Cavitation technology development: industrial innovation for process water and effluent treatment

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Cavitation Technology Development: Industrial Innovation for Process Water and Effluent Treatment

The Problem

Industrial water and wastewater treatment is aimed towards developing barrier free methods for selective removal of product or hard-to-remove contaminants without chemical addition.

Introduction to Industrial Cavitation Processes

Cavitation introduces a strong acoustic field in an aqueous solution that results in the generation of cavitation microbubbles. The growth and collapse of these microbubbles focusses and transfers energy from the macro-scale to the microbubbles, producing extremely high localized pressures and temperatures. This energy can be harnessed to generate highly reactive free radicals that have been observed to significantly enhance chemical processing, and are applied as an advanced oxidation process in wastewater treatment.

However,

- Limited understanding of the chemical effects and controlling the cavitation process exists
- Process scale up from bench to commercial is not well understood

NRC has pioneered the development of understanding industrial cavitation processes (Kirpalani *et al.*, 2002, 2006, 2007) and applied this towards the improvement of process operations.

Cavitation in the Mining Industry

Hydrodynamic cavitation is quickly emerging as a process water management solution for increased process water recycling and downstream effluent treatment, due to ease in process integration, modularity, scale up potential and suitability for removing contaminants. Examples of cavitation technology used in industry include;

- In-situ generation of bubbles in flotation applications
- Increased fines and coarse particles recovery with reduced reagent consumption at Copper Cliff, Inco Ltd., Sudbury (Zhou, 2009)
- Neutralization of drill wastewater produced when drilling shafts (Litwinienko et *al.*, 2005).

Technology Application

Industries of Application	
Mine Wastewater	**Non-Mine Wastewater**
• Cement mine effluent • Coal mine effluent • Gold mine effluent • Metals effluent • Acid rock drainage • Gold refining operations	• Recovery of high value products from aqueous streams • Fermentation process water treatment • Removal of contaminants from oils

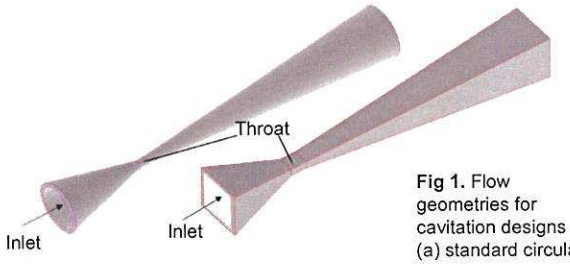

Fig 1. Flow geometries for cavitation designs (a) standard circular (b) slit (Bashir et al, 2011)

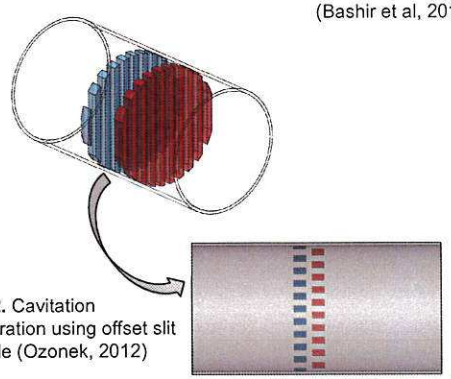

Fig 2. Cavitation generation using offset slit nozzle (Ozonek, 2012)

Outputs

- Demonstration scale industrial application of cavitation process for mining industry

Impacts

- Due to its vast range of application, cavitation has the potential to create tremendous impacts in mining and related industries.
- Previous studies, as well as research done at NRC, have shown the promise of cavitation technology towards water treatment.

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PARTNERS

- NRC-ACC Program.
- Potential Partners:
  - CO_2 producers
  - Mining companies
  - Industrial wastewater treatment facilities.