA, and MTBE production
• MTBE – The sad story of the demise of MTBE in the US
• Maleic Anhydride (MAN) – Exception to the rule. No need for a double bond, made direct from n-butane

10:00 am  
Coffe Break

10:20 am  
Exploring the Aromatics Value Chain

• Styrene – An interconnected story – conventional technology versus POSM technology
• Polystyrene – GPPS/HIPS/EPS – What are they and their different end-use applications
• ABS – High impact plastic. Key to Lego products
• Nylon 6,6 and Nylon 6 - First well understood polymers and led to the development of the synthetic fiber industry
• Cyclohexane/Adipic Acid – Nylon 6,6 precursors
• Caprolactam – Nylon 6 precursor

12:00 pm  
Lunch

Day 3 Afternoon Session

1:00 pm  
Exploring the Aromatics Value Chain (continued)

• Polyurethanes – Very high value business
• MDI/TDI – The two large volume isocyanates for polyurethane production. Phosgene provides a barrier to entry
• PTA/DMT – Key monomers for polyester
• Polyester (PET) – The fastest growing polymer in the world. Fiber, film and bottle end-uses

2:30 pm  
Coffe Break

2:50 pm  
Exploring the C1 Value Chain – Cheap Shale Gas and Coal is Stimulating Interest

• Synthesis gas (Syngas) – what is it, how we make it and what we do with it
• Ammonia – The world’s largest volume chemical
• Methanol – Who says you can’t teach an old dog new tricks!
• Acetic Acid/Acetic Anhydride – Totally built up from C1 chemistry
• VAM/PVAc/PVOH/PVB – An extensive value chain into very specialized end-use applications

Wrap-up and Conclusion of Course