



Phytoremediation and PEPS

Phytoremediation is the use of plants to extract, degrade, contain and immobilize chemicals, including petroleum hydrocarbon and salt, from the soil.

PEPS stands for plant growth promoting rhizobacteria (PGPR) enhanced phytoremediation systems. PEPS has been developed through collaboration between Earthmaster Environmental Strategies Inc. and the University of Waterloo. After years of extensive laboratory research and field scale trials, it is a proven, innovative, science-based, cost effective, practical and green technology for the removal of salt, petroleum hydrocarbon (PHC), and some metals from impacted soils.

The PEPS Process

Seeds are treated in a controlled environment with a strain of Pseudomonads, a plant growth promoting rhizobacteria (PGPR). The Pseudomonads occur naturally in Canadian soils and are classified Biosafety Level 1, which is the safest possible level. They pose no threat to humans, wildlife or the environment.

PEPS utilizes a number of different plants, typically a mix of tall fescue, annual ryegrass and perennial ryegrass. Tall wheatgrass, oats, red fescue, slender wheatgrass and barley are also employed. Landowner preference is taken into consideration when choosing the seed mix.

The impacted site is cultivated to homogenize the soil and prepare a seedbed. Amendments to promote plant growth, such as fertilizer, gypsum and straw, are incorporated. The seeds are planted using a drill or broadcast seeder followed by harrowing.

Soil samples are taken at the beginning and end of the growing season to determine contaminant levels to track remediation progress.

The Science Behind PEPS

The challenge with impacted or impaired soils is getting plants to grow. Plants under stress produce a chemical called ethylene which significantly inhibits growth. When PGPR treated seeds germinate and begin growing, the PGPR bind to the roots and consume a chemical precursor required for ethylene production. As a result, the amount of ethylene produced is minimized and plant growth is enhanced. At the same time, the PGPR synthesize a chemical called auxin which is transferred to the plant. Auxin stimulates plant root and shoot growth. These two mutually beneficial processes lead to rapid re-vegetation of contaminated soils.

Hydrocarbons (F2, F3 and F4) are metabolized by the PGPR and degraded in the soil. In salt impacted sites, plant roots effectively partition the contaminant out of the soil into the above ground plant tissue. The plants can be safely grazed or harvested for animal feed.

PEPS Results

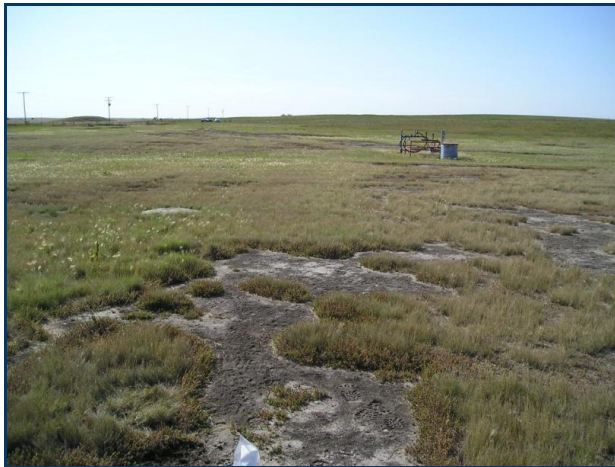
Success has been achieved at more than 30 salt and PHC impacted sites across Canada.

Salt Remediation

- In the past 3 years, PEPS has been deployed at 12 sites in AB, SK, MB and NWT.
- For soils with EC_e up to 25 dS/m, vigorous plant growth and NaCl uptake have been achieved.
- The average amount of salt uptake by the plants has been 25 – 50 g NaCl per kg plant dry weight.
- Each year, approximately 100 kg NaCl per hectare have been removed from the sites in above ground plant biomass.

PHC Remediation

- From 2006 – 2011, generic Tier 1 criteria (F2, F3 and F4 PHCs) have been met at 7 sites.
- Sixteen new sites are currently under treatment in AB, SK, MB and BC.



Weyburn, SK – PEPS site prior to seeding. $EC_e \sim 10$ dS/m.



Weyburn, SK – PEPS site after three months.

Advantages

PEPS is a proven technology for remediation of salt and PHC impacted soils. While remediation is the goal, there are added benefits to the PEPS system:

- Rapid re-vegetation of physically impaired or contaminated sites.
- Soil is a valuable resource. Soil is remediated in-situ and quality is dramatically improved.
- Corporate liability is not transferred to a landfill.
- Costs are typically lower than conventional remediation, especially at remote sites.
- More rapid and complete removal of salt and PHC than other bioremediation techniques.

Contact

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