World Academy of Science, Engineering and Technology
International Journal of Environmental and Ecological Engineering
Vol:10, No:02, 2016

Hybrid Advanced Oxidative Pretreatment of Complex Industrial Effluent for Biodegradability Enhancement

Authors : K. Paradkar, S. N. Mudliar, A. Sharma, A. B. Pandit, R. A. Pandey

Abstract : The study explores the hybrid combination of Hydrodynamic Cavitation (HC) and Subcritical Wet Air Oxidation-based pretreatment of complex industrial effluent to enhance the biodegradability selectively (without major COD destruction) to facilitate subsequent enhanced downstream processing via anaerobic or aerobic biological treatment. Advanced oxidation based techniques can be less efficient as standalone options and a hybrid approach by combining Hydrodynamic Cavitation (HC), and Wet Air Oxidation (WAO) can lead to a synergistic effect since both the options are based on common free radical mechanism. The HC can be used for initial turbulence and generation of hotspots which can begin the free radical attack and this agitating mixture then can be subjected to less intense WAO since initial heat (to raise the activation energy) can be taken care by HC alone. Lab-scale venturi-based hydrodynamic cavitation and wet air oxidation reactor with biomethanated distillery wastewater (BMDWW) as a model effluent was examined for establishing the proof-of-concept. The results indicated that for a desirable biodegradability index (BOD: COD - BI) enhancement (up to 0.4), the Cavitation (standalone) pretreatment condition was: 5 bar and 88 min reaction time with a COD reduction of 36 % and BI enhancement of up to 0.27 (initial BI - 0.17). The optimum WAO condition (standalone) was: 150oC, 6 bar and 30 minutes with 31% COD reduction and 0.33 BI. The hybrid pretreatment (combined Cavitation + WAO) worked out to be 23.18 min HC (at 5 bar) followed by 30 min WAO at 150oC, 6 bar, at which around 50% COD was retained yielding a BI of 0.55. FTIR & NMR analysis of pretreated effluent indicated dissociation and/or reorientation of complex organic compounds in untreated effluent to simpler organic compounds post-pretreatment.

Keywords : hybrid, hydrodynamic cavitation, wet air oxidation, biodegradability index
Conference Title : ICWPC 2016 : International Conference on Water Pollution and Control
Conference Location : Paris, France
Conference Dates : February 22-23, 2016