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AUTOCONSERVATION OF SOME WASTE OF MINING INDUSTRY (SOUTH URALS, RUSSIA)

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In the South Urals (Russia) semi-liquid flotation waste of Cu-Zn ores are disposed as a pulp to the open tailing ponds. During storage, some valuable components such as Au and Ag accumulate and may be utilised as technogene deposits.

The fresh tailings contain on average (wt%): pyrite 45, quartz 35, aluminosilicates of K, Na, Ca 10, carbonates 5, primary Cu-Zn sulphides 2–4. In old tailings aluminosilicates and carbonates practically disappear, and Cu and Zn sulphides occur as single grains only in the deeper levels of the settling ponds. The major minerals of old tailings are pyrite, quartz and gypsum. Pyrite content varies from 20–80%, with the general trend of decreasing from deeper levels to the surface of the settling ponds along with the relative concentration of fine-grained shlam bands. On the surface of old, closed settling ponds, the pyrite content is significantly lower up to the absolute disappearance of this mineral. Quartz content varies from 10–35%, increasing towards the top levels of old settling ponds where as a rule a sharp increase of the average size of quartz grains is also observed. Gypsum content varies from 5–40%, generally increasing towards the surface of the settling ponds. In the near-surface parts of tailing ponds Fe sulphates are abundant: jarosite (up to 15%) and rozenite (up to 10%) are found in most old settling ponds; and szomolnokite (10–15 %) occurs in young ponds. Melanterite, rhomboclase, coquimbite and copiapite occur rather rarely.

The features of the structure and composition of tailings indicated consistent stages of tailing transformations as a result of prolonged storage, in relation to the age of the settling ponds. In the transformation processes of tailings, pyrite is oxidised under the action of oxygen enriched atmospheric waters to form sulphuric acid and hydrous ferroan sulphates $FeSO_4 \cdot nH_2O$ (n = 1–7), firstly in the surface zone with coarse-grained bands of tailings. Sulphuric acid has a major role in the chemical transformation of tailings resulting in direct crystallisation of ferroan sulphate phases of low water content, oxidation of ferroan sulphates to ferrian ones and decomposition of aluminosilicates and carbonates of tailings with the formation of secondary SiO_2 along with Ca, K, and Al sulphates. As a result of these processes, the originally friable tailings are transformed into compact rocks (technogenic sandstones) in which separate mineral grains (mainly quartz and pyrite) are cemented by the newly formed sulphates. In the deeper levels of settling ponds pyrite concentrations reach 70–80%. In contrast, a quartz–sulphate crust is formed on the settling pond surface. In the composition of this crust water-soluble sulphates (melanterite, rozenite) are replaced by an insoluble one (jarosite) for a time. Such crusts, varying in thickness from 0.5–0.7 m, cover the surface of settling ponds completely within 15-25 years, isolating them and causing difficult access to the inner parts for atmospheric waters and preventing the further oxidation of pyrite. Any attempt to develop the settling pond as a potential technogene deposit will likely result in disturbance of the surface crust and the established equilibrium, and pose renewed environmental risk.