THE EFFECT OF AIR SPARGE TYPE ON AGITATOR PERFORMANCE IN GASSED REACTORS

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ABSTRACT

Mixers (agitators) used in minerals processing often are required to provide the suspension of solids in combination with gas dispersion and oxygen mass transfer. Some examples of these types of gas-liquid applications include cyanide destruction, leach tanks, biological leaching, neutralization, and pre-aeration, among others. As installed equipment is asked to process higher production capacities, it becomes necessary to fully understand the hydrodynamics in these large reactors, especially how the agitator and sparge system interact with each other. Knowing the options that exist for retrofit can allow processing plants to optimize existing design without necessarily starting with brand new equipment.

Gas is typically injected in these large vessels through a sparge system. As presented previously (Richard Kehn and Antonio Iñiguez, “Improvements in Mass Transfer by Sparge System Design Optimization for Minerals Processing,” Society of Mining Engineers Conference, Minneapolis, MN, February 2018), it has been shown that an agitated vessel operating under the same air injection rate and gassed power density will yield different oxygen mass transfer rates when different sparging devices are used. The observed change in oxygen mass transfer is due to how the gas interacts with the impeller system, with the physical dispersion and bubble size changing as sparge type is varied. The experimental set up consisted of a 1.1 m clear acrylic tank with a flat bottom and four (4) anti-swirl wall baffles and a 406 mm diameter Lightnin A320 high-solidity blade hydrofoil. The high-solidity blade hydrofoil design is typically used for large gassed reactors in minerals processing. The three sparge types that are compared is a single open pipe, a ring sparge and a single open pipe with a serrated edge plate sparge placed over the pipe.

Since presenting this work in 2018, additional experimental work has been conducted to determine the mechanical design implications of one sparge system over another on the mixer. The same experimental set up was utilized with the added ability to measure live forces on the impeller/shaft system. Fluid forces translate into bending loads which affect agitator shaft and gearbox design. It was found that the mechanical response of each sparge system was different since the gas dispersion was different in each case, with some set ups being more stable than others. Knowing how the sparge system effects the mixer process performance and its mechanical design allows the design engineer to optimize the solution further depending on the constraints at the mine.

Finally, the three cases are compared using modern Computational Fluid Dynamics (CFD) methods to compare bubble distribution and mixer kLa. It has been shown in previous work (Richard Kehn and John A. Thomas, “Effect of Gas Sparge Type on Oxygen Mass Transfer in an Agitated Vessel”, AIChE Annual Conference, Orlando, FL, November 2019) that the Lattice Boltzmann approach can be used to predict both oxygen mass transfer rates and physical dispersion phenomena. This approach provides direct access to the bubble size distribution and any spatial variations in the gas transfer rates using readily available computer resources that closely matches the results predicted by experiment.

Keywords (use Keywords style): biological leaching, large gassed reactor design, air sparge design considerations, computational fluid dynamics, oxygen mass transfer, suspension of solids