

ISSF 2022 Brunner Lecture

Polymers and Supercritical Fluids – A Personal Journey
*Excitements, Setbacks & Failures, Partial Successes, and Hindsight***E. Kiran***Department of Chemical Engineering, Virginia Tech, Blacksburg, VA 24061, USA*

I am honored to be the Brunner Lecturer at this international symposium. In this presentation, I hope to share with you a highly personal journey with supercritical fluids and their applications in polymers, spanning a nearly 40-year period. Even though polymers were not the primary research area of Professor Gerd Brunner, I had the privilege of knowing and interacting with him for the past 35 years. Thus, my journey includes numerous occasions with Gerd and Annemarie that I also hope to share during my presentation.

My formal educational background is in chemical engineering and polymer science with a Ph.D. in 1974. My first exposure to and appreciation of supercritical fluids was later at a Gordon Research Conference on Analytical Pyrolysis held in Holderness School in Plymouth, New Hampshire in 1983 where Prof. Milton Lee gave a talk entitled “super-critical solvent chromatography” in which he described the potential of supercritical fluids in separation of high molecular weight compounds such as polymers. I was immediately intrigued by the tunability of the properties of these fluids and in particular their dissolving power that could be modulated with density and/ or through designing solvent mixtures. These fluids appeared to provide limitless possibilities as process or processing fluids for a wide range of applications in polymers, from polymer formation to polymer modifications. That is how I embarked on my journey which has been filled with many excitements, some setbacks and failures arising from not fully understanding the complexities of the systems, and also some successes. In each project, I pursued fundamental questions with applications in mind, seeking funding from federal agencies, and always working closely with industrial organizations which included companies like Pressure Chemicals, DuPont, Johnson & Johnson, and Dow Inc.

In pursuing the fundamentals, the central theme has been the thermodynamics and transport properties of polymer + solvent systems at high pressures. Specific focus areas have been miscibility and phase separations, thermophysical transitions, and the coupled dynamics associated with these processes. These concepts and the relevant data are key for rational selection of processing conditions of polymers in generating particles, fibers, blends, composites, or foams. Addressing the challenges often necessitated the development of new instrumentation and unconventional characterization procedures. I will be elaborating on all these with specific examples as part of my journey that I will be sharing.

