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Case Study

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REMEDIATION OF OIL SANDS PROCESS-AFFECTED WATER (OSPW) BY INDIGENOUS MICROORGANISMS BASED BIOFILTRATION

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1 Introduction

Large amount of oil sands process-affected water (OSPW) has been generated by the extraction of bitumen from the oil sands using hot alkaline water (Hwang et al. 2013). Naphthenic acids (NAs), which attribute the major toxicity of OSPW, are resistant to conventional wastewater treatments. Effective NA degradation processes are eagerly needed for the remediation and safe discharge of the OSPW. Previous researchers found that the toxicity of the OSPW towards to selected test organisms can be reduced and the NAs can be partially degraded through biological treatment. Biofiltration shows a clear advantage in terms of low energy cost. Biofiltration has been considered as one of the most important biodegradation processes for the removal of organic pollutants from wastewater (Hollender et al. 2009). The indigenous microorganisms based biofiltration system shows high possibility to be used for the OSPW treatment.

2 Objective

The main objective of this research was to investigate the efficiency of indigenous microorganisms based fixed bed biofilm reactor to treat OSPW using sand as a media.

3 Methods

Pure sand was used as a media for the establishment of the biofiltration system. Microorganisms from the raw OSPW are supposed to attach and form biofilm on the sand media when the OSPW is going through the fix-bed bioreactor. Sand media sample was collected for DNA extraction and applied for the qPCR detection three times. Z stack technology from the confocal microscope was used to measure the thickness of the biofilm on the sand surface two times. Next generation sequencing technique was used for the mega genomic sequencing analysis of the microorganisms on the biofilter. After the mature of the biofiltration system, the effect of the biofiltration on the remediation of the OPSW was assessed through the OSPW recirculation. Biofiltered OSPW was assessed in terms of NAs and toxicity towards *Vibrio fischeri*.

4 Results

Under steady state condition, the number of total bacteria on the biofilter media was 10^9 copies per gram of sand media and the thickness of the biofilm on the sand filter was 36.3 μm. Through the 12 times of circulation on the biofilter, classical NAs from raw OSPW were removed by 39.05% (Figure 1). Microtox® bioassay was used for the toxicity analysis, and it was found that the toxicity of the OSPW toward *Vibrio fischeri* decreased from 27.27% to 20.33% (5 min) and from 31.22% to 24.06% (15 min) after 12 times of circulation on the biofilter. The microbial community structure investigation showed that *Rhodococcus spp* was the dominating bacterial species on the biofilter, which indicated that *Rhodococcus spp* played a critical role during the biodegradation of NAs.

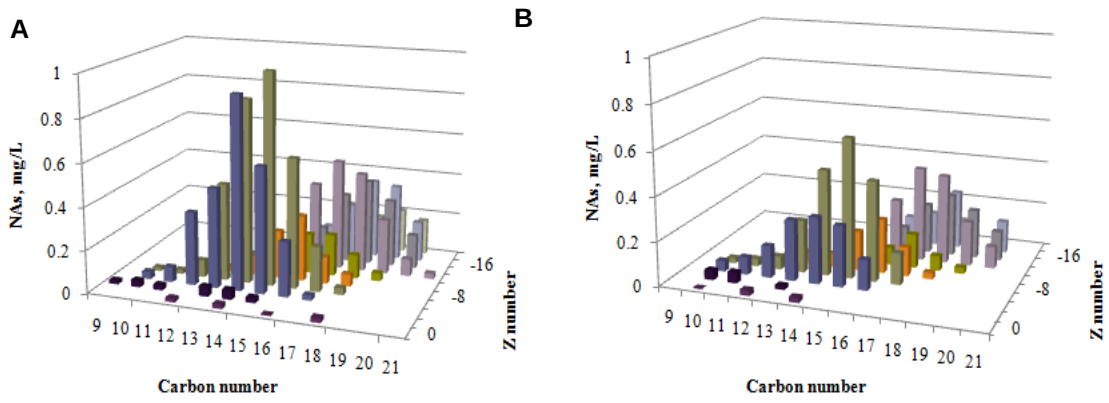

Figure 1: Removal of NAs from the OSPW by biofiltration. A: NAs concentration from raw OSPW; B: NAs concentration from biofiltered OSPW.

5 Conclusions

Indigenous microbes based fixed-bed biofiltration system can be established efficiently by using raw OSPW as influent wastewater. The mature biofiltration system can remove the NAs from OSPW effectively.

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