

COURSE OUTLINE

THE GLOBAL PETROCHEMICAL INDUSTRY

Understanding the complex interactions between Technology, Economics, and Markets

DAY 1

9:00 Industry Cyclicity – are we doomed to ride this cycle forever? • The “Old (and current?) Paradigm” • Industry restructuring • The impact of private equity • Some thoughts on profitability The Chemical Industry • Commodity versus specialty • Historical beginnings of the industry • Emergence of a true global business • Key success factors • Major players (including US shale, Middle East and China)	13:15 Economics • How to calculate cost of production • CAPEX categories • Economy of scale – why size matters • Transfer pricing – who makes profit? • Cost curves – what are they and what they can predict • The concept of “shut-down” economics Ethylene* – The 1st Building Block Polyethylenes – The single largest segment in the industry • LDPE – the accidental discovery • HDPE – Ziegler’s invention LLDPE – the best of both worlds!
Break The energy context • Split of major energy uses • Gas, oil and coal; who has the reserves • What’s happening to oil prices? How the energy world is changing • The connection between energy and chemicals – impact of changing prices	Break Linear Alpha Olefins – A diverse and challenging segment • Full range processes – make one, make them all • On-purpose technologies changing the LAO landscape
How to organize the industry – The 7 basic Building Blocks • Ethylene, Propylene, • The C₄s (Butadiene/Butylenes) • Benzene, Toluene, Xylenes • Synthesis Gas (Syngas) The petroleum refinery / petrochemical interface – providing the Building Blocks • Components of oil and gas • Catalytic Cracking • Catalytic Reforming • Steam Cracking • Difference between cracking gases (ethane) versus liquids (naphtha)	VCM and PVC – The Vinyls chain • Value chains and integration • Vinyls – environmental issues Ethylene Oxide / Ethylene Glycol • Who controls the technology • Why the Middle East dominates production and Asia dominates demand Styrene (Covered in Day 2) Ethanol – Synthetic versus natural • Is ethanol in gasoline a good thing? • Polymers from renewables – a complex topic
12:30 Lunch	17:00 Finish Day 1

*Each Building Block and major product will include a discussion on technology, economics, major players, regional end-use patterns, logistics, trade flows and current trends. The use of photos, videos, samples and animations will complement the understanding of each product family.

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DAY 2

9:00 Propylene* – The 2nd Building Block

Regional propylene supply and demand dynamics – the world needs Propylene

- The propylene molecule: what's special
- Historical, current, and forecast demand by region
- Supply sources and limitations – where will the propylene come from?
- New and developing on-purpose propylene production technologies (PDH, Metathesis, MTO/MTP, etc.)

Polypropylene – The versatile plastic driving Propylene growth

- Natta and Phillips discover polypropylene catalysts at the same time and a patent fight ensues
- Evolution and massive restructuring
- Major global players
- End-uses

Break

Acrylic Acid – A protected segment

- Key players – a few players dominate the market
- Polyacrylic acid – superabsorbent polymers (SAPs)
- Acrylates – water based paints and UV curing

Acrylonitrile – Technology still a barrier

- Ammoxidation technology – a patent dispute settled in a most unusual way!
- HCN by-product – provides a barrier to entry
- Trade – the U.S. maintains a major presence
- End-uses – synthetic wool, ABS, HMDA and emerging applications (carbon fiber)

12:30 Lunch

13:15 Propylene Oxide – New technologies are changing industry dynamics

- Technology evolution – from chlorohydrin to HPPO
- New co-product free routes driving change
- The power of the press release – how companies signal each other in the news

Styrene – How the PO/SM technology caused havoc

- PO/SM versus conventional EB dehydro
- Polystyrene: General purpose (GPPS), High Impact (HIPS), Expandable (EPS)
- The Huntsman story
- How a Donald Duck cartoon became prior art
- Inter-polymer competition – the pressure on Polystyrene

Break

Cumene / Phenol / Acetone – A rich value chain

- Phenol and acetone – a 2 for 1 process
- Will a co-product free route emerge?
- Phenolics – a very old thermoset
- Bisphenol A (BPA) – toxicity issues
- Epoxy resins – a business in transition
- Polycarbonate – a strong polymer
- Acetone/Methyl Methacrylate (MMA)

Oxo Alcohols – Regulation affecting this segment

- Technology: the oxo-reaction
- 2-Ethylhexanol and phthalate plasticizers (DOP) – health and safety concerns impacting demand
- Other oxo-alcohols

17:00 Finish Day 2

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DAY 3

9:00 The C₄'s* – The 3rd Building Block

- Separation of the C₄ Olefins

Natural and synthetic Elastomers

- Historical development of the industry
- Charles Goodyear finds the key to curing rubber but dies penniless
- Why rubbers are elastomeric
- Development of synthetic rubbers
- Polybutadiene rubber (BR) and Styrene butadiene rubber (SBR)
- Butyl rubber, EP, EPDM
- Thermoplastic elastomers – a neat trick

Other C₄ derivatives

- ABS – the ChiMei story
- MTBE and alternatives
- Maleic Anhydride

Break

Sources of Aromatics – A question of balance

- Primary sources – pyrolysis gasoline, reformat, coke oven light oil
- Secondary sources – hydrodealkylation, disproportionation, transalkylation
- Regional differences

Benzene* – The 4th Building Block

- Styrene (already covered)
- Cumene / Phenol (already covered)
- Nylon / Polyamide – how DuPont invented it and how BASF got around their patents
- Isocyanates (MDI) and Polyurethanes – a versatile and protected business

Toluene* - The 5th Building Block

- Major players – why refiners dominate
- Making other aromatics from Toluene
- Isocyanates (TDI)

12:30 Lunch

13:15 Xylenes* – The 6th Building Block

- *ortho*-, *meta*- and *para*-xylene
- Separating the xylenes

PX / PTA / Polyester – A fast growing segment in the industry

- Polyethylene Terephthalate (PET) fibers and bottles – two distinct segments
- Other polyesters (PBT, PTT)

OX / Phthalic Anhydride – A mature product

- Plasticizers
- Unsaturated polyester resins (UPR)
- Alkyd resins – under pressure from water-based paints

Break

Synthesis Gas (Syngas)* – The 7th Building Block [from Methane and Coal]

- Different routes to synthesis gas
- Many potential sources and uses
- Fischer Tropsch / Gas to liquids (GTL)
- Ammonia and fertilizers
- Methanol
- Formaldehyde
- Acetic acid / Acetic anhydride
- 1,4-Butanediol / THF (a sad, but true story of how one company failed to understand "shut-down" economics)

Review of key concepts

- Importance of the chemical industry
- Chemistry working for us
- Final reflections

17:00 Conclusion of the course

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ABOUT THE PRESENTER



Manuel Asali is a Vice President at NexantECA and is responsible for Nexant Training globally. Manuel is a Chemical Engineer and has an MBA from London Business School. He has 30 years of experience in the petrochemical industry working for a number of companies including PEMEX in Mexico and SABIC in Saudi Arabia. As instructor of the course, **Manuel brings a unique combination of broad knowledge of the global petrochemical industry complemented with his experience in strategy, marketing and sales.** Manuel delivers numerous training courses throughout the year. He is a lively presenter and a regular speaker at petrochemical industry forums and conferences.