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**Title: Offshore Produced Water Treatment: Optimizing Dissolved Air Flotation with Coagulation and Adsorption**

**Research Advisor: Dr. Margaret Walsh**

**Category: Environment**

The objective of this research project is to investigate coagulation and adsorption as a pre-treatment for dissolved air flotation (DAF) for the treatment of oil and gas produced water as part of an ongoing study jointly funded by Petroleum Research Atlantic Canada (PRAC) and the Natural Sciences and Engineering Research Council (NSERC). Produced water is water trapped in underground formations which is brought to the surface along with oil and gas, and represents the largest volume waste stream associated with oil and gas production (Veil et al, 2009). Produced water contains a mixture of hydrocarbons, including free and dispersed oil and grease, as well as soluble petroleum products such as benzene, toluene, ethylbenzene and xylene (BTEX) (Ahmadun et al, 2009).

Oil and grease are the constituents of produced water that receive the most attention in both onshore and offshore operations. Current regulations in Canada require the total oil and grease content of the effluent water to be reduced to a monthly average of 30mg/L and a daily average of 44mg/L (CNSOPB, 2010). Typically, produced water treatment methods do not effectively remove the dissolved oils, which contribute significantly to the toxicity of produced water (Veil et al., 2004). The proposed treatment scheme comprises ferric chloride ( $\text{FeCl}_3$ ) coagulation or adsorption with powdered activated carbon (PAC) and organoclay (OC) as a pre-treatment for DAF. This treatment train should provide enhanced removal of dissolved contaminants from produced water in addition to reducing oil and grease concentration below discharge standards.

Bench-scale tests are being conducted using a DAF jar tester to treat synthetic produced water prepared by emulsifying 100 mg/L crude oil in salt water with a non-ionic surfactant. This research is investigating the impact of coagulant and adsorbent dose, pH and mixing time on the removal of oil and grease and BTEX constituents from synthetic produced water. Preliminary coagulation-DAF results show oil and grease concentrations of treated water below 20 mg/L, which meet discharge standards. Subsequent studies will compare the impact of adsorption with PAC and OC on oil and grease removal and will also investigate the removal of dissolved BTEX constituents.

DAF with chemical pre-treatment may provide an effective method for enhanced removal of dissolved and dispersed oils from produced water. This research may benefit the offshore oil and gas industry in Atlantic Canada by increasing wastewater treatment capacity and encouraging environmental stewardship.