POLYMER REACTION ENGINEERING

27th North American
Intensive Short Course on

POLYMERIZATION CHEMISTRY
AND
REACTION ENGINEERING FEATURING
METALLOCENE CATALYSIS,
EMULSION/SUSPENSION PROCESSES
AND
POLYMER PROPERTIES

Monday, June 2
to
Wednesday, June 4
2003

Directed by

Dr. A. Penlidis, FCAE, FCIC
Professor and Director of the
Institute for Polymer Research
Department of Chemical Engineering
University of Waterloo

and

Dr. J.B.P. Soares
Associate Professor
Institute for Polymer Research
Department of Chemical Engineering
University of Waterloo

to be held at:

Waterloo Inn
Waterloo, Ontario
CANADA

REGISTRATION FORM
POLYMER REACTION ENGINEERING
June 2 – June 4, 2003
Waterloo, Ontario

Two ways to register--please note payment and contact information are found at the bottom of the page.

1) You may fill in the information below and send your completed form, along with the cheque, directly to Professor A. Penlidis. Please send an email advising that you have sent the registration and cheque in the mail.

OR

2) You may email us your intention, including details as listed below, and send us the cheque separately by mail.

Name……

Mailing
Address……..

……..

Tel#……..

Fax#……

Email……..…..

The cost of the course is US$1000. per person. For possible reduction in cost, look under COURSE FEES in the GENERAL INFORMATION section.

Enclosed is a cheque for US$ . . . . . .
(drawn on a US bank)

payable to "**UWPOLYCOURSE**"

Mail cheque and registration form to:
Professor A. Penlidis
Department of Chemical Engineering
University of Waterloo
Waterloo, Ontario, Canada N2L 3G1
Tel: 519/888-4567 ext. 6634
Fax: 519/888-6179
Email: penlidis@cape.uwaterloo.ca

POLYMER REACTION ENGINEERING

Monday, June 2
to
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PROGRAMME

Monday, June 2

Morning Session: 9:00 – 12:00 **CHAIN-GROWTH POLYMERIZATION MECHANISMS AND KINETICS**

An introduction to free radical and ionic (heterogeneous and homogeneous Ziegler-Natta and metallocene catalysis) polymerization kinetics.

Topics include:
- Linear, branched and cross-linked chains via free-radical mechanisms
- Linear and branched chains via ionic mechanisms (heterogeneous and homogeneous Ziegler-Natta and metallocene catalysis)
- Stockmayer's bivariate distribution - instantaneous property methods

Afternoon Session 2:00 – 5:00 **ADVANCED POLYMERIZATION KINETICS**

Topics include:
- Identification of multiple active site types (CRYSTAF/TREF/GPC/NMR)
- Identification of active site performance
- Long chain branching
- Ziegler-Natta, metallocene, and late transition metal catalysts

5:00 **PLANT TOURS ON REQUEST**

Tuesday, June 3

Morning Session 9:00-12:00 **EMULSION / DISPERSION / SUSPENSION PROCESSES**

Topics include:
- Styrenics, PVC
- Batch, semi-batch and continuous operation
- Relevant thermodynamics and surface chemistry
- Particle nucleation/growth
- Ionic/steric stabilization
- Particle size distribution and molecular weight distribution

Afternoon Session 2:00 – 5:00 **POLYOLEFINIC PROCESSES**

Topics include:

- Molecular, rheological and solid state properties which are relevant to production, processing and end use applications of polyolefins (LDPE, HDPE, LLDPE, polypropylene, and copolymers)
- Effects of short and long chain branching and molecular weight distributions
- Effects of main process variables on productivity and polymer properties
- Models of polyolefin production processes and plant data comparisons. Examples will include free radical high pressure processes (tubular and autoclave reactors) & heterogeneous catalytic processes (solution, slurry and gas phase)

5:00 Dinner at University Club
University of Waterloo
(drinks, 5:00 – 6:00; dinner, 6:00 pm)

Wednesday, June 4

Morning Session 9:00 – 12:00 **PRINCIPLES OF POLYMER REACTOR MODELLING AND KINETIC DATA COLLECTION; CONTROL OF POLYMERIZATION PROCESSES**

In this section, ideas from all previous lectures (i.e. physico-chemical phenomena operative in polymerization systems) will be incorporated into mathematical models. Steps for the development of polymerization models will be outlined, and applications/uses of models will be discussed. Important modern aspects on parameter estimation and the optimal design of experiments in aid of meaningful kinetic data collection will also be highlighted.

Topics include (part A):

- Batch, semi-batch and continuous operation
- Dynamic modelling of reactor systems
- Population balance equations for particle size and molecular weight
- Screening and factorial designs for data collection
- Sequential and non-linear design of experiments
- Evolutionary operation
- Model discrimination issues
- Advances in initiators
- Bulk/solution/emulsion terpolymerization
- Reactivity ratio estimation
- Monte Carlo methodology/applications

Topics include (part B):

- Overview of current control practices
- Sensors for monitoring reactor behaviour
- Energy balance and rate control
- Control of product properties
- Model uses to combine on-line and off-line data
- Kalman filtering and inferential control
- Software sensors and multivariable statistics
- Optimal reactor grade changes
- Advanced linear and non-linear control

Afternoon Session 2:00 – 5:00 **CHEMICAL MODIFICATION OF POLYMERS THROUGH REACTIVE EXTRUSION**

Part A:

- Fundamental concepts
- Extruder reactors
  - Equipment/Features/Process requirements
- Polymer reactive extrusion
  - Reaction engineering considerations
  - Types of polymer modification reactions
- Case studies/Industrial applications
- Recent advances

Part B: Special Topics

- Rubber technology and properties
- Polymer property characterization techniques/sensors

5:00 **ADJOURNMENT**

GENERAL INFORMATION

COURSE FEES

The cost per person is $1000 US. Two people from the same organization will be charged $1800 US and three people will be charged $2500 US. **(Please ensure cheques are in US dollars drawn on a US bank).** The course fee includes registration, coffee breaks, course notes and dinner on Tuesday, June 3.

CANCELLATION

An administration fee of 15% will be charged for cancellations received before May 20, 2003**. NO REFUNDS after that date.**

COURSE NOTES

The course notes have recently been updated and expanded and are included in the cost of registration. Copies are available for purchase by non-participants for $500 US. Notes will be given to participants just before lectures start.

LOCATION
The course will be held at:

The Waterloo Inn
475 King Street North
Waterloo, ON Canada N2J 2Z5
Tel: 519/884-0220, Fax: 519/884-0321
Toll-free: 800/361-4709

YOU MUST MAKE YOUR OWN HOTEL RESERVATIONS
A block of rooms at special rates has been set aside (until May 4, 2003) for course participants. In order to obtain the special rate, when contacting the Waterloo Inn, please indicate that you are attending the Institute for Polymer Research short Course on Polymer Reaction Engineering.

TRANSPORTATION/OTHER DETAILS
For ground transportation or any other details regarding your visit to Waterloo, please contact the Conference Coordinator:

Rosemary Anderson, Tel: 519/888-4789
Fax: 519/888-6179, Eml: ipr@uwaterloo.ca

LECTURERS
Department of Chemical Engineering
University of Waterloo
Waterloo, Ontario, Canada N2L 3G1

- Dr. Alex Penlidis, Professor and Director of the Institute for Polymer Research
- Dr. João B. P. Soares, Associate Professor
- Dr. Costas Tzoganakis, Professor
- Dr. Tom A. Duever, Professor and Chair
- Dr. Neil McManus, Lecturer and Research Associate
- Dr. Leo Simon, Assistant Professor

IN-HOUSE COURSES

The Institute for Polymer Research at University of Waterloo has more than 20 years experience in conducting in-house courses specifically tailored to your needs and requirements. Secrecy agreements could be signed permitting the consideration of highly relevant material.

Further information on this course or other courses may be obtained from Professor A. Penlidis at:

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