CFD Analysis of a Macro Scale Ultrasonic Separator

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Abstract

Macroscale ultrasonic separation is a new filtration technology, with various applications such as cell clarification, cell therapy, blood-lipid separation, oil-water separation etc. These systems use piezoelectric transducers to create standing waves in fluid-particle mixture. Suspended particles get clustered by action of acoustic radiation forces and are separated out by enhanced gravity/buoyancy. Such systems have been shown to successfully filter 1-10% PCM (packed cell mass) cell-protein mixtures at more than 90% clarification with 1-3 MHz transducers. The fluid dynamics associated with such systems is often more complicated than their microscale counterparts due to strong multiphase effects with interactions between particles, fluid and acoustics. Computational fluid dynamics analysis of such systems consists of two main components, fluid-particle mixture simulations to optimize the fluid path, and piezo-electric simulation coupled with structural mechanics and acoustics for selection of optimal operation frequencies and prediction of acoustic radiation forces. This paper presents results obtained with the COMSOL Multiphysics® software for macroscale ultrasonic separator systems and highlights important insights gained into working of such systems.