Fenton's Reaction by Sulphide Oxidation on Coal Mining Rejects

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Abstract

Fenton's reaction is used in acceleration weathering test for sulphides associated with Brazilian Coal Mining Residues (CMR), that are vulnerable to oxygen and water during the mining of coal. TEM and SEM/EDX were used to determinate the origin, occurrence and ordering of minerals in remaining coals and other lithological units, before and after applying the test. Oxidation of CMRs was analysed by determination soluble sulphur (sulphate) and dissolved metals by ICP-MS or ICP OES. As dissolved sulphate increases, dissolved Zn, Cd, Cu and Co concentrations increase, conducting to undetectable amounts in the remaining solid phases; dissolved Ni and Mn also increase with the mobilized sulphur, but the remainder in the solids is the most relevant fraction; Fe and Pb are not mobilized due to precipitation as jarosite or hematite in the case of Fe or as sulphate in the case of Pb. Agreement between the observed results and the predictions by geochemical modelling is discussed. The accelerated weathering procedure based on Fenton's Reaction has shown the release of toxic metals from the sulphide fractions associated with coal residues. The use of SEM/EDX, TEM, XRD, ICP-MS and ICP OES analyses were conducted on various samples from the Santa Catarina coal region with the aim of improving the understanding of the mineralogy and geochemistry of CMRs. The measurements were conducted on the original materials as well as on the materials left after applying the accelerated oxidation by hydrogen peroxide. Accordingly with the theoretical predictions by geochemical modelling, the experimental results demonstrate the effective oxidation of pyrite, as well as the other metal sulphides, by hydrogen peroxide within a short time period complete after 72 h. In terms of relative mobility (% of total metal released during the test), Cu, Co, Cd and Zn appear as metals of high mobility, liberating practically all total content. The released concentration of Ni and Mn increases as sulphate increases but a considerable concentration of both metals remains immobile in the solid phases. The Fe presentes a relatively lower release, because it suffers processes of further immobilization after pyrite oxidation, even at lower pH values, due to secondary mineral precipitation, such as jarosite; this fact considerably limits its mobility. Finally, Pb presents a practically null mobility and it does not represent a risk of potential contamination even in samples with high sulphide concentrations due to the possible formation of insoluble lead sulphate.

Keywords: *Fenton's Reaction, accelerated weathering, coal mining residues, environmental impact*