

June 1, 2006

Dear Oil and Gas Research Council Members,

Attached you will find a final report for the project entitled "Remediation of Salt and Hydrocarbon Impacted North Dakota Soils" completed by BioRem Consultants, Amerada Hess Corporation and the North Dakota Oil and Gas Division.

All project activities are now completed.

Sincerely,

Lynn D. Helms
Director
NDIC Department of Mineral Resources
Oil & Gas Division
600 E Blvd Ave. - Dept. 405
Bismarck, ND 58505-0840
Phone (701) 328-8020
Fax (701) 328-8022
<http://www.oilgas.nd.gov/>

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Project Description

The purpose of the proposed project was to develop a user-friendly, low-cost, and environmentally appropriate soil remediation process and organize, document and publish a practical soil remediation guide for salt and hydrocarbon contaminated soils.

Dr. Len Gawel with BioRem Consultants organized and documented the remediation process in development of a field guide entitled A Guide for Remediation of Salt/Hydrocarbon Impacted Soil. The guide documents a step-by-step approach to remediation beginning with the impacts of salt/hydrocarbon spills on soils and proceeding through the site evaluation process, field sampling and analytical tests, selection and application of soil amendments, and monitoring and site closure requirements. A glossary of terms is included with the guide as well as documentation of supporting science and additional resources in the appendices. NDIC Oil and Gas Division (NDIC) and Amerada Hess Corporation (Hess) critiqued and edited the field guide for publication. NDIC published the guide and it is available to all North Dakota operators and the general public.

A one day workshop was conducted May 7, 2006 at the Williston Basin Petroleum Conference held in Minot, ND. The workshop included instruction by Dr. Gawel in use of the remediation guide, hands-on demonstrations of field sampling and analytical tests, and presentation of case studies of successful applications of the remediation methods by Hess and the NDIC. Each participant was presented with a copy of A Guide for Remediation of Salt/Hydrocarbon Impacted Soil which includes a 5.5" x 8.5" paper copy in a field-friendly ring binder format and a copy in compact disc format. The participants also received paper copies of the slides used in the workshop and documentation of the case studies.

Executive Summary

Day-to-day production operations and transportation of petroleum fluids may result in accidental spills. The purpose of this project was to develop, organize, and publish a guide to remediate soil impacted by salt water and hydrocarbon spills. The remediation guide will assist field personnel to restore impacted soil to a state consistent with original land-use.

The remediation technology is based on practical, reproducible, and field friendly procedures. The remediation procedure requires a limited amount of analytical data and observations. The analytical methods can be conducted in the field by trained technicians or in a local laboratory. Steps detailing these analysis and observations are outlined in the field guide.

When soil is impacted by produced water and hydrocarbons a number of critical factors can indicate immediate and long-term impact of the soil structure and fertility. The use of and response to these factors are the key to success of the remediation procedure. Field experience has demonstrated a success rate greater than 80% when the method in this guide is properly followed. The remediation is based on a 3 to 4 year duration with the exception of difficult problem sites. In these cases, the remediation time may be extended or additional remediation action may be required.

The remediation method in this guide utilizes naturally occurring soil amendments, basic soil chemistry and time to achieve success. The amount of rainfall received on the site will impact total remediation time. Gypsum, the major remediation amendment is a natural occurring product in the earths crust. In addition, Humex, also known as leonardite, is a secondary amendment that is also naturally derived.

The cost of the remediation process is an important part of the remediation plan; however, cost may vary significantly from area to area. Therefore, costs were not included in the guide. Record keeping can be tailored to the unique needs of each operator. Since a remediation project may take up to four years, record keeping is very important from the initiation of the project.

Before using the remediation guide, a thorough knowledge of the procedure is helpful.

The use of a GPS unit, computer and appropriate software will increase accuracy and reduce the time spent on documentation.

Len J. Gawel
BioRem Environmental Consultants
1601 Meadowbrook Dr.
Ponca City, OK, 74604

Value to North Dakota

Many of the oil and gas operators do not have, at their disposal, a workable method to remediate salt and/or hydrocarbon spills. Many of the operators do not have the technology to conduct a successful remediation. In addition, the operators consider the remediation process to be a very costly undertaking and therefore hesitate to conduct any remediation. The NDIC was frequently asked for recommendations on how to remediate a spill site. The process presented in the guide provides a step by step, cost effective procedure for remediation of salt/hydrocarbon contaminated soil that will benefit all members of the petroleum industry. The procedure guidelines also provide NDIC personnel a standardized technology and workable guidelines for remediation which can be distributed to operators to assist them in their remediation efforts.

The benefit to North Dakota is in the preservation and protection of the soil environment, one of North Dakota's greatest resources.

Budget

Total project cost: \$40,954

Total project duration: October 2005 – May 2006

Grant Support

\$20,000

Cost Share

Amerada Hess Corporation

\$14,000

NDIC Oil and Gas Division

\$6,954