World Academy of Science, Engineering and Technology
International Journal of Environmental and Ecological Engineering
Vol:17, No:11, 2023

The Optimization of the Parameters for Eco-Friendly Leaching of Precious Metals from Waste Catalyst

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Abstract : Goal 12 of the 17 Sustainable Development Goals (SDGs) encourages sustainable consumption and production patterns. This necessitates achieving the environmentally safe management of chemicals and all wastes throughout their life cycle and the proper disposal of pollutants and toxic waste. Fluid catalytic cracking (FCC) catalysts are widely used in the refinery to convert heavy feedstocks to lighter ones. During the refining processes, the catalysts are deactivated and discarded as hazardous toxic solid waste. Spent catalysts (SC) contain high-cost metal, and the recovery of metals from SCs is a tactical plan for supplying part of the demand for these substances and minimizing the environmental impacts. Leaching followed by solvent extraction, has been found to be the most efficient method to recover valuable metals with high purity from spent catalysts. However, the use of inorganic acids during the leaching process causes a secondary environmental issue. Therefore, it is necessary to explore other alternative efficient leaching agents that are economical and environmentally friendly. In this study, the waste catalyst was collected from a domestic refinery and was characterised using XRD, ICP, XRF, and SEM. Response surface methodology (RSM) and Box Behnken design were used to model and optimize the influence of some parameters affecting the acidic leaching process. The parameters selected in this investigation were the acid concentration, temperature, and leaching time. From the characterisation results, it was found that the spent catalyst consists of high concentrations of Vanadium (V) and Nickel (Ni); hence this study focuses on the leaching of Ni and V using a biodegradable acid to eliminate the formation of the secondary pollution.

Keywords : eco-friendly leaching, optimization, metal recovery, leaching
Conference Title : ICEFTES 2023 : International Conference on Eco-Friendly Technologies and Environmental Sustainability
Conference Location : Cape Town, South Africa
Conference Dates : November 06-07, 2023