

## 3rd Quarterly Report

### Paraffin Control in Oil Wells Using Anaerobic Microorganisms

**Period Covered by the Report:** April 15, 2006 to August 15, 2006

**Date of Report:** September 20, 2006

**EPA Grant Number:** X83-2428-01

**Title:** Paraffin Control in Oil Wells Using Anaerobic Microorganisms

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**Institution:** The University of Oklahoma

**EPA Project Officer:** Bala Krishnan

**Project Period:** 10-15-05 to 10-14-06 (Year 1)

**Project Amount:** \$149, 298

**Research Category:** Petroleum Environmental Technology, Wellbore Cleanout

**Objective(s) of the Research Project:** Paraffins that form waxy deposits upon removal from reservoirs have been implicated in numerous oil field problems leading to reductions in oil recovery. In oil reservoirs, anaerobic conditions usually predominate. Thus the addition of anaerobic microbial populations that can definitively biodegrade paraffins under such conditions can be of great use to treat wax accumulations. Our aim is to evaluate the feasibility of using anaerobic microbial consortia to biodegrade waxy hydrocarbons in order to ameliorate paraffin accumulations in oil reservoirs.

**Progress Summary/ Accomplishments:** The cultivation and study of microbial populations from a variety of sources capable of degrading waxy paraffins under anaerobic conditions is ongoing. Enrichment cultures derived from hydrocarbon-contaminated marine sediments continue to show enhanced levels of sulfate reduction in the presence of C<sub>28</sub>, C<sub>40</sub>, or C<sub>50</sub> provided as the paraffinic substrate relative to substrate-free controls. Preliminary molecular analysis of these mixed, sediment-free enrichment cultures have revealed the presence of several sulfate-reducing bacteria, some of which are closely related to known anaerobic hydrocarbon degraders. We have also established incubations using anaerobic sediments from a freshwater, hydrocarbon-impacted aquifer to determine the ability of the microbial population to utilize a high molecular weight paraffin mixture, Polywax (Polywax 655, Supelco, containing ~ C<sub>30</sub> to C<sub>100</sub>), under sulfate-reducing and methanogenic conditions. These sediments are already known to be capable of utilizing alkanes in oils up to C<sub>34</sub> in length under anaerobic conditions. Further, we established similar incubations using a sediment-free, oil-degrading methanogenic population as the inoculum developed from the same aquifer site. Over the course of approximately 7 months, we have observed enhanced levels sulfate reduction over substrate-free controls when the enrichments were established in the presence of Polywax. This was observed for incubations containing sediments as well as for those containing the sediment-free oil-degrading inoculum. In contrast, no enhanced levels of methane production from Polywax have been observed in methanogenic incubations. The active Polywax-degrading incubations have recently been re-amended with sulfate and continue to be monitored for Polywax degradation activity.

**Publications/ Presentations:** A poster describing the activity and microorganisms present in the C<sub>28</sub> to C<sub>50</sub>-degrading enrichment cultures will be presented at the International Symposium for Microbial Ecology (ISME) to be held in Vienna, Austria August 20-25, 2006.

**Future activities:** Enrichment and monitoring of the above-described cultures for the ability to degrade waxy paraffins under anaerobic conditions will continue. Experiments will be conducted to determine the nutritional requirements of some of the enrichment cultures to improve growth. More detailed molecular analyses will continue to identify the organisms predominantly responsible for anaerobic paraffin biodegradation. All promising enrichments will be challenged with field paraffins and paraffinic oils. Enrichments will also be established under more thermophilic conditions using field samples such as oil production waters. The concentration of paraffins will be assessed in addition to measures of electron-accepting processes.

**Supplemental Keywords:** paraffin treatment, anaerobe, biodegradation, oilfield reservoir

**Relevant Web Sites:** Not applicable at this time.