2007 Remediation of Salt Affected Sites by Leaching

Nancy Finlayson, Matrix Solutions Inc.

Sodium chloride (NaCl) based brine known as “produced water” is frequently produced along with petroleum hydrocarbons in western Canada. Remediation of soils impacted by produced water spills is an ongoing challenge since sodium chloride salts can have a negative impact on soil productivity, penetrate soils rapidly potentially affecting groundwater quality, and do not biodegrade.

The objective of this study was to evaluate current soil leaching technologies as a remediation tool for sodium chloride-impacted soils in western Canada. The study used existing spill monitoring data provided by a number of companies operating in western Canada. Data from 35 spills were included in the study. Because of the requirement for soil monitoring over several years, sites made available to the study tended to be larger or more persistent spills; they were not necessarily a typical cross-section of spills in Alberta or Western Canada.

Results indicated that leaching often moves salts downward very rapidly, particularly in the first

several years after the spill. Produced salts can move through the soil profile to a depth of 5 m or more within 10 years, in permeable soil. Both engineered and passive systems can be effective in restoring good crop growth but there is some evidence that tile drainage may enhance the rate of salt leaching, particularly if the system is well maintained.

Leaching was not effective in removing salts from the topsoil at all spills. At about 10% of the passively remediated spills, electrical conductivity (EC) and sodium adsorption ratio (SAR) increased in topsoil between monitoring events. Resalinization can occur if there is upward movement of salts by capillary action from a high water table, or if the spill occurred in a groundwater discharge area.

Calcium (Ca) amendments appear to be very important to the leaching process. Because calcium applied as gypsum has a much lower solubility than sodium chloride and therefore moves more slowly through the soil profile, subsoil SAR sometimes increases during the leaching process, until sufficient applied calcium reaches subsoil. Data showed that calcium applied to the soil as gypsum can leach effectively through the soil profile to a depth of 1.0 m or more within 10 years despite its low solubility.

Sufficient water is needed to flush salts out of the root zone or into tile drains. Otherwise, salts can accumulate in subsoil at the maximum depth of water

penetration resulting in a “bulge” in EC and/or SAR values. If the volume of leaching water is insufficient, additional time may not help move the salt “bulge” deeper into the soil profile. Spill remediation monitoring including yearly vegetation monitoring and less frequent soil sampling was recommended.

2007 Matrix_REMEDIATION OF SALT AFFECTED SITES BY LEACHING Report
2010 Matrix_Wetlands and Salts Presentation