POLYMER REACTION ENGINEERING

Sixteenth
Intensive Short Course

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

Monday, June 10
to
Friday, June 14
2002

Directed by

Dr. A.E. Hamielec, FRSC, FCIC
Professor Emeritus and Director of
McMaster Institute for Polymer Production Technology,
McMaster University

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:

Athos Palace Hotel
Kallithea, Kassandra, Halkidiki
GREECE

REGISTRATION FORM

POLYMER REACTION ENGINEERING

June 10 to 14, 2002

1. Name……

   Mailing
   Address……

   ……

   Tel#……..

   Fax#……

   Email……..…..

2. Name……

   Mailing
   Address……

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   Tel#……..

   Fax#……

   Email……..…..

The cost of the course is $2000 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, June 10
to
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PROGRAMME

Monday, June 10

Morning Session: 9:00 – 12:30	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 crosslinked 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 5:00-8:00	ADVANCED POLYMERIZATION KINETICS

Topics include:

- Identification of multiple active site types (TREF/GPC/NMR)
- Identification of active site performance
- Long chain branching
- Ziegler-Natta and metallocene catalysis

Tuesday, June 11

Morning Session 9:00-12:30	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
5:00 – 8:00

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)

Wednesday, June 12

Morning Session
9:00 – 12:30

PRINCIPLES OF POLYMER REACTOR MODELLING AND KINETIC DATA COLLECTION

In this section, ideas from all previous lectures (i.e. physico-chemical phenomena operative in polymerization systems) will be incorporated into a mathematical model. Steps for the development of a polymerization model 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

Wednesday afternoon is available for study, questions or other personal pursuits. We hope that tradition continues this year as we engage in our usual soccer game.

Thursday, June 13

Morning Session
9:00 – 12:30

MODERN SPECIAL TOPICS

Topics include:

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

Afternoon Session
5:00 – 8:00

RUBBER MANUFACTURING PROCESSES AND PRODUCT CHARACTERIZATION

An overview of the science and technology of the basic materials used for elastomeric applications and recent developments in the production of rubbers will be given.

Topics include:

- Definitions: macromolecules, rubbers, elastomers
- Synthesis and production of rubbers
- Recent developments in EP(D)M and poly-alpha-olefins:
  - Metallocene catalysts
  - Gas phase process
  - Single-site vs multi-site catalysts
- Molecular structure and physical properties
- Compounding, vulcanization and applications

Friday, June 14

Morning Session
9:00 – 12:00

MONITORING, DYNAMICS AND CONTROL OF POLYMERIZATION PROCESSES

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 $2000 US. Two people from the same organization will be charged $3800 US and three people will be charged $5400 US. **(Please ensure cheques are in US dollars drawn on a US bank).** The course fee includes registration, room for five nights, breakfast and dinner for five days, beverage breaks and course notes.

CANCELLATION

An administration fee of 15% will be charged for cancellations received before June 1, 2002**. THERE WILL BE 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 8:50 am just before lectures start.

RECEPTION

An informal reception and wine and cheese welcoming party will be held on Sunday evening (8:00 pm), June 9, 2002. The reception will be followed by dinner.

HOUSING

The course will be held at Athos Palace Hotel, Kallithea, Kassandra, Halkidiki GREECE. The participants will be accommodated for five days, and this is included in the cost of registration.

Athos Palace is a delightful luxury holiday resort set in one of the most unspoiled and picturesque regions of Greece. If you wish to extend your visit, the management assures us that you can obtain special rates.

MEALS

Breakfast, dinner and beverage breaks (Sunday evening through Friday morning) are included in the cost of registration.

TRANSPORTATION

The Athos Palace resort is located approximately 100 kilometers south-east of Thessaloniki International Airport. There are direct flights to Thessaloniki from all major airports. Barring large currency fluctuations, taxi fare for the 1-1/2 hr ride is expected to be less than $100 US in the summer of 2002.

More details about the area, its location and how to get there, are available upon request. Please email penlidis@cape.uwaterloo.ca.

SPOUSES & ACCOMPANYING PERSONS

The cost for spouses or accompanying persons is $300 US. This includes a double room with breakfast and dinner for five days, and all events. Attendance at the lectures and the course notes are not included.

LECTURERS

Possible lecturers include:

- Dr. A.E. Hamielec, Professor Emeritus and Director of McMaster Institute for Polymer Production Technology, Department of Chemical Engineering, McMaster University, Hamilton, Ontario, Canada.

- 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. Gao, ZK/AV-B1, BASF Aktiengesellschaft, 67056 Ludwigshafen, Germany

- Dr. E. Kontos, New Business Development, Crompton Corporation, Middlebury, CT, USA

- Dr. H. Rutten, DSM Engineering, Stamicarbon Technology Department, P.O. Box 10, 6160 MD Geleen, The Netherlands

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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