



# Ethylene Production & Troubleshooting Workshop

(& Lessons Learned)

(Customised as needed)

SIMPLE & PRACTICAL INSIGHTS INTO ETHYLENE PRODUCTION & TROUBLESHOOTING

TRAINING SINCE 2006

## Ethylene Production & Troubleshooting Workshop

by Kinetics Process Improvements

**OBJECTIVE:** 3-days of comprehensive workshop provides simple and practical insights into Ethylene production with an improved understanding of the fundamentals, technology, operations, troubleshooting, performance monitoring and economics with a focus on Cracking Furnace technology to assist the attendees in making better decisions

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### PRACTICAL INSIGHTS\*

- ✓ Ethylene Process Overview
- ✓ Feedstock Considerations
- ✓ Cracking Furnaces (see details\*)
- ✓ Major Process Systems
  - ✓ Cracking, Combustion & Coking
  - ✓ HP Steam generation
  - ✓ Quench, Fract'n & Heat Recovery
  - ✓ Acid Gas removal
  - ✓ Compression
  - ✓ Separation, Recovery & Purifi'on
  - ✓ Hydrogenation
  - ✓ Refrigeration
  - ✓ Steam System
- ✓ Critical Equipment
  - ✓ Cracking Furnaces
  - ✓ Cold Boxes
  - ✓ Compressors & Drivers
  - ✓ Towers & Internals
- ✓ Major Safety/Reliability Considerations
- ✓ Environmental Considerations
- ✓ Cost of Production & Economics
- ✓ Key Startup & Shut down Considerations
- ✓ Troubleshooting to improve:
  - ✓ Performance
  - ✓ Reliability
  - ✓ Safety

\*See Training outline on next page

### TARGET GROUP

- ✓ Process/Tech Service Engineers
- ✓ Operations Engineers
- ✓ Production Sup'dt/Supervisors
- ✓ Mechanical Engineers
- ✓ Project Engineers
- ✓ Maintenance/Inspection Engineers
- ✓ Planning Engineers
- ✓ Reliability/Safety Engineers
- ✓ Plant Managers
- ✓ Project Developers/Planners

### KEY BENEFITS

- ✓ Deeper understanding of Ethylene Technology & Critical Equipment
- ✓ Impact of Feedstocks on the Plant Operation and Economics
- ✓ Learn simple techniques to improve Plant Performance
- ✓ Better handle for improved margins
- ✓ Better appreciation of Olefins Value Chain & the drivers
- ✓ Training material for future reference

### TRAINING FORMAT

- ✓ Very Interactive Q&A with group participation for practical learning
- ✓ What-if scenarios for improvements
- ✓ Discussion and Analysis of Practical Case Studies
- ✓ Use of our in-house Yield models for better understanding

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# TRAINING OUTLINE

## Overview

- ✓ Key Historical Developments
- ✓ Production Routes & Value Chain
- ✓ Feedstock Considerations

## Ethylene Process & Technology

- ✓ Cracking Fundamentals
- ✓ Cracking Furnaces (*Refer detailed outline*)
- ✓ Process Configurations

## Major Process Systems

- ✓ Cracking, Coking & Combustion
- ✓ Quench, Fractionation & Heat Recovery
- ✓ Acid Gas removal
- ✓ Compression
- ✓ Separation, Recovery/Hydro'n & Purification
- ✓ Refrigeration
- ✓ Steam System

## Major Equipment

- ✓ Cracking Furnace
- ✓ Cold Boxes
- ✓ Compressors & Drivers
- ✓ Towers & Internals

## Safety & Reliability Considerations

- ✓ Key Safety Aspects
- ✓ Lessons Learnt

## Environmental Considerations

- ✓ Pre & Post NOx mitigation options
- ✓ Other Emissions & mitigation

## Key Operating Variables

- ✓ Impact on Production, Run length & Performance

## Cost of Production & Economics

- ✓ Maximize profit for market conditions
- ✓ Economics of cracking coil upgrade

## Start Up & Shut Down Considerations

- ✓ Key controls for safe operation
- ✓ Burner management
- ✓ Safe Start-up & Shut down considerations
- ✓ Emergency shut down considerations

## Troubleshooting/Retrofitting

- ✓ For Capacity & Efficiency Improvements
- ✓ For Improved Reliability & Safety

## OUTLINE- CRACKING FURNACE (*Included*)

### Cracking Chemistry & Thermo

- ✓ Liquid, Gas & Co-Cracking discussion
- ✓ Key variables affecting Yields (*Review models*)

### Coil & TLE Systems

- ✓ Short/Medium & Long Residence time coils
- ✓ Coil type- impact on Yield, TMT and R/length
- ✓ Coil selection considerations
- ✓ TLE design & operational considerations
- ✓ Coil & TLE Metallurgies

### Coking & Mitigation

- ✓ Coke Formation Mechanism
- ✓ Key Coking Variables
- ✓ Coking & Run-length
- ✓ Coking Inhibitors, products, economics
- ✓ De-coking Options & Techniques

### Firebox Arrangements

- ✓ Radiant Coil Arrangements
- ✓ Burners & Firing Arrangements
- ✓ COT/COP Considerations
- ✓ Metallurgy discussion

### Convection Section

- ✓ Convection Coil Configurations
- ✓ Draft/ID/FD Fans discussion
- ✓ Air Preheater discussion

### Burners & Combustion Controls

- ✓ Burner design/operational considerations
- ✓ Burner arrangements (Floor & Wall)

### Refractory/Insulation

- ✓ Design & Selection Criteria
- ✓ Heat loss Estimate

### Furnace Operations & Maintenance

- ✓ Key controls for safe operation
- ✓ Burner management
- ✓ Safe Start-up & Shut down considerations
- ✓ Emergency shut down considerations

### NOx Mitigation

- ✓ Factors affecting NOx formation
- ✓ Ultra-Low NOx Burners
- ✓ Post NOx mitigation options (*SNCR & SCR*)

## VENUE & TIMINGS

### WORKSHOP VENUE/TIMINGS\*

*At Plant site/ Client Location- as suitable (3 days, 8 am to 4 pm)*



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## COURSE INSTRUCTORS

**VK Arora**, a registered professional Chemical Engineer in Texas with degree from IIT and 35 years of diversified hands-on practical experience in Olefins and Syngas technologies including strategic planning, development and execution of major Petrochemicals projects.

He worked in operating Ethylene & Dehydro plants of Shell JV-NOCIL/Reliance and SABIC. He also worked with various Licensors including Lummus, KBR & KTI.

He led the design, start-up and performance test of the first world scale Olefin production facility for Saudi location. With KPI, he also spearheaded the development and execution of a world-scale Propylene derivatives complex to produce Acrylic Acid, Oxo-Alcohols and Acrylic Esters for Saudi location. He also led more than hundred different project feasibilities and many revamps for major Petrochemicals projects globally.

He holds three patents relating to process technology improvements. Published & presented more than twenty Technical Papers including a Chapter on 'Propane Dehydrogenation to produce Propylene' in McGraw-Hill "Handbook of Petrochemicals Production Processes".

**John Brewer**, a former Chief Engineer for Stone & Webster's Furnace and Fired Heater division. He studied Chemical Engineering at the University of Birmingham and holds a number of patents relating to Ethylene Cracking Furnaces

**Dr. Sam Narayanan**, a Chemical Engineer, with more than forty years of hands-on experience and an industry specialist in Olefin Pyrolysis Furnaces including modeling yields, Process design, Troubleshooting and Operations management in Europe, North America and South-East Asia.

He is a Ph.D. in Chemical Engineering from IIT followed by Post-Doctoral work at Technical University of Delft. He made significant contributions in the development of Radiant coil designs with improved olefins yields using the Pilot plant work for Industrial applications at Gent University. He holds five patents related to process improvements in Cracking Furnaces and several publications including Co-cracking.

He worked as specialist in Ethylene Furnace design groups at KTI, Stone & Webster, KBR and Westlake Ethylene Plants. He has been conducting many training courses in Cracking furnaces.

### KPI TRAINING REFERENCES

**The Companies who attended our Training workshops and several multiple times:**

- |                   |                |
|-------------------|----------------|
| • SABIC           | DOW            |
| • PETRONAS        | WESTLAKE       |
| • Lyondell/Basell | SASOL          |
| • ELEME           | CPChem/Chevron |
| • BASF            | CFI            |
| • PCS             | ENIP           |
| • AUM             | PLNL           |
| • AMPCO           | CNC            |
| • MOSAIC          | ADVANSIX       |

*\*We have conducted many 'on-site' custom training sessions covering more than 500 candidates since 2006*



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