Dewatering of lake sediment – Phosphorus and ecotoxicology

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Most of Danish lakes are eutrophic due to high concentration of phosphorus (P). Phosphorus are non-substitutable element required for all living organism and it is energy-intensive for mining. Hence, phosphorus should be removed from lakes and reused. High amounts of phosphorus are bound in lake sediment, which could be dredged and collected. The large water content in the dredging lake sediment causes the costly transportation and difficulties in directly utilizing the dredging sediment. Thus, sediment have be be dewatered. The current used dewatering technologies are treating the dredged sediment using synthetic polymer which can be harmful for the environment.

In this study, pilot-scale belt filter and filter bags were tested for separating water from solid sediment. The dredged sediment was flocculated using either the conventional synthetic polymer (polyacrylamide) or biopolymers (modified starch, low-MW chitosan and high-MW chitosan). The results showed that dry matter content (%DM) of dewatered sediment was increased from 3-7%DM of dredged sediment to 6-14%DM of dewatered sediment after belt filter and subsequently 12-16%DM of dewatered sediment in big bag. The reduction of P, N and Fe was 84-99%, 27-93%, and 89-94% of filtrate water compared to lake sediment. Toxicity tests with three aquatic model organisms representing bacteria, phytoplankton and zooplankton indicated low ecotoxicity of most polymer filtrates with median effective concentrations (EC50). Lake water with the synthetic polymer (polyacrylamide) showed the greatest ecotoxicity of the tested polymers whereas the biopolymers (modified starch, and cationized chitosan) displayed lower overall ecotoxity.

The pilot test in this study was an important result obtaining good results with biopolymer (less ecotoxicity but increasing the filtration time). This expects to enhance the lake-sediment dewatering technology using biopolymers and supporting P recovery project with respect to technical feasibility and environmental criteria according to circular economy.