

COLDREM - soil remediation in a cold climate: a national Swedish research program

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In order to develop and evaluate new cost-efficient methods for remediation of soil and groundwater in the Nordic countries, the interdisciplinary soil remediation research program COLDREM was launched with the support of the Foundation for Strategic Environmental Research (MISTRA). The research is organized around two target sites, an old gasworks site in Stockholm and a chlor-alkali site outside of Gothenburg. Both sites are heavily polluted with organic compounds and heavy metals.

One limiting factor in the soil will be oxygen. A different approach is to supply the alternative electron acceptor Fe^{3+} . This was done by adding chelating substances, assuming that the iron present in the soil was sufficient but needed to be mobilized. The approach is developed in laboratory experiments concomitantly with pilot scale studies at the gasworks site. It may be possible to mobilize organic compounds by '*in situ* soil wash'. This is achieved by pumping water through the soil volume. By this operation, a contaminated aqueous stream is generated which can be treated in high cell density reactors. In an *ex situ* slurry experiment, soil from the old gasworks site, contaminated mainly with PAHs, is treated in laboratory-scale bioslurry reactors. Together with the addition of detergent the use of vegetable oil will be studied.

Psychrophiles/psychrotrophs play an important role in environmental biotechnology since cold-adapted microorganisms have the ability to be catalytically efficient at low temperatures. Monitoring of the indigenous micro-flora is a key issue for optimization and prediction of bioremediation processes *in situ*. Changes in the microbial flora in PAH-contaminated soil during remediation, or in a bioreactor during treatment of PAHs are studied by means of analyzing the genetic material that can be extracted.

From the chlor-alkali site, which contains high concentrations of heavy metals, soil fungi were isolated and stressed with mercury to assess the complexing capacity and selectivity of produced metabolites. To test physico-chemical methods as a remediation process, the contaminated soil will undergo experiments in comparison to a model system contaminated with mercury as well as a mixture of heavy metals, using electroreclamation.

There is a number of supporting methods within COLDREM where co-operation between projects is performed and further techniques are being studied. Chemical analysis of the pollution situation at start, during and after the remediation constitute an important part of the program.