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Abstract title
GREEN ENGINEERING: REMOVAL OF VANADIUM AND MOLYBDENUM FROM SPENT HYDRODESULFURIZATION CATALYST

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1. BACKGROUND

Spent hydroprocessing catalysts have been classified as hazardous wastes by the EPA in the USA (Rapaport, 2000). Then, it presents an opportunity to apply the principles of Green Engineering (Anastas, 2003) and transforming into an environmentally acceptable material.

Rojas-Rodríguez (2012) treated a spent catalyst, which was leached with an alkali solution at 100 °C. Alonso (2008) proposes an extraction with CS_2 to 100 ° C for 12 hours. Inoue K. (1996) treated a spent catalyst, roasted it at 973 K, suspended in 63% H_2SO_4. Chen Y. (2006), extracted metals from ammonia leaching residue, by roasting the residue at 750 °C.

2. AIMS

The purpose of this research was to determine the process conditions to recover the maximum amount of V and Mo, based on the principles of Green Engineering.

3. METHODS

A 14 g sample from the calcined spent catalyst was taken and dissolved in a NaOH solution. Afterwards, the solution was acidified with 35% HCl to a pH of 1.5 – 2.0, in order to precipitate vanadium and molybdenum. Reactions were performed in a 250 mL round bottom flasks.

4. RESULTS

A calcined spent catalyst sample was treated with 2% NaOH solution. After 4 h of leaching time, 67.3% V and 57.8% Mo were extracted. A further increase of time produces a decrease in the recovery.

Effect of NaOH concentration was studied using different concentrations in the range 2 - 25% at a constant temperature equal to 25 °C, the results reveals that at 20 wt. % of NaOH content in the feed mixture, molybdenum recovery reaches 91.0 % and about 97% of the V present in the spent catalyst was extracted.

The process has three by-products outputs. The gaseous effluents from calcination, formed by CO_2, SO_3 and H_2O. These gases are washed with magnesium hydroxide to produce $MgSO_4$ and $MgCO_3$; they are compatible with the nature. The only solid by-product is NaCl, which is safe. The third effluent is an aqueous output with excess HCl, which can be reused in the process.

5. SUMMARY/CONCLUSIONS

Various processes have been developed for the extraction of metals from spent catalysts. These methods involve the use of solvents, high temperatures, and the use of strong acids. In this paper, were taken as a basis the principles of Green Engineering to develop a process to work at normal conditions (temperature and pressure), eliminating the use of solvents for the extraction of vanadium and molybdenum from spent catalyst, besides the by-products obtained are inert to the environment. Through the Principles Green Engineering the spent gasoil hydrodesulfurization catalyst may be used as a secondary source for V and Mo. It is possible to recover up to 90% of V and Mo, if the product reacts with 20 wt.% NaOH solution at 25 °C, with a reaction time of 4 hours. The gaseous products can be treated for inert salts. The solid product (NaCl) represents no problems for environment and the aqueous output can be reused in the process.