Effects of artificial impeller blade wear on bubble-particle interactions using CFD (k-e and LES), PIV, and 3D printing

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Abstract

Wear reduces velocity and turbulence by reducing the volume of impeller blades; yet there is a lack of knowledge on flotation cells. Additionally, there is a lack of knowledge in the literature regarding the effect of blade wear on bubble-particle interactions. Hence, computational fluid dynamics simulations investigated artificial impeller blade wear of a laboratory-scale Denver cell. Simulations of chalcopyrite flotation showed that blade wear increased floatability of 10 mu m particles by 1.4 %, but decreased that of 180 mu m particles by 3.0 %. Accordingly, it is proposed that curved surfaces due to wear increased epsilon (volume-averaged epsilon [m(2)/s(3)]: no-wear 20.5 and wear 25.8), increasing collision of fine particles and detachment of coarser particles. These were supported by results from large eddy simulation and particle image velocimetry measurements using three-dimensional (3D) printed impellers. Finally, experimental results from flotation experiments using 3D printed impellers and 250-300 mu m methylated quartz confirmed a floatability decrease (2.1 %-3.8 %) due to wear.

Keywords

Author Keywords: Computational fluid dynamics; Particle image velocimetry; 3D printing; Froth flotation; Impeller blade wear

Keywords Plus: EROSION WEAR; NATURAL FLOTABILITY; FLOTATION MACHINE; CENTRIFUGAL PUMP; SLURRY EROSION; FLOW PATTERN; SIMULATION; RATES; SIZE; ATTACHMENT

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