NorthPestClean
Pesticide Remediation

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NorthPestClean

Demonstration of alkaline hydrolysis as a new technology for remediation of pesticide contaminated soil and groundwater

NorthPestClean - Background

The national parliament of Denmark has decided that all contaminated sites in the country must be registered. Contaminated soil posing a risk to human health or the environment must be decontaminated or in other ways neutralized.

The European Commission will probably adopt a proposal for a Soil Framework Directive with the objective to protect soils across the EU.

"Groyne 42" – the testsite of this project – is a contaminated site posing a risk to human health and the environment. The site – close to a groyne facing the North Sea "Groyne 42" – was in the 1950'ies and 1960'ies a large chemical dumpsite. Today, the area is heavily contaminated by approximately 260 tons of mainly pesticides. The site is situated in the western part of Denmark, on the beach facing the North Sea.

The heavily contaminated stretch of coast at Groyne 42 is an obvious site for large scale tests of *in situ* alkaline hydrolysis (in situ = on the site).

NorthPestClean - Objectives

The primary objective of the project is to demonstrate the effectiveness of the method in situ alkaline hydrolysis in large scale experiments.

In addition the project must

- generate a decision-basis for a full-scale remediation of the site ”Groyne 42”
- demonstrate the effect and usability of 3 different “enhancement” technologies. The experiments will demonstrate to what degree each of these technologies will increase the effectiveness of the remediation method.
- create awareness among authorities and environmental scientists in the European Member States that a novel remediation technology has been developed and proven to be effective in a large-scale pilot experiment.
- generate a model of the expected concentration of toxic substances in the seawater at different clean-up scenarios.

History of the dumpsite at “Groyne 42”

During the years 1957-62 Cheminova deposited waste from the production of pesticides in the sand dunes at Groyne 42. It was permitted by the Danish Government. The state itself used the site to deposit chemical waste in the 1960’ies.

The first excavation of contaminated soil took place in the 1970’ies. In the following years the local citizens and the authorities became aware that the dumpsite posed a considerable risk to the environment and the wildlife, since dead fish and diseased birds were observed.

In 1981 the Danish EPA financed excavation of contaminated soil down to the water table. 1.200 tons of toxic chemicals were removed. Unfortunately, 200-300 tons of toxic chemicals were still to be found under the water table.

In 2000 the authorities realized that chemical seepage from the dumpsite was still posing a risk to the environment and wildlife. The former Ringkjøbing County and the Danish EPA agreed to share the costs of encapsulating the contaminated area.

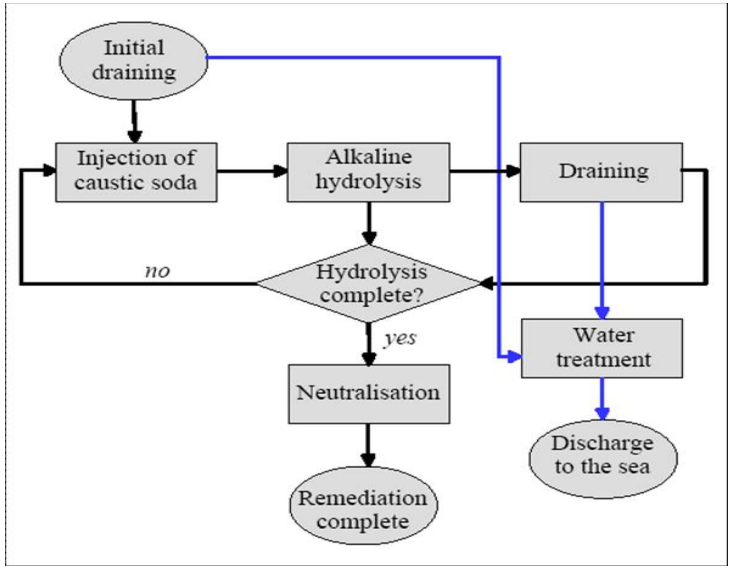
The exact location of the contamination was investigated before encapsulating the area. The contaminated site was found to cover 20.000m^2 and go as deep as 10m below the surface.

Encapsulation of the area was completed in 2006. 600m of 14m deep iron sheet piling encircles the contaminated soil. The area is covered by a membrane and the water table is kept lower than outside the site to prevent seepage. The iron sheet piling is guaranteed to be functional for 15 years and is expected to last even longer.

NorthPestClean - Technology

It is well described in the scientific literature that alkaline hydrolysis can be used to degrade organophosphorous insecticides such as ethyl-parathion to less toxic and water-soluble metabolites. The method has been used for many years by agrochemical companies producing organophosphorus pesticides to neutralise the compounds upon accidental spill, but also as a pre-treatment of wastewater containing organophosphates before it is led to the biological wastewater treatment plant.

In situ alkaline hydrolysis has not previously been used as a technology to remediate soil and groundwater contaminated with organophosphorus pesticides. But since 2005 Region Midtjylland and the Danish EPA have been developing a remediation technique based on encapsulation of the contaminated soil followed by degradation of toxic substances by adding strong alkaline liquid. Lab experiments and experiments in small scale on site have shown that alkaline liquid is able to degrade toxic substances in the soil matrix effectively. The metabolites are water-soluble and can be pumped to the surface for further treatment.



NorthPestClean - Experiments

A remediation method based on *in situ* alkaline hydrolysis is tested at “Groyne 42” as a part of the project NorthPestClean running from 2010 to 2013. (in situ = on the site)

The main objective of NorthPestClean is to demonstrate in large-scale pilot experiments the effectiveness of a new remediation method based on *in situ* alkaline hydrolysis.

A number of test cells will be constructed at the site. Each cell will be enclosed by a 14 m deep steel sheet piling. The test cells will be placed within the most heavily contaminated area of “Groyne 42”. The steel sheet piling is anchored in a thick layer of clay, whereby there is almost no contaminated water leaving or entering the cells.

Draining off the groundwater is the first step in the new remediation method. Then the contaminated soil in the test cells is infiltrated by diluted sodium hydroxide. In this way the pH in the remaining groundwater is raised to 12. The alkaline hydrolysis is allowed to take place subsurface for 3-6 months. The toxic parathion is degraded to two water-soluble and less toxic substances, which can be removed from the soil by pumping groundwater to the surface. The treatment cycle is repeated 2-3 times.

Contact-enhancement technologies are also tested at the site. The sole purpose of these techniques is to enhance the contact between reagent (sodium hydroxide) and contaminant (parathion) and thereby accelerate the process.

NorthPestClean - Perspectives

The cost of soil remediation is the most frequent reason for not taking action. The approach of this project makes it possible to decontaminate soil containing high concentrations of pesticides at much lower costs than assumed previously.

If NorthPestClean is able to demonstrate that *in situ* alkaline hydrolysis is an effective method for remediation of soil containing pesticides, the project will ensure remediation of a larger amount of pesticide contaminated soil in the future all over Europe.

NorthPestClean – Contact information

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