

POLYMER REACTION ENGINEERING

Second South American
Intensive Short Course on

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

Monday, April 23
to
Thursday, April 26
2001

Directed by

Dr. A. Penlidis, 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:

The Imperial Hall
São Paulo, SP
BRASIL

REGISTRATION FORM

**POLYMER
REACTION
ENGINEERING**

April 23 to 26, 2001

1. Name.....

Mailing
Address.....

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Tel#.....

Fax#.....

Email.....

2. Name.....

Mailing
Address.....

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Tel#.....

Fax#.....

Email.....

The cost of the course is \$1000 US 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 application form and cheque 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, April 23
to
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PROGRAMME

Monday, April 23

Morning **CHAIN-GROWTH POLYMERIZATION MECHANISMS
Session:** **AND KINETICS**
8:30 – 12:00

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 **ADVANCED POLYMERIZATION KINETICS**
Session
1:00-4:30

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

Tuesday, April 24

Morning **EMULSION / DISPERSION /SUSPENSION PROCESSES**
Session
8:30-12:00

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 **POLYOLEFINIC PROCESSES**
Session
1:00 – 4:30

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)

Wednesday, April 25

Morning **PRINCIPLES OF POLYMER REACTOR MODELLING AND**
Session **KINETIC DATA COLLECTION**
8:30 – 12:00

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:

- 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

Afternoon **MODERN SPECIAL TOPICS**
Session
1:00 – 4:30

Topics include:

- Polycondensation polymerization (industrial aspects)
 - Advances in initiators
 - Bulk/solution/emulsion terpolymerization
 - Reactivity ratio estimation
 - Monte Carlo methodology/applications
 - Reactive processing
 - (GPC/MISC/LALLS)
- CRYSTAF (Crystallization Analysis Fractionation)

Thursday, April 26

**Morning
Session**

**MONITORING, DYNAMICS AND CONTROL OF
POLYMERIZATION PROCESSES**

8:30 – 12:00

A good understanding of the reaction mechanisms and of the dynamic behaviour of the reactor system is essential to ensure safe and stable operation and achieve tight product quality control.

Topics include:

- 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

12:00 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. Academic participants will be charged \$600 US (**Please ensure cheques are in US dollars drawn on a US bank**). The course fee includes registration, coffee breaks, and course notes.

CANCELLATION

An administration fee of 15% will be charged for cancellations received before March 19, 2001. **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 at 8:20 am just before lectures start.

HOUSING

The course will be held at:

The Imperial Hall
Rua da Consolação 3555
Jardim Europa
CEP 01416-001
São Paulo, SP, Brasil
Tel: 55+(0)11+ 3061-1320
Fax: 55+(0)11+3062-1005
flat@imperialhall.com.br
www.imperialhall.com.br

YOU MUST MAKE YOUR OWN HOTEL RESERVATIONS

When contacting The Imperial Hall, please indicate that you are attending the Polymer Reaction Engineering Course to obtain the special rate.

LECTURERS

- Dr. A. Penlidis, Professor and Director of the Institute for Polymer Research, Department of Chemical Engineering, University of Waterloo, Waterloo, Ontario, Canada.
- Dr. J. B. P. Soares, Associate Professor, Department of Chemical Engineering, University of Waterloo, Waterloo, Ontario, Canada
- Dr. T. A. Duever, Associate Professor, Department of Chemical Engineering, University of Waterloo, Waterloo, Ontario, Canada
- Dr. J. Zacca, OPP Petroquímica, Centro de Tecnologia, Triunfo, RS, Brasil.

IN-HOUSE COURSES

Drs. Penlidis and Soares are available to conduct 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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