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The role of natural zeolite for restoring anoxic environments

Ierotheos Zacharias and Areti Gianni
Environmental Engineering Laboratory, Department of Civil Engineering, University of Patras, Greece (izachari@upatras.gr)

Anoxic environments' management attracted researchers' interest for decades. Mechanical ventilation or oxygenation used to restore anoxic hypolimnia in many natural and artificial lakes. These techniques improved sufficiently oxygen concentrations only in small environments, and for short time periods, since they were focused on the problems' results and not on the cause of it.
The close relationship between the worldwide eutrophication increase and the rapid expansion of the hypoxic/anoxic water basins is now confirmed. In many cases anoxic ecosystems' restoration was attempted controlling the organic matter and nutrient fluxes into the water basins. However, such management efforts were quite often unsuccessful.
Quickly became apparent that the failure of these management practices was due to the aquatic ecosystems' internal load that was refueling anoxia. Bottom water anoxia accelerates PO43, NH4+ and S2- recycling and accumulation from organic matter decomposition. This, toxic layer is a permanent menace for the balance of the entire ecosystem, as it can supply PO43-, NH4+ and S2- to the surface layers altering their qualitative character and threatening the welfare of fish and other aquatic organisms.
To overcome this problem, materials with the ability to remove phosphorus and nitrogen forms from aquatic ecosystems were sought and developed. In these, activated $Al2O_3$, ferrihydrite, crushed concrete, ferrous iron, titanium dioxide, calcite, Phoslock^{TM}, natural and modified zeolites are included.
Natural zeolite is a natural inert material, particularly effective in removing ammonium from aquatic solutions, while due to its negative charge doesn't adsorb phosphate ions. However, in the presence of cations (Ca+2, Na+, K+) it turns to an appropriate substrate for the formed phosphate salts. This study aims to demonstrate for the first time the ability of natural zeolite to remove sulfides from aqueous solutions.
Zeolitic minerals of different origin were tested under a range of physicochemical conditions. The uptake of sulfides was evaluated vs. pH in adsorption kinetics and adsorption isotherms. The effects of initial concentration, temperature and salinity on adsorption capability were also investigated.
Natural zeolite can function efficiently within a wide range of pH, e.g. 5–9. Adsorption kinetics showed that the removal rate reached up to 90% after a period of 24h. Zeolite's removal capability appeared to be directly depended on the S2- initial concentration. The maximum zeolite removal capacity was calculated equal to 123.1 10-3 mg/g S2-. Zeolite removal capacity varied by about 10% as the solution's salinity varied from 0 to 35‰Ṡmall changes in zeolite removal capacity cause temperature variation as well.
The ability of zeolite to remove from aqueous solutions forms of nitrogen, phosphorus and sulfur makes it a material could play a key role, in eutrophic/anoxic environments restoration efforts, since PO43-, NH4+ and constitute the three aspects of the problem called anoxic basins' internal load.