

Department of Chemical Engineering Seminar

Title : Science and Engineering of Pores, Particles and Interfaces in Development Green Chemical and Biological Processes

Speaker: Ganapati D. YADAV, *Vice Chancellor and R.T. Mody Distinguished Professor*
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Date and Time : 21st February 2014 (Friday) 17:00-18:00

Venue : L-9
(Tea will be served at 16:45)

Abstract:

We have been fascinated by phenomena occurring at the boundaries which has grown over the years with confluence of chemical and biological sciences and engineering, the formation of nanoparticles, pores and the interfaces residing within them. On one hand, network models and percolation processes in reservoir rocks, enhanced oil recovery and coal gasification, hydrogen generation to the finer aspects of multiphase reaction engineering and Green Chemistry. There is a very interesting thread among this areas which can be broadly viewed as Science & Engineering of Pores, Particles and Interfaces to develop clean and green processes, whether physical, chemical or biological or otherwise.

In recent years, my group has been working in three different areas of Green Chemistry and Engineering using heterogeneous chemical catalysis, biocatalysis and phase transfer catalysis. New opportunities for the conversion of glycerol into value-added chemicals have emerged in recent years as a result of glycerol's unique structure, properties, bioavailability, and renewability. Different reaction pathways for selective catalytic conversion of bioglycerol into commodity chemicals include oxidation, hydrogenation (commonly called hydrogenolysis), dehydration, pyrolysis and gasification, steam reforming, thermal reduction into syngas, transesterification, etherification, oligomerization, polymerization, acetalization and carbonylation. The development of novel solid acids, bases, hydrogenation and oxidation catalysts for glycerol conversion will be discussed with examples. A recent area of great interest includes synthesis of enantiopure drugs, separation of racemic mixture and biocatalytic synthesis of fine chemicals. Our work encompasses different approaches to synthesize important pharmaceutical intermediates to overcome the limitations of conventional organic synthesis methods. Immobilized lipases were employed to study some pharmaceutically important reactions, under enzyme catalysis and microwave irradiation including development of kinetic models.

The liquid-liquid phase transfer catalyzed reaction can be intensified by converting it into three-liquid phases. An attractive process for the production of mandelic acid is through reaction between benzaldehyde, sodium hydroxide and chloroform in the presence of polyethylene glycol 4000 as a phase transfer catalyst. We address the modeling

of a well-stirred reactor for the foregoing process in which organic droplets surrounded by a thin film of catalyst-rich phase are suspended in the aqueous phase. A population balance model is formulated L-L-L PTC reaction and solved by Monte Carlo simulation using interval of quiescence technique. Transport processes and intrinsic reaction kinetics are extracted from the experiments. This population balance model serves to assess and interpret the relative roles of various processes in L-L-L PTC reaction, such as diffusive transport, reaction and interaction between dispersed phase droplets. The model is expected to be an effective tool for reactor design and scale up.

About the speaker:

Professor Dr. Ganapati D. Yadav is the Vice Chancellor and R.T. Mody Distinguished Professor and J.C. Bose National Fellow (Govt of India), Institute of Chemical Technology, Mumbai. He is also appointed as the Adjunct Professor at RMIT University, Australia and University of Saskatchewan, Canada

He ranks among the preeminent engineers and academicians in India, who is internationally recognized by many prestigious awards, fellowships and honours for his seminal contributions to education, research, innovation and development of clean technologies. He has provided inspiring academic and professional leadership to the Institute of Chemical Technology (ICT), the Indian Institute of Chemical Engineers (IChE) and Catalysis Society of India, and Maharashtra Academy of Sciences.

He has received numerous honours and distinctions for his path-breaking contributions to green chemistry and engineering, catalysis science and engineering, chemical reaction engineering, nanotechnology and energy engineering. He has supervised 75 doctoral students and 74 masters students, and has authored over 300 original research papers in 51 cross-disciplinary international peer-reviewed journals. He also holds 65 patents and has authored 3 books. He has h-index of 39. He is a Fellow of both, the Indian National Science Academy (INSA) and the National Academy of Sciences, India (NASI), among others. He has been honoured by the Government of India's Department of Science and Technology with its prestigious Jagdish Chandra Bose National Fellowship and is the only active university faculty member in the state of Maharashtra to be elected as Fellow of The World Academy of Sciences (TWAS) in Trieste, Italy. He was recently bestowed with the D. M. Trivedi Lifetime Achievement Award of Indian Chemical Council as well as the Dr. B. P. Godrej Lifetime Achievement Award of the Indian Institute of Chemical Engineers (IChE). The Indian Speciality Chemical Manufacturers Association (ISCMA) and PSN College of Engineering TN has bestowed the Best Researcher award for 2012. Three Rotary Clubs in Mumbai have bestowed on him vocational awards.

Other notable international recognitions to be bestowed upon him include the Fellowships of The Royal Society of Chemistry (RSC), UK and The Institution of Chemical Engineers (IChemE), UK; the Canadian Catalysis Foundation's Cross-Canada Lectureship Award; the University of Amsterdam's John van Geuns Lectureship; the Park Reilly Distinguished Speakership of the University of Waterloo; the Johansen Crosby Visiting Professorship in Chemical Engineering at Michigan State University; the Distinguished Asian Visiting Scholar at Purdue University; Visiting Professorship at the Lunghwa University of Science and Technology, Taiwan; and Adjunct Professorship at the Royal Melbourne Institute of Technology and University of Saskatchewan, Canada. In India, Prof. Yadav has been awarded with prestigious honours such as: IIT-Roorkee's Khosla National Award; RPG Life Sciences' Padma Vibhushan Prof. MM Sharma Medal and Chemcon Distinguished Speaker Award of IChE; Institution of Engineer's Eminent Engineer Award; Ashland Padma Vibhushan Prof. CNR Rao Medal & Chemcon Distinguished Speaker Award; Best Teacher Award of the Government of Maharashtra; Dr. Anji Reddy Innovator of the Year Award; Anna University's National Award for the Most Outstanding Academician; and VASVIK Foundation Award for Excellence in Research in Chemical Sciences and Technology.

The American Chemical Society (ACS) has organized a special issue of Industrial and Engineering Chemistry Research in 2014 in his honour to highlight his immense and exceptional research contributions. The ACS has also elected him as the only non-American editor of its new journal, ACS Sustainable Chemistry and Engineering. He is also an editorial board member of 8 international journals of considerable repute.

Prof. Yadav's contributions to development of the chemical engineering profession in India are incomparable. During his tenure as President of the IChE, he reinvigorated the body by incorporating 51 national awards through endowments. He also serves as Director of the Asia-Pacific Confederation of Chemicals Engineering Institutes. He has also been a member or chaired several national and international committees of

GOI ministries and autonomous bodies such as MHRD, DST, DBT, UGC, AICTE, CSIR, FICCI, the PSA's on Green Chemistry, the Planning Commission's Pan India S&T Committee, and the Government of Maharashtra's Rajiv Gandhi S&T Commission Peers Group. He was also the member of the DST's Special Peer Review Committee for Evaluation of Reports on the Bhopal Gas Disaster, and has led two delegations of Indian scientists to South Korea and Germany. He is Chairman, Research Council, CSIR-CSMCRI, and member of RC of IICT Hyderabad and NIIST Trivandrum. He also serves as Chairman, Advisory Council of DST-National Centre for Catalysis Research, IIT-Madras.

Prof. Yadav is also a vociferous advocate of the chemical sciences and industry in the print, radio and television. He has been championing the rejuvenation of the chemical industry through adoption of sustainable clean and pollution-free technologies. He is also a widely sought after speaker who has traversed the world to give more than 400 lectures.

About the Institute:

The ICT is rated as the best in chemical sciences and engineering ranked among the best in the world with several awards such as : CHEMTECH Foundation's Best R and D Institute, Number 1 rank in Chemical Engineering in India and No. 4 in the World in research publications. Maharashtra Government's Elite Institute Status and Centre of Excellence like IITs, IISc, IISERs, No. 1 TEQIP funded institute among 127 during Phase 1 and lead institute in Phase II. The Tata Chemicals AICTE-CII Best Industry Linked Institute award in Chemical Engineering was bestowed recently on ICT for 2012. All departments of the Institute are supported by the DST-FIST and UGC-SAP with 710 doctorates, 450 masters and 1100 UG students. It is recognised as a model for industry-institute collaboration. Several prestigious universities from the USA, UK, Australia, France, Canada and New Zealand, as well as leading industries from across the globe and from India have signed MOUs with the ICT to promote research and development of technologies.