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Wood ash fertilization as a remediation method for pit lakes affected by acid rock drainage

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At sulfide-rich mine sites, it is common for pit lakes to have low pH-values and elevated metal concentrations due to acid rock drainage (ARD) generated when sulfide minerals are exposed to oxygen and water. Degraded water quality in these pit lakes is an environmental concern, as they can impact surface and groundwater resources for a long time post mine closure and remediation is therefore often required which is both costly and time-consuming. Fertilization has been proposed as a remediation method for pit lakes, as they often lack nutrients and algae have the potential to take up and sorb metals. This study aimed to investigate if fertilization with the byproduct wood ash, that is rich in many nutrients, could be used to increase algal growth and improve the water quality of two pit lakes affected by ARD that currently are limed over the summer season.

24-hour batch leaching tests were utilized to study the element release from several wood ashes using both pit lake water and ammonium acetate buffer solutions with pH-values representative of the pit lakes (~5 and ~7). Microcosm studies were conducted in both pit lakes with various nutrient amendments and chlorophyll-a concentrations measured with spectrophotometry were used as an indicator of algal growth. Metal concentrations were determined using inductively coupled plasma-sector field mass spectrometry (ICP-SFMS).

Variations in element release were seen both among the various wood ashes and depending on pH. An ash with a relatively low metal release was chosen for the microcosm experiment. Chlorophyll-a concentrations were considerably higher in the fertilized microcosms in both pit lakes compared to control microcosms, averaging 18.3 µg/L and 34.5 µg/L compared to 0.19 µg/L and 0.37 µg/L. In the pit lake with a pH of 7, the pH increased to ~10 over the course of the experiment, along with a decrease in the filtered phase (<0.22 µm) for several metals. The results suggest that fertilization with wood ash might be a viable remediation option for pit lakes. A full-scale follow-up study will be conducted in one pit lake over the summer 2025.