

# **Thermal Cracking, Experiences & Advancements**

## **Syllabus**

### **Day One**

- 1. Introduction to Petrochemical Industry (1 Hour)**
  - A. Overview of the Petrochemical Industry**
    - 1. Ethylene Position in the Hydrocarbon Processing Industry**
    - 2. Overview of Up Stream and Down Stream of Ethylene**
  - B Safety in the Petrochemical Industry**
    - 1 Review of 2002 Algiers Incident**
    - 2. Review of BP Incident**
    - 3. Ethylene Boiler Incident**
    - 4. Ethylene Flare Incident**
  - C. Discussions and Review**
- 2. Ethylene Overview (1 Hour)**
  - A. Comparison of Flow Schemes**
    - 1. Gas Crackers and Liquid Crackers current designs and comparisons**
    - 2. DeMethanizer First**
    - 3. DeEthainzer First**
    - 4. DePropanizer First**
  - B. Discussions and Review**

**3. Ethylene Furnace Technology (1.5 Hour)**

**A. Historical Development**

**B. Design Constraints**

- 1. Residence time**
- 2. Partial Pressure**
- 3. Low Pressure**

**C. Comparison of Current Designs**

- 1. One pass coil**
- 2. Two pass U coil**
- 3. W coil**
- 4. Hybrid coil**

**D. Furnace Run lengths**

- 1. Design and normal run lengths of current designs**
- 2. Factors affecting run lengths**

**E. Anti Coking**

- 1. Comparison of technologies**

**F. Future Opportunities**

- 1. Catalytic**
- 2. Latest patents**

**G. Ethylene Furnace Trouble Shooting**

- 1. Convection Bowing**
- 2. Insulation**
- 3. External transition designs**

**H. Discussions and Review**

- 4. Quench System Review (2.5 Hours)**
  - A. Overview of Quench System**
    - 1. Quench Oil Tower**
    - 2. Quench Water Tower**
    - 3. Dilution Steam Generation**
      - A. Case study of a Saturator revamp**
      - B. Case study of DSG reboiler fouling**
  - B. Design of Quench System Towers**
    - 1. Fundamentals of Distillation for Olefin Plants**
      - A. Fundamentals overview**
      - B. Review of distillation equipment selection**
    - 2. Designing Towers for Fouling Service**
    - 3. Case Studies**
      - A. Quench Water Tower Revamp**
      - B. Quench Oil Tower Fouling**
  - C. Discussion and Review**

# Syllabus

## Day Two

### 5. Compressor Review (1 Hour)

#### A. Compressor Overview

1. Four versus Five Stages
2. Efficiency gains
3. Eliminating recycles
4. Inter-stage cooler issues and fouling
5. Caustic tower issues and design

#### B. Compressor Run Lengths

1. Review of Run Length
2. Wash oil and inhibitor
3. Water Wash

#### C. Discussion and Review

### 6. Acetylene Reactor Review (1 Hour)

#### A. Front End vs. Back End Overview

#### B. Review of current catalyst

1. Catalyst run lengths
2. Catalyst conversion
3. Operating windows

#### C. Operational Issues

#### D. Discussion and Review

**7. Molecular Sieve Review (0.5 Hour) – Optional based on time constraints**

- A. Molecular Sieve Application in Olefin Plants**
- B. Molecular Sieve principles**
- C. Discussion and Review**

**8. Ethylene Unit Economics (1 Hour)**

- A. Investment Guide Lines**
- B. Follow The Money**
  - 1. Where is the money made?**
  - 2. Where is the money spent?**
  - 3. Where is the money lost?**
- C. You verses the industry**
- D. Discussion and Review**

**9. C3 and C4 Reactors (0.5 Hour) - optional**

- A. Overview of C3 Reactors**
  - 1. Catalyst Review**
  - 2. MAPD Safety Issues**
- B. Overview of C4 Reactors**
  - 1. Catalyst Review**
  - 2. Safety Issues**
    - A. Challenges with temperature excursions**
- C. Discussion and Review**

**10. Ethylene Distillation (2-3 Hours)**

**A. Olefin Fractionation System Overview**

**1. Cold Fractionation Tower Review**

- 1. Low Pressure vs. High Pressure DeMethanizer**
- 2. Open loop vs. closed loop C2 Towers**
- 3. Heat integration issues**

**2. Hot Fractionation Tower Review**

- 1. Fouling**

**B. Optimize Distillation Column Design for Improved Reliability in Operation and Maintenance**

- 1. Correct distillation equipment for process conditions**
- 2. Correct equipment selection for expected run length**
- 3. Thermal stability, chemical stability and safety**
- 4. Maintenance reliability, accessibility and simplicity of repair**
- 5. Evaluation of the most cost effective solution for minimum life cycle cost**

**C. Chemical Treatments for Distillation Columns**

- 1. Applications and Optimization of chemical treatment programs**

**D. Process Control for Olefin Plants**

**A. Tower Balances**

- 1. Material Balance**
- 2. Energy Balance**
- 3. Composition Balance**

- B. APC and Optimization**
  - 1. Follow the money**
  - 2. Thermodynamics and Equilibrium**
  - 2. Percent on Line**

**E. Trouble Shooting Distillation Columns**

- 1. Principles of troubleshooting**
- 2. Do the simple checks first**
- 2. Calculations of trouble shooting**

**F. Revamping Distillation Columns**

- 1. Test run to determine current unit constraints**
- 2. Simulation and hydraulic analysis of current operations**
  - A. Simulation Guide lines**
  - B. Hydraulic Guide lines**
- 3. Design of new required equipment**
- 4. Inspection of new equipment**
  - A. Case studies of fabrication and installation issues**
- 5. Pre Commissioning and Commissioning**

**G. Discussion and Review**

**11. Summary**

- A. Furnaces**
- B. Compression**
- C. Fractionation**