

Forest ash fertilization to stimulate algal growth and remediate pit lake water – a microcosm study

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The water quality of pit lakes is an important issue facing the global mining industry, where low pH and elevated metal concentrations are some of the problems often arising as a consequence of acid mine drainage. Algae have been shown to be able to take up metals (Fisher and Lawrence, 2006) but the nutrient availability in pit lakes is often limited. Here we investigate the potential of a naturally alkaline fertilizer, forest ash, to stimulate algal growth. Forest ash is naturally rich in most nutrients except for N. 15 microcosms divided into 5 different setups were installed in the Åkerberg pit lake during 15 days of the summer season 2021. The nutrient additions to the different setups were 1) 40 µg/L of P (KH₂PO₄) and 289 µg/L of N (KNO₃), 2) 80 µg/L of P and 578 µg/L of N, 3-4) 2 types of forest ash containing a P amount corresponding to 200 µg/L and N (KNO₃) (1445 µg/L) and 5) control microcosms containing only lake water. Chlorophyll-a was used as an indicator of algal growth while filtered (<0.2 µm) and suspended particulate element concentrations (>0.2 µm) were used to estimate algal element uptake. Measurements of water quality parameters and water sampling were conducted every 5 days as well as at the start of the experiment to gather knowledge of temporal changes. The results showed that chlorophyll-a concentrations in the microcosm fertilized with ash were significantly higher (53.3-76.6 µg/L) than lake concentrations at the start of the experiment (0.3-0.8 µg/L) and compared to the control microcosms (0.8-1.7 µg/L). This suggests that forest ash could be successfully used to stimulate algal growth in the Åkerberg pit lake by acting as a source of P and potentially other nutrients in combination with additions of N. Several elements showed increased suspended particulate concentrations together with P, indicating that they were actively assimilated by, or sorbed to, the surfaces of the algae.

References

Fisher, T.S.R., Lawrence, G.A., 2006. Treatment of acid rock drainage in a meromictic mine pit lake. *J. Environ. Eng. (N.Y.)* 132, 515–526. [https://doi.org/10.1061/\(ASCE\)0733-9372\(2006\)132:4\(515\)](https://doi.org/10.1061/(ASCE)0733-9372(2006)132:4(515)).