

### **34e Biopharmaceutical Scale-up and Scale-down Using Fluid Mixing Analysis and Computational Fluid Dynamics (CFD)**

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This presentation describes how industrial fluid mixing techniques, pilot-scale experiments and computational fluid dynamics (CFD) can be combined to insure optimal bioreactor scale-up and scale-down. Using fundamental theories of mixing, the process engineer can blend the best of fluid mixing engineering practices with state-of-the-art computational techniques to optimize the performance of pharmaceutical and biopharmaceutical stirred tank reactors.

This presentation will outline a fluid mixing engineering review strategy which is important in developing an overall understanding of bioreactor performance at the different scales. The bioreactors must be properly designed to meet multiple design criteria such as liquid blending, gas dispersion, cell suspension, gas-liquid mass transfer, cell-liquid mass transfer, local turbulence, local shear rate, and bubble size distribution. The critical design criterion can change depending on reactor scale, agitation rate, gas rate, sparger design and impeller selection.