CAPP CANADIAN ASSOCIATION OF PETROLEUM PRODUCERS

REPORT ON 2003 RESEARCH PROJECTS

ENVIRONMENTAL RESEARCH ADVISORY COUNCIL

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FIELD VERIFICATION OF NUMERICAL MODELS FOR PREDICTING THE IMPACTS OF SALT CONTAMINATION

WHAT WAS THE PURPOSE OF THIS PROJECT?

The release of brine may occur during petroleum exploration and development around, say, pipeline breaks and flare pits. The resulting salt contamination can degrade soils, stunt vegetation growth and impair surface and ground water quality. To remediate such sites in a protective, expedient and cost-effective manner, a cleanup strategy must be matched to the relative risk or complexity of each site.

This project is part of ongoing work to develop a practical, risk-based assessment and classification system for salt-affected sites to help industry choose appropriate remediation technologies. A key to developing such a system is the ability to quantitatively predict the movement of salt within the subsurface. A vital tool here is numerical models, which integrate data, highlight data deficiencies and help quantify a conceptual model of plume behaviour in the subsurface.

Test software for assessing risk at sites contaminated by petroleum-related salt releases.

In 2002, Alberta Environment commissioned MDH Engineered Solutions to choose software suitable for site-specific risk assessment or for the development of generic risk-based scenarios that can be used to guide remediation of soil and groundwater. The detailed analysis resulted in the recommendation of three modeling codes – CHEMFLO, UNSATCHEM and VS2DTI. This project sought to verify these potential modeling codes in the field.

HOW WAS THE PROJECT CONDUCTED?

Four salt-contaminated sites – covering a range of soil types and salt-loading scenarios typical of Alberta's foothills and prairies – were selected for the model verification exercise. They were:

- A field trial site for heavy oil waste sludge application and improvement of sandy soil
- A field trial site for land spreading of drilling muds
- A road salt storage and maintenance facility
- A pipeline break site.

Although extensive data had already been gathered from each site, additional collection was required to provide necessary information for the models. All four sites were then modeled to test the ability of the software to predict salt movement within the subsurface.

WHAT ARE THE RESULTS?

At the heavy oil waste sludge and salt storage sites, detailed hydrogeological models were constructed from extensive, quality data. These models were thus able to explain the distribution of subsurface salt and to partly reconstruct the history of plume development. A concern is such models could not have been constructed with the limited data normally available for a small spill investigation.

At the drill mud site, a simple 1D unsaturated zone model was able to predict measured chloride levels. At the pipeline break site, it was also possible to match the observed plume with a 1D model, but with no source information it was impossible to verify the models were performing accurately. Still, this site illustrates the value of models in constraining the mass of an unknown source, given high-quality, site-specific data.

Overall, the field verification exercise clearly confirmed the recommended modeling packages can be effectively applied to site-specific problems with the help of high-quality data.

WHAT HAPPENS NEXT?

A final report will be issued in the spring of 2004.

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