

Remediation of PFAS Impacted Soil at a Fire Station in Sweden

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Site Background

An operating Fire Station located in a suburban neighbourhood in close proximity of private housing in south of Sweden, was expanding its facility to make room for emergency vehicles. As the Fire Station handles hazardous products containing poly- and perfluoroalkyl substances (PFAS), a site investigation was carried out as a first step in the expansion to document the environmental status of soil and groundwater.

Site Investigation

The results from the site investigation showed a small area containing PFAS levels above the guideline levels for sensitive land (KM) in soil, and elevated levels of PFOS were found in the groundwater.

As a response to the findings, the local EPA demanded the area to be remediated with regards to both soil and groundwater, and Envytech was engaged for the work. The planned remedial approach involved excavation of the contaminated soil as well as a pump and treat system for the groundwater as the spread was localised.

As the soil was to be excavated, the local EPA decided that the soil could only be deposited at a certified treatment plant that could demonstrate a specific handling procedure for PFAS soil that met the EPA's demands. After asking several treatment plants, none could show a sustainable treatment procedure. Envytech then suggested using the stabilisation agent RemBind®, which is manufactured in Australia and has been widely used to stabilise soils to minimise the potential for PFAS leaching.

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Excavation during Fire Station Expansion



PFAS Soil being Immobilised with RemBind

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PFAS Immobilisation with RemBind

Contaminated soil was treated with RemBind and a two-step leachability test, certified method EN-12457/1-4, was performed at an accredited commercial laboratory (Eurofins).

The results showed that the leaching properties of the PFAS contaminated soil could be reduced by >99.9% when mixed with RemBind. PFAS concentrations of 1,400 ng/L were recorded for the non-treated soil at LS/2 (i.e. after 2 leaches) and 290 ng/L at LS/8 (i.e. after 8 leaches). For the stabilised soil treated with 2% RemBind the final leachate concentrations of PFAS (sum SLV 11) were <50 ng/L at LS/2 and 0.77 ng/L at LS/8.

This showed that leaching of PFAS from the soils were greatly reduced after adding 2% RemBind. But the results also showed that the most significant leaching of PFAS happens after only a short time, which is stimulated at LS/2. At LS/8, which simulates leachability after a long period of infiltration, significantly lower levels were noted, which means that by LS8, all leaching has already occurred, and that a LS/2 analysis more accurately reflects the true leaching potential of PFAS in the soil.

Based on the results of the trial, the local EPA approved that the PFAS contaminated soil, after stabilisation with RemBind, could be relocated for disposal at an approved treatment plant.

The soil was also approved by Hässleholm Energi och miljö AB (HMAB) for deposit at their plant. As HMAB had access to a treatment area at the plant in Vankiva, Envitech were offered the opportunity to carry out the stabilisation work at the facility. Envitech designed the mixing and stabilisation approach and performed it with its own staff in collaboration with HMAB.



RemBind Bulk Bags

Reduction in PFAS Leachability after Immobilisation with RemBind

Treatment Sequential Leach Number Units	Untreated LS2 ng/L	RemBind Treated (2%) LS2 ng/L	Untreated LS8 ng/L	RemBind Treated (2%) LS8 ng/L
PFAS Analytes				
6:2 FTS	12	<10	<10	<0.30
PFBA	24	<20	<20	<0.60
PFBS	<0.30	<10	<10	<10
PFDA	220	<10	57	<0.30
PFHpA	21	<10	<10	<0.30
PFHxA	58	<10	<10	<0.30
PFHxS	10	<10	<10	<0.20
PFNA	42	<10	<10	<0.30
PFOA	20	<10	<10	<0.30
PFOS	830	<10	220	0.77
PFPeA	150	<10	12	<0.30
Sum PFAS SLV 11	1,400	<50	290	0.77

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As the installation work for the pump and treat system was carried out, additional soil masses needed to be excavated. When sampled, the soil showed significantly higher levels of PFAS than the previous batch. Samples collected from walls of the shaft showed total PFAS levels of around 200 µg/kg. However, no samples were analysed on the excavated masses for total PFAS. Only leaching analysis was performed. The results from the leaching tests showed levels for total sum of PFAS (SLV 11) of 25,000 ng/L for the LS/2 analysis.

In order to determine if the soil with higher levels of PFAS could also be sufficiently stabilised, new tests were performed with RemBind. The results showed that leaching was greatly reduced even for this more heavily contaminated soil. Results for LS/2 showed PFAS leachate concentrations of 25,000 ng/L for the untreated soil, and 3,100 ng/L for soil treated with 2% RemBind. At LS/8, the leaching had a concentration of 220 ng/L. The results demonstrated again that the significant leaching of PFAS occurred already at LS/2.

However, it was also shown that the material leached about 3,000 ng/L despite stabilisation with 2% RemBind. Since no guideline values have been developed for leachate with PFAS in Sweden, and since leachability analysis are not performed on lower levels of hazardous wastes, a discussion was held between Eurofins, Envytech and HMAB to assess how the measured leachate properties should be interpreted.

Developing Guidelines for Levels of PFAS in Leachate from LS/2 Analysis

A crucial part of the discussion on how to interpret the leachate PFAS data, was the information that HMAB produced from its plant in Vankiva (near Hässelholm, Southern Sweden) regarding how much baseline PFAS the plant releases into the environment from its various cells.

HMAB have analysed the Vankiva plant PFAS levels in all leachate streams for more than 12 months, and the results show that the plant has an average outflow of about 5,000 ng/L PFAS in leachate. Based on these results, the decision was made that in the case of soils leaching less than 5,000 ng/L, these will not add any additional load to Vankiva's general leachate, or to the surrounding areas. Based on this, HMAB now demand the LS/2 analysis for all materials possibly contaminated with PFAS, and no materials are accepted if LS/2 concentration are above 5,000 ng/L.

Based on this decision by the EPA and HMAB, all soil from the Fire Station was treated with RemBind, and safely deposited at the plant without posing a risk to the surrounding environment. This was a ground-breaking project in Sweden and paves the way for PFAS soil stabilisation and safe disposal.