Electrohydrodynamics of aqueous droplet systems in non-conducting media such as air and insulating oils are encountered in quite a few applications. These include electrosprays, mass spectroscopy and ion traps, electro-emulsification of water in high viscosity oils and electrocoalescence in desalting of crude oils.

It is well known that a spherical drop charged beyond its Rayleigh limit becomes unstable (when subjected to small shape perturbation) and ejects a significant fraction of original charge in the form of jet. Our computations predict the charge loss in Rayleigh break up process where in drop is modeled as a perfect conductor. The extension of this model to include charge dynamics, which is typically ignored in literature owing to great differences in the conductivities of the droplet and the medium (air), highlights the importance of tangential stresses in the formation of a jet and progeny droplets.

Another problem where the fast but finite dynamics of charges in aqueous is important in the electrocoalescence of droplets under electric filed. One of the major applications and successes in electrohydrodynamics is in the desalting process in refineries, where salt is removed from the oil by destabilization of water emulsion using electrocoalescence. The physics of two droplets under electric field is complicated and yields surprises such as non-coalescence under strong fields. Moreover, quite non-intuitively, the mode of non-coalescence depend upon the nature of oil and the conductivity of aqueous droplets, indicating the relevance of charge dynamics.

Abstract

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About Prof. C. V. Seshadri

The late Prof. C. V. Seshadri (CVS) was a distinguished Chemical Engineer. He did his Ph.D. with Professor Herbert L. Toor of Carnegie Mellon University, Pittsburgh, followed by a Research Associateship at MIT. He joined IIT Kanpur as an Assistant Professor in 1965, and later became a Professor and Head of the Chemical Engineering Department. Finally he became the Dean of Students Affairs, IITK.

While here, he wrote the famous best selling textbook: C. V. Seshadri and S. V. Patankar, Elements of Fluid Mechanics, Prentice Hall of India, New Delhi, 1971. CVS left IITK in 1974 to join Kasturi Paper Food and Chemicals Ltd., Bangalore, where he set up India's first fodder-yeast plant. In 1976, he joined the Shri A. M. M. Murugappa Chet-tiar Research Center in Chennai as its founder Director, an institute emphasizing appropriate technology, the forte of CVS. It was here that CVS really blossomed and helped develop several appropriate technologies, including Spirulina Algae. For his efforts in this direction, CVS received the prestigious Jamnalal Bajaj award for S & T for rural development (1981). As Rajni Bakshi sums up: "CVS's youthful zest and enormous energy made it easy to forget the linear dimension of this mortal frame. Yet this is all the sea snatched away. The man's bequest remains, awaiting the nurturing care of fellow travellers in this and other times." CVS received enormous support and encouragement for his efforts from Mr. M. V. Murugappan, with whose vision the Research Center was set up.

About the Speaker

Rochish Thaokar joined IIT Bombay in 2005 and is currently professor in department of chemical engineering. He obtained his BTech from LIT Nagpur, ME and PhD from IISC Bangalore, followed by Postdoctoral stint at Max Planck Institute for Polymerforschung in Mainz, Germany. He also worked for a year in TRDDC Pune.

His research interests include pattern formation in planar electrohydrodynamic systems, drop emulsification and coalescence using electric fields, capsule and vesicle hydrodynamics for dielectrophoresis and electroporation applications as well as droplet levitation and breakup in electric traps. He uses analytical theory, experimental methods and boundary integral calculations to understand electrohydrodynamics of soft matter.

About the Donors

The corpus of the Professor C. V. Seshadri (CVS) Memorial Distinguished Lecture in the Department of Chemical Engineering, IITK has been set up by several students, family members and friends of CVS. This lecture is to be delivered by a promising young Chemical Engineering researcher (below about 45 years) working in India.

Previous Speakers

- Dr. Amol A. Kulkarni, NCL Pune, 2017
- Dr. Narendra M. Dixit, IISC Bangalore, 2016
- Dr. Ganesh Subramaniam, JNCASR Bangalore, 2015
- Dr. Guruswamy Kumaraswamy, NCL Pune, 2014
- Dr. Mahesh S Tirumukudulu, IIT Bombay, 2013