

## **BOEM ENVIRONMENTAL STUDIES PROGRAM: Ongoing Studies**

**Region:** Alaska

**Planning Area(s):** Beaufort Sea, Chukchi Sea

**Title:** Biodegradation and Transport of Crude Oil in Sand and Gravel Beaches of Arctic Alaska (AK-13-03-10)

**BOEM Information Need(s) to be Addressed:** This study will provide information about the potential fate of crude oil on the Arctic coast. It will investigate transport processes through sediments, as well as degradation of crude oil by microorganisms. Additionally, BOEM analysts will use this information in NEPA analysis and documentation for Lease Sales, EPs and DPPs.

**Total Cost:** \$56,310  
plus Joint Funding

**Period of Performance:** FY 2014-2015

**Conducting Organization:** CMI, UAF

**BOEM Contact:** [Rick Raymond](#)

### **Description:**

**Background:** Low temperatures (such as those present during most of the year in arctic Alaska) affect the physical properties (e.g. viscosity) as well as biodegradability of crude oil. It is common practice after such spills to begin spill clean-up with mechanical means, and then enhance microbial degradation of petroleum hydrocarbons by adding nutrients after preliminary efforts; this was the process for the Exxon Valdez Oil Spill. However, the efficiency of nutrient addition may be reduced due to the washout resulting from tidal and wave action. The majority of coastal oil-spill remediation research has focused on biostimulation of microbes to aid crude oil degradation. Little research has been conducted on the movement of oil through the soil profile and the effect that wave action can have on this movement. Flushing due to tides and waves will impact hydrocarbon transport both within the soil/sediment matrix and into the sea. This important aspect has not received much scientific attention. Limited quantitative information is available on the fate of crude oil spilled on arctic shorelines or on the efficiency of crude oil biodegradation in cold climates.

### **Objectives:**

- Analyze the combined effect of crude oil concentration and temperature on the rate of crude oil biodegradation in seashore sediments, under conditions typical for Alaska's arctic coasts.
- Determine the fate of nutrients and crude oil through sand/gravel beach sediment samples with different grain size distributions using a wave simulation tank.

- Evaluate the movement of crude oil through the soil profile on the Arctic coast, with special consideration of wave action
- Analyze the rate at which oil moves through the soil, oil pooling, the amount of oil remaining in the soil (not washed away), and the extent to which biodegradation can contribute to oil removal

**Methods:** This study will address both biodegradation and contaminant transport processes in a comprehensive laboratory setting to evaluate the feasibility of treating crude oil spills along arctic shores with bioremediation. Soil samples from an inter-tidal zone from a North Slope beach will be used to provide soil profiles representative of an Arctic Alaskan coast. The samples will be characterized in terms of grain size distribution, hydraulic conductivity, porosity and bulk density.

Beach sediment samples from the Barrow area will be infused with crude oil. Mass transfer processes will be studied in a Plexiglas wave tank and in small scale soil columns. Biodegradation will be examined in microcosms containing crude oil-contaminated soil to identify effects from a number of parameters, including: soil grain size (sand/gravel), temperature, nutrient addition, crude oil concentration, and number of flushing cycles or intensity and duration of simulated wave action. Gas chromatography mass spectrometry will be used to measure microbial respiration rates and hydrocarbons remaining in the soil, as well as hydrocarbons volatilized and sorbed to activated carbon. Concentrations of hydrocarbon degrading microorganisms and nutrients will also be quantified.

**Current Status:** Ongoing

**Final Report Due:** May 2015

**Publications Completed:** None

**Affiliated WWW Sites:** <http://www.boem.gov/akstudies/>  
<http://www.sfos.uaf.edu/cmi/>

**Revised Date:** April 2015

**ESPIS: Environmental Studies Program Information System**

**All *completed* ESP studies can be found**

**here:** [http://www.data.boem.gov/homepg/data\\_center/other/espis/espisfront.asp](http://www.data.boem.gov/homepg/data_center/other/espis/espisfront.asp)