Residence Time Distribution Measurements in Complex Multiphase Systems – Application of Radiotracers in Metallurgical Industry

Dr. Sanja Miskovic, Assistant Professor
Metallurgical Engineering, The University of Utah

Abstract

According to fundamental chemical reactor theory, the residence time distribution (RTD) is defined as the probability distribution of the time that particular finite element of a mixture (solid, liquid, or gas) stay inside of monitored part of the process (i.e. unit/reactor or series of units/reactors) in a continuous flow system. The RTD approach has been widely used to understand, monitor, and model the material flow profile and material transport phenomena inside of various industrial continuous flow systems. By RTD measurement, potential system problems such as channeling, bypassing, short-circuiting, and existence of dead volumes, could be determined. The RTD measurement is performed by the injection of a suitable tracer into the inlet and monitoring the concentration of the tracer at one or several control points at regular time intervals. Due to their great physico-chemical compatibility, high detection sensitivity, and feasibility of in-site detection, radioisotopes and radiation detectors can be used successfully to reliably troubleshoot industrial processes via RTD method. When obtained experimentally, radiotracer RTD information generally suffers from substantial noise as a result of background radiation, radioisotope decay, and signal fluctuations, among others. Standard signal processing steps, such as background correction, radioactive decay correction, starting point correction, and signal extrapolation, will be presented. In this presentation, most commonly used RTD modeling strategies, including the CSTR and PFR series model, axial dispersion model, stochastic model, and RTD prediction by means of computational fluid dynamics (CFD) simulation, will be reviewed. Final part of the presentation will address several case studies related to application of radiotracer RTD measurements in minerals and metallurgical industries.

Presenter's Biography:

Dr. Sanja Miskovic is an Assistant Professor at the Department of Metallurgical Engineering, University of Utah. She received her B.S. in chemical engineering and M.S. in environmental engineering from the University of Novi Sad, Serbia, and her Ph.D. in minerals engineering from Virginia Tech in 2011. Dr. Miskovic's expertise is in the broad area of modeling, optimization, and control of separation processes in minerals and metallurgical industries. Her research work focuses on computational and experimental fluid dynamics of complex multiphase systems in macro-, meso-, and micro-scale. Currently, Miskovic's research group is working on the development of advanced measurement methods for multiphase flow characterization and process diagnostics. In her work she is utilizing a combination of computational and experimental studies to understand the relationship between energy input, flow dynamics, machine design, and separation efficiency of mineral processing unit operations.