www.venturecenter.co.in

The Indian Society of Rheology

Technical Workshops Series /Polymers/2014

Three-Day Intensive Workshop on
Rheology of Polymer Melts

- Organized by The Indian Society of Rheology, CoE-SPIRIT, and Venture Center -

Learn	• Introduction to the fundamentals of rheology, with special emphasis on the rheology of polymer melts. • Special applications, of direct relevance to the polymer/plastics industry • Laboratory demonstrations • Analysis and interpretation of rheological data from experiments on polymer melts
Organized by	• Indian Society of Rheology (ISR) • CoE-SPIRIT: Sustainable Polymer Industry through Research, Innovation and Training - A Centre of Excellence in Polymers at CSIR-National Chemical Laboratory, Pune sponsored by the Department of Chemicals and Petrochemicals (DCPC), Govt. of India • Venture Center – a Technology Business Incubator
Co-sponsored by	• TA Instruments
For whom	• Polymers/plastics/petrochemical industry professionals in R&D, applications development, manufacturing, QC, QA functions • If seats are available, students, academics and researchers with interest in polymer rheology shall be included • Maximum 10 seats; First-come-first-serve.
When	**Monday-Tuesday** **December 22- 23, 2014 (Tentative)**
Where	• Classroom sessions: Training Room, Venture Center, NCL Innovation Park, Dr. Homi Bhabha (Pashan) Road, Pune-411008 • Lab sessions: Polymers and Advanced Materials Lab, CSIR-NCL, Dr. Homi Bhabha (Pashan) Road, Pune-411008
Contact	Ms. Lipika Biswas Venture Center, 100, NCL Innovation Park, Dr. Homi Bhabha Road, Pune – 411008; Phone: +91-20-20250934; +91-20-25865877 Email: eventsdesk@venturecenter.co.in
Cost	• Medium and large companies: Rs. 15,000/- • Micro and small enterprises/Individuals: Rs. 8,000/- • Non-profit and academic institutions: Rs. 5,000/- • Students with valid ID card: Rs. 3,000/-

www.venturecenter.co.in

The Indian Society of Rheology

Introduction

Rheology is one of the key characterization tools for the polymer/plastics industry. Any melt processible polymer needs to be characterized thoroughly using rheological techniques wherein the flow properties are accurately measured. The rheological properties directly correlate with the processing performance of the polymer which in turn governs the final product performance in a given end application. Rheology is very sensitive to the macromolecular architecture of the polymer and is helpful in solving polymer-processing problems. For e.g. a long-chain branched (LCB) polymer exhibits shear-softening/thinning as well as extensional-hardening characteristics, both of which make this polymer easy to process in an extruder as well as in processes that involve free-surface flows such as thermoforming or film/foam extrusion. Developing a linkage between the microstructure of the polymer and its processing through the application of rheology is therefore critical.

The workshop content will be tailored to meet the interests of participants from varying educational backgrounds, who are closely associated with R&D, manufacturing, QC and applications. Specifically, researchers and R&D managers from the polymer/plastics industry, with interests in applying rheological techniques/methods to industrial processes will benefit from attending the workshop.

The workshop will be taught by foremost experts working on various aspects of polymer melt rheology. The Venture Center and CSIR-NCL, which will be the venue for the workshops, have excellent classrooms and rheology labs with state of the art rheometers.

This workshop is meant to provide a general introduction to the fundamentals of rheology, with special emphasis on the rheology of polymer melts. Special applications, of direct relevance to the polymer/plastics industry will be covered. The workshop will comprise classroom lectures, which will be interactive and will convey some of the excitement of doing rheology, as well as laboratory demonstrations, which will enable participants to understand standard test protocols and get familiar with apparatus, as well as analyze rheological data from experiments on polymer melts. The workshop will also have ‘group assignment’ sessions in which participants will learn to interpret rheological data.

Course Outline

- Introduction to rheology of complex fluids.
- Lab sessions introducing rheometers and standard experiments at PAML, CSIR-NCL.
- Introduction to rheometric techniques.
- Rheology of polymer melts.
- Lab sessions on rheology of polymer melts.
- Special topics: Rheology of filled polymers and of polymer blends & alloys
- Interpretation and analysis of rheological data

www.venturecenter.co.in

The Indian Society of Rheology

Schedule

Day#1

09:00 AM to 1:00 PM and 02:00 PM to 3:30 PM	Theory of Rheology	• Definitions of stress, strain • Ideal fluids and solids • Linear viscoelasticity (LVE) • Introduction to non-linear viscoelasticity • Linking LVE to Molecular weight Distribution (MWD) • Introduction to mol. constitutive equations
	Rheometry	• Controlled stress and controlled strain rheometers • Cone & plate and parallel plate geometries • Capillary rheometry • Extensional rheometry: uniaxial, biaxial, exponential shear, hyperbolic die, equibiaxial • Instabilities (slip, fracture, inertia)
04:00 PM to 06:00 PM	Lab sessions on rheometry, data interpretation and problem solving	• Examples linking rheology to macromolecular structure • Examples linking rheology to polymer processing • Interpreting rheological data

Day#2

09:00 AM to 1:00 PM and 02:00 PM to 3:30 PM	Linking rheology to macromolecular structure	• Effect of MWD on rheology or determining MWD from rheology
		• Transformations of LVE data
		  ○ Creep to G', G" and inverse
		  ○ Stress relaxation to G', G" and inverse
		• Effect of long-chain branching (LCB) on rheology

	Non-linear rheology	• Shear thinning, extrudate swell (using capillary rheometry) • Strain sweep • Large amplitude oscillatory shear (LAOS) technique to generate Lissajou and other

		harmonics data
	Extensional rheometry	• Uniaxial extensional rheology using EVF fixture (of TA Instruments) • Melt tension/strength data using Rheotens instrument (of Gottfert)
	Other topics of interest to industry	• Effect of fillers on rheology of filled polymers • Rheology of polymer blends and alloys
04:00 PM to 06:00 PM	Lab sessions on rheometry, data interpretation and problem solving	• Exercise on interpreting rheological data • Generating and interpreting data for rheology of filled polymers and polymer blends/alloys.

www.venturecenter.co.in

The Indian Society of Rheology

Anchor Faculty	
	**Dr. Ashish Lele** **Chief Scientist, Polymer Sci. & Engg. Division, CSIR-NCL** **Dr. Ashish Lele did a BE in Chemical Engineering from UDCT, Mumbai followed by a PhD in Chemical Engineering from University of Delaware, USA. Immediately after receiving his PhD degree, he joined the Polymer Science and Engineering Division of the CSIR-National Chemical Laboratory, Pune in 1993 where he is presently a Chief Scientist. Dr. Lele**
	**Dr. Harshawardhan Pol** **Senior Scientist, Polymer Sci. & Engg. Division, CSIR-NCL** **Dr. Harshawardhan Pol did an M.S. in Materials Science and Engineering from Clemson University, USA followed by a PhD in Chemical Engineering from University of Pune. He has worked at The Dow Chemical Company in USA for three years before joining the Polymer Science and Engineering Division of the CSIR-National Chemical Laboratory, Pune in 2003 where he is presently a Senior Scientist. Dr. Pol works on understanding the role of macromolecular architecture on the rheology and processing of polymer melts, and on industrial projects involving development of new polymeric materials based on detailed understanding of structure-property relations.**

Course includes

- Course notes (hard copy) including slides, case studies, application notes
- Lab demo
- Access to restricted website with online compilation of resources
- One-on-one feedback on data interpretation exercise
- Certificate of Participation issued by Venture Center and Indian Society of Rheology
- Course includes tea and lunch at Venture Center cafeteria

*** Please note the participants will have to arrange for their own travel, local transport, accommodation and dinners.**

www.venturecenter.co.in

The Indian Society of Rheology

About the Organizers	
	The Indian Society of Rheology has been created to promote closer ties between the rheology communities in Indian academia/R&D institutes and Indian industry, to assist in the development of human resources in the area of rheology within the country, to support the activities of the complex fluids community in India and to establish formal links with other Societies of Rheology across the globe.
	About Venture Center Entrepreneurship Development Center (Venture Center) – a CSIR initiative – is a Section 25 company hosted by the National Chemical Laboratory, Pune. Venture Center strives to nucleate and nurture technology and knowledge-based enterprises by leveraging the scientific and engineering competencies of the institutions in the Pune region in India. The Venture Center is a technology business incubator supported by the Department of Science & Technology's National Science & Technology Entrepreneurship Development Board (DST-NSTEDB). Venture Center's focuses on technology enterprises offering products and services exploiting scientific expertise in the areas of materials, chemicals and biological sciences & engineering. For more information, visit http://www.venturecenter.co.in/

About the Sponsors	
	About SPIRIT at National Chemical Laboratory, Pune SPIRIT stands for Sustainable Polymer Industry through Research, Innovation and Training. SPIRIT is a Centre of Excellence in Polymers sponsored by the Department of Chemicals and Petrochemicals, Government of India, at the CSIR-National Chemical Laboratory, Pune. More information: http://coespirit.in/
	About TA Instruments TA Instruments' reputation for high technology products, quality manufacturing and unbeatable after sales support is why more customers recommend TA products to their colleagues around the world. Headquartered in New Castle, DE, USA, TA Instruments takes pride in the technical competence and professionalism that their sales force offers. TA Instruments is the world-wide leader in in thermal analysis, rheology, and microcalorimetry. More information: http://www.tainstruments.com/