Modeling bioremediation of As-rich acid mine drainage in a flow reactor

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Oxidation of iron and arsenic by autochtonous bacterial community in acid mine drainage (AMD) promotes natural attenuation of these elements. This process offers a promising possibility to treat As-rich AMD in a passive way. In this framework, the COMPAs project aims to find an optimal combination of passive or semi-passive bioreactors to treat As-rich AMD at the Carnoulès mine in France. The AMD (pH ~ 3.2) contains about 100 mg/L of arsenic (80% as As(III)) and 1000 mg/L of iron (97% as Fe(II)).

We present a reactive transport model of previous bench-scale continuous flow bioreactor experiments [1,2] performed at two different water heights (4 and 25 mm), various residence times and with/without forced aeration. The model was first calibrated on previous batch experiments [3]. Both experiments were made with natural AMD waters sampled at the Carnoulès mine.

First and second order kinetic rate constants were obtained for the Fe(II) and As(III) oxidation. The subsequent precipitation of As-bearing schwertmannite and amorphous ferric arsenate was modeled under batch and dynamic conditions. The effect of the biofilm location (bottom of the reactor or floating), as well as the flux of dissolved oxygen through the water column, were analyzed.

The reactive transport modeling of the coupling between bacterial oxidation rates, oxygen transfer and the amount of Fe and As removed by precipitation will support the design of field bioreactor treatment.

[1] Fernandez-Rojo et al. (2017) *Water Res* **123**, 594. [2] Fernandez-Rojo et al. (2018) *Appl Microbiol Biotechnol.* **102**, 9803. [3] Tardi et al. (2018) *Appl Microbiol Biotechnol.* **102,** 2413.