5th Polymer Reaction Engineering

An Industrial Short Course on Olefin Polymerization Processes

April 27 - May 1, 2009

www.polyolefins.org

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Location

CasaMagna Marriott Puerto Vallarta Resort
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Puerto Vallarta, Jalisco 48354 Mexico
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Course Description

This is a one-week course designed for engineers, chemists and scientist in the area of olefin polymerization with coordination catalysts, polyolefin physical properties and microstructural characterization.

The course covers olefin polymerization, polyolefin characterization techniques and physical properties, starting from fundamental concepts and expanding to the state-or-the-art technology in the field. All sessions include case studies where the concepts covered in the lectures are applied to real situations in laboratory and industrial scales. The lectures are designed in such a way that both beginners and specialists can benefit from the course.

An electronic copy of the full course notes describing all subjects covered in the course is provided to each participant. Copies of the PRE educational software developed by the instructors to illustrate the subjects covered in the course will also be provided. We encourage the participants to bring their laptop computers so they can follow the notes and experiment with the PRE educational software during the lectures.

Lectures will be given in English.

Instructors

Professor João B.P. Soares (http://chentserver.uwaterloo.ca/faculty/soares.html) is a specialist in the areas of olefin polymerization kinetics and catalysis (Ziegler-Natta, metallocene, and late transition metal catalysts), mathematical modeling of olefin polymerization processes and polyolefin microstructural characterization.

Professor Leonardo C. Simon (http://lsimon.uwaterloo.ca) is a specialist in the areas of coordination catalysts for olefin polymerization, modeling polymerization mechanisms, correlation synthesis-structure-properties of polymers, polymer nanocomposites and materials.

Professor Timothy McKenna (http://www.chemeng.queensu.ca/people/mckenna/) is a specialist in the area of polyolefin particle morphology and experimental methods for the evaluation of particle morphology, single particle modeling, and the production of impact copolymers.

Registration

Please contact Professor Soares to register in the course by e-mail (jsoares@uwaterloo.ca), fax (519-746-4979) or telephone (519-888-4567 x 33436). The cost per person is US$ 3,000.00 for industrial participants and US$ 1,500.00 for academic participants.

The course fee includes registration and an electronic copy of the course notes and PRE educational software.

Special discounts exist for two or more participants from the same company. Please contact Professor Soares for more information.

Location

The course will be held at the CasaMagna Marriott Puerto Vallarta Resort & Spa, Av. Paseo De La Marina No. 5, Marina Vallarta, Puerto Vallarta, Jalisco 48354 Mexico, Tel: + 52 (322) 226-0000, Fax: + 52 (322) 226-0060 (https://www.marriott.com/hotels/travel/pvrmx).

A special room rate is available for the course participants until March 12, 2009. Please contact the hotel directly to make your reservation.

The PRE Course Series

The PRE course was designed to fill the need in the industry and academia for graduate-level training on polyolefin reaction engineering, characterization and physical properties. This is the 5th course of the series that started in 2005. Our previous courses are listed below:

- 1st PRE: Lyon, France, June 17-18, 2005
- 2nd PRE: Porto Alegre, Brazil, July 10-14, 2006
- 3rd PRE: Lyon, France, November 15-17, 2006
- 4th PRE: Dubai, United Arab Emirates, April 19-23, 2008

For more information on the PRE Course Series, please visit our website at www.polyolefins.org

Course Contents

Monday, April 27 (9:00 – 17:00)

1. **Introduction to Polyolefins** (JBP Soares)
   - 1.1. Polyolefin types
   - 1.2. Polymerization reactor types
   - 1.3. Catalyst types
   - 1.4. Levels of mathematical modeling for polyolefin reactors

2. **Catalyst for Olefin Polymerization** (LC Simon)
   - 2.1. Ziegler-Natta, Phillips and vanadium catalysts
   - 2.2. Metallocene and late transition metal catalysts
   - 2.3. Mechanism of coordination polymerization
   - 2.4. Cocatalysts
   - 2.5. Catalyst supports
   - 2.6. Catalyst characterization (FTIR, NMR, UV-Vis, XAS)

3. **Industrial Reactors** (TF McKenna)
   - 3.1. Slurry processes
   - 3.2. Gas-phase processes
   - 3.3. Solution processes

4. **Principles of Mathematical Modeling** (JBP Soares)
   - 4.1. Population balances
   - 4.2. Method of instantaneous distributions
   - 4.3. Monte Carlo simulation

Tuesday, April 28 (9:00 – 17:00)

5. **Polymerization with Single-Site Catalysts** (JBP Soares)
   - 5.1. Molecular weight distribution
   - 5.2. Chemical composition distribution
   - 5.3. Long chain branch distribution

6. **Single Particle Models: Transport Phenomena and Particle Growth I** (TF McKenna)
   - 6.1. Mass and heat transfer in growing polymer particles
   - 6.2. Polymeric flow and multigrain models

7. **Polyolefin Microstructural Characterization I** (JBP Soares)
   - 7.1. Gel permeation chromatography
   - 7.2. Batch fractionation
   - 7.3. Extraction or solution fractionation
   - 7.4. Crystallization analysis fractionation
   - 7.5. Temperature rising elution fractionation
   - 7.6. Solution calorimetry
   - 7.7. Field flow fractionation
   - 7.8. Mass spectrometry
   - 7.9. Cross-fractionation

8. **Polyolefin Microstructural Characterization II** (LC Simon)
   - 8.1. Nuclear magnetic resonance (^{1}H and ^{13}C)
   - 8.2. Fourier transform infrared

Wednesday, April 29 (9:00 – 17:00)

9. **Applications of Mathematical Modeling Techniques** (JBP Soares)
   - 9.1. Chain walking and late transition metal catalysts
   - 9.2. Production of thermoplastic elastomers via heterogeneous long chain branching
   - 9.3. Production of linear-block olefin copolymers

10. **Polyolefin Properties** (LC Simon)
    - 10.1. Crystallinity and morphology
      - 10.1.1. X-ray diffraction
    - 10.2. Thermal analyses
      - 10.2.1. Differential scanning calorimetry
      - 10.2.2. Thermal gravimetric analysis
    - 10.3. Thermal properties
      - 10.3.1. Melting point
      - 10.3.2. Glass transition
      - 10.3.3. Heat distortion temperature

11. **Population Balances and the Method of Moments** (JBP Soares)
    - 11.1. Homopolymerization
    - 11.2. Copolymerization and the method of pseudo-kinetic constants

12. **Parameter Estimation for Polymerization Kinetic Models** (JBP Soares)
    - 12.1. Homopolymerization models
    - 12.2. Copolymerization models
    - 12.3. Effect of impurities on productivity and molecular weight

Thursday, April 30 (9:00 – 17:00)

13. **Single Particle Models: Transport Phenomena and Particle Growth II** (TF McKenna)
    - 13.1. New trends in single-particle modeling: particle morphology

14. **Dynamic Monte Carlo Polymerization Modeling** (JBP Soares)
    - 14.1. Stopped-flow reactors
    - 14.2. Living and controlled polymerizations

15. **Multiple-Site Catalysts** (JBP Soares)
    - 15.1. Characteristics of Ziegler-Natta and Phillips polymers
    - 15.2. MWD deconvolution for Ziegler-Natta polymers
    - 15.3. CCD deconvolution for Ziegler-Natta polymers
    - 15.4. Mathematical models for TREF and CRYSTAF

16. **Polyolefin Mechanical Properties and Testing** (LC Simon)
    - 16.1. Stress-strain curves
    - 16.2. Dynamic mechanical properties
    - 16.3. Impact testing
    - 16.4. Creep

Friday, May 1 (9:00 – 17:00)

17. **Special Topics on Polyolefin Reaction Engineering** (Guest Speaker - TBA)
    - 17.1. Free-radical LDPE processes and mathematical modeling
    - 17.2. High-throughput polymerization experiments

18. **Steady-State and Dynamic Simulation of Industrial Reactors in Series** (JBP Soares)

19. **Functional Polyolefins** (LC Simon)
    - 19.1. Catalysts for polar comonomer
    - 19.2. Post-polymerization reactions
    - 19.3. Properties of functional polyolefins

20. **Polyolefin/Clay Nanocomposites** (LC Simon)
    - 20.1. Catalyst supports
    - 20.2. Properties of nanocomposites