WASHING SLUDGE FROM NEUTRALIZATION CYANIDE IN THE PROCESS OF BENEFIT OF GOLD IN A MINE IN NORTH OF COLOMBIA

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Introduction

Within the gold beneficiation, we have to neutralize the cyanide to get the gold, producing with it sludge with high pollutants such as cyanide (CN), arsenic (As), cadmium (Cd), lead (Pb), etc, which are deposited to abiotic medium without management and proper treatment, generating noxious effects in the environment (Yupari, 2001). Using washing as a sludge treatment, it could reduce the concentration of this substances; commonly is used HCl and other acid for mobilization of metals and H_2O_2 for degradation of cyanide. The objetive of this research was evaluate a treatment to the sludge of neutralization generated in the process of gold benefit in a mine in north of Colombia.

Methodology

Previously the following parameters were evaluated: organic matter, pH, concentrations of total cyanide (SM 4500-CN), heavy metals (EPA 3051B) and bioavalability (Tessier 1979) of the metals more concentrates. Initial treatment was performed to metals and then the cyanide present in the sludge. Two consecutive washes were implemented , the first with HCl at concentrations of 1, 3 and 6M, HCN vapors were collected in 0.5M NaOH solution; and second with H_2O_2 grams relationships to add related on the grams of residual CN- present in the sludge after washing with acid (1ml H_2O_2 / 10 ml H_2O_2), to degrade the remaining cyanide in the simple after treatment with acid. these washes were made to 1, 2 and 3 hours each one. Also on final of each washing it was washed twice with water.

Results

Sludge characterization: The percent of organic matter was low with a value of 1.35%, pH less than 7 considerate slightly acid, which could favor the leaching of metals. A high concentration of total cyanide was obtained with a value of 20433mg/kg and 0.128mg/kg of free cyanide. The meals analyzed more concentrates were 55.25mg/kg of Hg, 462.35mg/kg As, 20415.05mg/kg Pb, 75.90mg/kg Cd, 11024.3mg/kg Zn and 131513.92mg/kg Fe; the high concentrations are related to the mineralogical composition of the ore (quartz (SiO_2), biotite $K(Mg, Fe)_3AlSi_3O_{10}(OH)_2$, Galena (PbS) and pyrite (FeS_2)) (Barrientos 2011).

Washing sludge: In Figure 1 we note the removal percents of heavy metals obtained in the three hour for the three acid concentrations and the two H_2O_2 relationships, showing a trend of increased removal at 3h,

this was verified by analysis of variance and Tukey ($p<0.05$), except for Cd, Hg and Zn in the wash with H_2O_2 where the best results are shown at 2h.

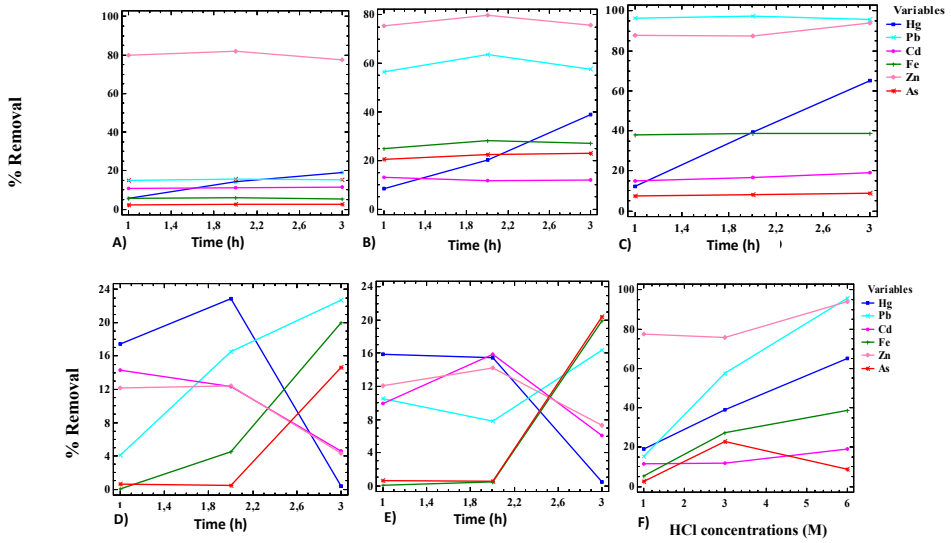

Fig 1. Variation of metal removal at different concentrations of HCl and H_2O_2 in different times and evaluated (A, B, C, D, E) and as a function of HCl concentration (F).

In addition the best metals removal and cyanide were obtained with HCl 6M at the first washing, except As, this had a better removal with HCl 3M, this is due to the presence of S^{2-}, that leads to formation of precipitate As_2S_3; the trend for all, is to increase their mobility as that the HCl concentration is increased, this is due to the processes of desorption and dissolution of metals increases with decreasing pH (Xu et al., 2014). In the washing with H_2O_2, the first relation had the highest removal of cyanide, as well as removal of Pb and Fe compared to all metals. Also, bioavailability of these metals before and after washing is low, where over 90% of their concentrations are found in the residual phase.

Conclusion: In this study was obtained high removals of Hg, Pb, Zn and cyanide with the use of HCl 6M as first wash and applying 1 ml of H_2O_2 as second wash, both with three hours. However, for metals such as Cd, Fe and As, also it reached considerable removals 22.6%, 51% and 22% respectively. Significantly, 90% of the bioavailability of metals studied are associated with the residual phase, after washing applied are not bioavailable to the disposal in the medium.

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