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Use of cemented paste backfill in arsenic-rich tailings

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Gold is extracted by cyanide leaching from inclusions in arsenopyrite from a mine in the north of Sweden. The major ore mineral assemblage consists of pyrrhotite and arsenopyrite-loellingite. Effluents from the gold extraction were treated with Fe2(SO4)3, with the aim to form stable As-bearing Fe-precipitates (FEP). The use of the method called cemented paste backfill (CPB) is sometimes suggested for the management of tailings. In CPB, tailings are commonly mixed with low proportions (3 – 7 %) of cement and backfilled into underground excavated area. To reduce costs, amendments such as granulated blast furnace slag (GBFS), biofuel fly ash (BFA) and cement kiln dust (CKD) are used for partial replacement of cement in CPB due to their pozzolanic and alkaline properties. The objective for this study was to evaluate the leaching behaviour of As in CPB-mixtures with low proportions (1 – 3 %) of BFA and ordinary cement and unmodified tailings. The selection of CPB-recipies was made based on technical and economical criterias to adress the demands deriving from the mining operations. Speciation of the As in ore and tailings samples revealed that mining processes have dissolved the majority of the arsenopyrite in the ore, causing secondary As phases to co-precipitate with newly formed FEP:s. Tank leaching tests (TLT) and weathering cells (WCT) were used to compare leaching behaviour in a monolithic mass contra a crushed material. Quantification of the presumed benefit of CPB was made by calculation of the cumulative leaching of As. Results from the leaching tests (TLT and WCT) showed that the inclusion of As-rich tailings into a cementitious matrix increased leaching of As. This behaviour could partially be explained by an increase of pH. The addition of alkaline binder materials to tailings increased As leaching due to the relocation of desorbed As from FEPs into less acid-tolerant species such as Ca-arsenates and cementitious As-phases. Unmodified tailings generated an acidic environment in which As-bearing FEPs were stable. The addition of binders increased the tailings' acid-neutralizing capacity and introduced more Ca-ions and Fe-precipitates into the tailings matrix, both of which may facilitate As adsorption and reduce the potential for sulphide oxidation on a long-term basis.