Numerical Analysis of Flow Chamber Morphologies for Pilot-Scale Ultrasonication

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Abstract

Ultrasonication effectiveness is an important consideration in the scale-up of lab-scale dispersion experiments. Unlike lab-scale experimentation, which can take advantage of localized tools such as probe and bath sonicators, pilot-scale processes may necessitate the use of large flow chambers coupled with powerful ultrasonic wave sources. This situation thus poses the question of whether flow chamber morphology has a salient impact on sonication effectiveness - and if so, what morphologies best optimize the degree of cavitation within flow chambers. To systematically explore a varied parameter space of flow chamber configurations, the COMSOL® Acoustics Module is used to investigate optimal scales, aspect ratios, and inlet/outlet configurations for ultrasonically equipped pilot-scale flow reactors. The information gained from this study aids the design of high-capacity ultrasonication chambers for the scale-up of dispersion experiments, and has broader implications in the field by drawing attention to the oft-ignored association between chamber shape and sonication quality.

Figures used in the abstract

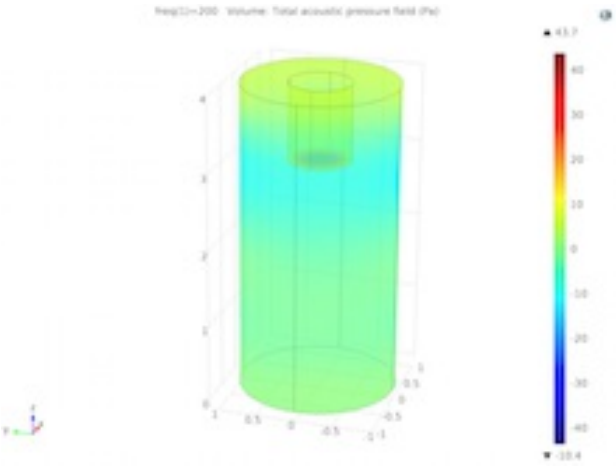

Figure 1: This study investigates the effect of flow chamber morphology on ultrasonication effectiveness through the use of frequency-domain acoustic analysis.