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Performance of modified materials for mine water treatment

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Modification of locally available materials, natural and residual, could reduce the costs of mine water treatment (by sorbent regeneration, metal recovery, reduced volumes, or better stability of the sludge) and safety-related issues.

Most materials can be modified by simple procedures (charring, hydrothermal treatment, clustering of functional groups, activation) to treat mine water effectively. The modification enhances their metal removal capacity and improves modified materials' physical and chemical stability and the produced sludge. Several modified materials were produced (half-charred dolomite, Fe-grafted wood ash, activated biochar) and evaluated for their performance in treating specific contaminants in synthetic and real mine water under optimal conditions. In particular, chemical activation is a quite effective procedure for obtaining highly porous materials ideal for the adsorption of organic and inorganic contaminants in water. Also, lignocellulosic-based materials are the most suitable precursors for preparing porous biochar and activated biochar. Factors influencing the modification efficiency were assessed, including solid surface characteristics (specific surface, porosity, granulometry) and chemical properties (cation exchange capacity, pHpzc, surface functionalization, redox potential, neutralizing capacity, and alkalinity generation). Metal recovery, material regeneration, water reuse, and transportation costs were also studied, to reduce the overall cost of mine water treatment.

Further studies on the production and use of modified materials are necessary. These should essentially focus on real effluents use, low-temperature effects, field-scale testing, and techno-economic evaluation.