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Design of Hydrodynamic Cavitation Process for Removal of Toxic Metal Ions from Industrial Wastewater

Prof. Dr. B. L. Pangarkar[1], Jadhav Prathmesh[2], Fulari Vivek[3], Fatangare Rohan [4].
[1]Associate Professor, [2,3,4] UG Students, Department of Chemical Engineering.
Pravara Rural Engineering Collage, Loni, Ahilyanagar

Abstract: *This project explores the treatment of a 5-liter synthetic aqueous solution containing a combined total of 100 ppm of heavy metals—specifically zinc, copper, and chromium—using hydrodynamic cavitation (HC). The treatment system incorporates a 3/4-inch Venturi tube and pipeline, a centrifugal pump for solution circulation, and a 10-liter capacity storage/collection chamber. Hydrodynamic cavitation is an advanced oxidation process (AOP) known for generating intense localized conditions (high temperature and pressure) that facilitate the formation of reactive hydroxyl radicals (·OH), which aid in the degradation or transformation of pollutants. Drawing on findings from previous studies, this project evaluates the effectiveness of controlled HC in reducing the concentration of heavy metals in wastewater. Operating parameters such as flow rate, inlet pressure, and residence time are optimized to enhance cavitation intensity and metal removal efficiency. The setup offers a compact, low-cost, and energy-efficient alternative for treating low-concentration industrial effluents. The results are expected to contribute valuable insights for scaling HC technology in real-world applications, especially for decentralized and small-scale wastewater treatment systems.*

Keywords: high temperature and pressure

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