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The effectiveness of photocatalysis on reducing the toxicity of oil sands process-affected water to Lemna minor

Oil sands process-affected water (OSPW) is a toxic by-product produced by the surface mining of oil sands in Alberta, Canada. OSPW has been found to be acutely and chronically toxic to many forms of wildlife, and due to the industry's 'zero-discharge' policy, it is stored on-site in tailings ponds. There is a need to establish a method to treat OSPW for environmental release as none currently exist. OSPW is a complex saline solution composed of high concentrations of clays, dissolved organic compounds, trace heavy metals, inorganic compounds, and trace amounts of solvents and bitumen. Naphthenic acids are a group of structurally diverse compounds found in the dissolved organics fraction and are among the most toxic organic pollutants present in OSPW. Photocatalysis using TiO2 is a promising method for reducing the toxicity of such compounds via organic mineralization, and it has been proposed that after a primary photocatalytic treatment step, the treated OSPW can be discharged into wetlands for phytoremediation. This research is focussed on determining the effectiveness of photocatalysis in reducing OSPW toxicity by exposing the treated OSPW to the freshwater macrophyte Lemna minor. Photocatalytic treatment of OSPW reduces the toxicity of dissolved organics such as naphthenic acids but not that of trace heavy metals. This report provides a better understanding of whether photocatalytic treatment of OSPW is an effective step in rendering OSPW nontoxic enough to be discharged into wetlands for further phytoremediation.