

Chemical and nano-mineralogical study for determining potential uses of legal Colombian gold mine sludge: Experimental evidence

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Abstract

The present study is focused on the chemical and nano-mineralogical characterization of sludge from gold mine activities, in order to put forward diverse solution alternatives, where lack of knowledge has been found. The sample was collected from “La Estrella” mine of Suarez, located in Department of Cauca, south-west Colombia. The sludge micro-structure and chemical composition were analyzed using a high resolution transmission electron microscopy (HR-TEM) equipped with a dispersive X-ray detector (EDS). X-ray diffraction technique was employed to identify the mineralogical phases present in the sludge. Additional mineralogical characterization was done by using RAMAN spectroscopy. Main findings points to its potential to be used as a fertilizer, this is why, mine sludge contains macronutrients such as P, Ca and S, together with micronutrients like Cu. However, the presence of goethite could decrease the mobilization of nutrients to soils, thus additional alternatives, for instance, a mixture with humus or another material containing Humic Acids should be done, in order to minimizing its retention effect. Additionally, another possible uses to explore could be as construction and ceramic material or in the wastewater treatment for nutrient retention and organic material removal. Rutile (TiO₂ nanoparticles) particles have been also detected, what could cause health concern due to its nanoparticle toxic character, mainly during gold extraction process.

Keywords

Fertilizer, Gold mine, Sludge, Tailing ponds.