Chemical Characterization and Minerals of Roasted Pyrite Ash of an Abandoned Sulphuric Acid Production Plant

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Abstract

The obtention of sulphur generte a hematite-rich waste, known as roasted pyrite ash, which contains significant amounts of environmentally sensitive elements in variable concentrations and modes of occurrence. Whilst the mineralogy of roasted pyrite ash associated with iron or copper mining has been studied, as this is the main source of sulphur worldwide, the mineralogy, and more importantly, the characterization of submicron, ultrafine and nanoparticles, in coal-derived roasted pyrite ash remain to be resolved. In this work we provide essential data on the chemical composition and nanomineralogical assemblage of roasted pyrite ash. XRD, HR-TEM and FE-SEM were used to identify a large variety of minerals of anthropogenic origin. These phases result from highly complex chemical reactions occurring during the processing of coal pyrite of southern Brazil for sulphur extraction and further manufacture of sulphuric acid. Iron-rich submicron, ultrafine and nanoparticles within the ash may contain high proportions of toxic elements such as arsenic, selenium, uranium, among others. A number of elements, such as arsenic, cromium, copper, cobalt, lanthanum, manganese, nickel, lead, antimony, selenium, strontium, titanium, zinc, and zirconium, were found to be present in individual nanoparticles and submicron, ultrafine and nanominerals (e.g. oxides, sulphates, clays) in concentrations of up to 5%. The study of nanominerals in roasted pyrite ash from coal rejects is important to develop an understanding on the nature of this by-product, and to assess the interaction between emitted nanominerals, ultra-fine particles, and atmospheric gases, rain or body fluids, and thus to evaluate the environmental and health impacts of pyrite ash materials.

Keywords: *coal rejects, sulphuric acid production, nanomineral impacts, potentially hazardous elements*