UCLA ENGINEERING
Chemical and Biomolecular Engineering

SEMINARS IN CHEMICAL AND BIOMOLECULAR ENGINEERING

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Engineering V 2101

Presented by

Prof. Morton Denn

Albert Einstein Professor of Science and Engineering Emeritus

City College of CUNY

Hosted By:

Prof. Yoram Cohen

"The Unusual Rheology of Particle-Filled Systems"

Most of our rheological intuition is derived from more than five decades of research on polymer melts and solutions. Commonly observed phenomena include the "Weissenberg effect," in which a liquid climbs up a rod that is rotating slowly in a beaker; non-zero normal stress differences that are dominated by a positive first normal stress difference that is typically six to ten times the magnitude of the negative second normal stress difference; and shear thinning, where the viscosity decreases with increasing shear rate. Suspensions of hard spheres, on the other hand, often exhibit a negative Weissenberg effect, in which the suspension climbs down the rod; normal stresses that are dominated by the second normal stress difference; and shear thickening, where the viscosity increases with increasing shear rate, in some cases discontinuously.

In this talk we will briefly review what we know about the rheology of certain filled systems, and we will present recent results obtained in collaboration with colleagues at the Benjamin Levich Institute and the Institute of Physics at the University of Amsterdam. In particular, we will address particle-scale simulations for Brownian and non-Brownian systems that establish the frictional mechanism of discontinuous shear thickening, as well as experiments that show a profound dependence of rheology on particle size and system type, which cannot be explained by scale-free classical treatments.

***Dr. Morton Denn** is the Albert Einstein Professor of Science and Engineering Emeritus at the City College of New York, CUNY, where he was Director of the Benjamin Levich Institute for fifteen years. Prior to joining CCNY in 1999, he was Professor of Chemical Engineering at the University of California, Berkeley, where he served as Department Chair, as well as Program Leader for Polymers and Head of Materials Chemistry in the Materials Sciences Division of the Lawrence Berkeley National Laboratory. He previously taught Chemical Engineering at the University of Delaware, where he was the Allan P. Colburn Professor. Additionally, Professor Denn was Editor of the AIChE Journal from 1985 to 1991 and Editor of the Journal of Rheology from 1995 to 2005. He is the recipient of a Guggenheim Fellowship; a Fulbright Lectureship; the Professional Progress, William H. Walker, Warren K. Lewis, Institute Lectureship, and Founders Awards of the American Institute of Chemical Engineers; the Chemical Engineering Lectureship and Lifetime Achievement Award in Chemical Engineering Pedagogy of the American Society for Engineering Education; and the*

Bingham Medal and Distinguished Service and Publication Awards of the Society of Rheology. He is a member of the National Academy of Engineering and the American Academy of Arts and Sciences, and he received an honorary DSc from the University of Minnesota. He is the author of seven books: Optimization by Variational Methods; Introduction to Chemical Engineering Analysis (coauthored with T. W. Fraser Russell); Stability of Reaction and Transport Processes; Process Fluid Mechanics; Process Modeling; Polymer Melt Processing: Foundations in Fluid Mechanics and Heat Transfer; and Chemical Engineering: An Introduction.