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Hazardous Metal Removal from Spent Hydroprocessing Catalysts

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Extended Abstract

Hydroprocessing catalysts (HPCs) are widely used in petrochemical industries, mostly to purify the hydrocarbon processing streams. These catalysts are mainly employed to enhance the efficiency of the process, remove sulphur from the stream, and to break the heavier hydrocarbons to short-chain sulphur-free hydrocarbons (Ancheyta. J., Speight. J. G., 2007). Spent HPCs are classified as hazardous solid wastes produced in petrochemical industries according to the United States Environmental Protection Agency (USEPA, 2003) and cannot be disposed into the environment, or landfilled without a proper treatment due to the presence of hazardous materials including, but are not limited to, the heavy metals, metal oxides, and metal sulphides.

In this research, a hydrometallurgical process has been developed for metal recovery from spent HPCs. After analysing our catalyst using ICP and SEM analysis, preliminary experiments showed that aqua regia is a more effective leaching agent to dissolve metals from our spent catalyst samples than hydrochloric and nitric acids. Two amine-based extractants (Alamine308 & Alamine336), and one quaternary ammonium salt (Aliquat336) were diluted in toluene and were tested for cobalt, nickel, and molybdenum extraction from leached catalysts in aqua regia. A face-centered central composite design (CCD) was employed for our experimental design, and the alamine 308 was selected as the best extractant, based on the ICP analysis on the efficiency, concentration requirement (cost-effectiveness), and required contact time for optimum metal removal. The effects of significant parameters on the extraction processes have been measured, and statistical models were developed using the Design Expert software. ANOVA results were also studied to measure the accuracy and significance of the fitted models. Optimization of each solvent extraction process was completed and optimum points were determined for maximum metal removal from spent HPCs.

Ancheyta, J., & Speight, J. G. (2007). Hydroprocessing Of Heavy Oils And Residua. *Chemical Industries,* CRC Press, ISBN: 1420007432, 9781420007435.

United States Environmental Protection Agency (USEPA). (2003). Hazardous Waste Management System. *Federal Register,* 68(202), 59935–59940.