CASE STUDY | KLOZUR® SP

ISCO-ISS FOR REMEDIATION OF TCE SOURCE AREA ACHEIVING CLEAN UP GOALS WITHIN ONE WEEK OF APPLICATION

IN SITU CHEMICAL OXIDATON AND IN SITU STABILIZATION REAGENTS APPLIED IN A SINGLE APPLICATION.

INTRODUCTION

During the development of a former industrial area located in Västerås, Sweden, elevated concentrations of TCE were found in dense clay near the planned housing development. Prior to the construction of new residential buildings could proceed, remediation of the contaminated soil was required. Site-specific challenges included high levels of TCE (>500 mg/kg), poor soil stability, low permeability soil, nearby infrastructure, and a short 6-month timeframe to complete the remediation. The contamination occurred from 2 to 7 meters below ground surface.

REMEDIAL APPROACH AND GOALS

Following a review of potential remedial options an in situ remedial approach combining In Situ Chemical Oxidation (ISCO) with In Situ Stabilization (ISS) was selected for treating the impacted soil. Justification for the choice of remedial approach included rapid results (fast acting), cost savings (relative excavation & disposal), minimal risk of degradation products being formed (DCE / VC), large reduction of soil-bound contamination, reduced potential for leaching and improved soil stability. The method also matched overall sustainability goals, as the soil was treated on site with minimal transport and energy consumption.

In total, 600 m^3 of contaminated clay was treated. The work was carried out over the course of one week; 8 tons of Klozur® SP sodium persulfate and 70 tons of Portland Cement were blended in to the soil using large diameter (60 cm) augers.

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SITE DETAILS

Site Type: Former Industrial Site planned for Redevelopment

Location: Västerås, Sweden

Contaminants: TCE source area

Remedial Approach: ISCO-ISS

Lead Consultant: Wescon

Soil Mixing Contractor: SMG

Remedial Goal: reduce TCE mass by at least 50%.

Table 1. Reagent volumes and dosages

	Klozur® SP	Portland Cement
Reagent Mass (ton)	8	70
Dose (% by soil mass)	0.8%	7%

▲ *SMG applying a blend of Klozur® SP and Portland Cement to the impacted area using large diameter augers.*

RESULTS

Sampling 5 weeks after the ISCO-ISS application showed a reduction in the average TCE concentrations by 90%, which was confirmed with a large number of soil samples collected before and after the remedial action.

Maximum TCE concentrations were reduced by 97%, from a high of 542 mg/kg measured prior to treatment to a maximum of 16.5 mg/kg measured after the ISCO-ISS application.

The overall TCE mass was reduced by an estimated 80 %. This exceeded the remedial goal of at least 50% reduction.

Preliminary sampling conducted 1 week post application also showed similar results.

Table 2. Contaminant reduction

	Baseline: CVOCs before treatment	Results: CVOCs 5 weeks post treatment	Reduction
Maximum conc (mg/kg)	542	16.5	97%
Average conc (mg/kg)	45	4.5	90%
Estimated CVOC mass (kg)	40	8	80%

CONCLUSION

The remediation cost landed below SEK 1000/ton (excluding surveys), which meant significant (~70%) cost savings relative a more traditional remedial approach involving excavation and disposal in this case, due to the need for sheet piling.

The stability of the soil was improved, infrastructure was minimally affected, and the action goals were reached a week after the ISCO-ISS application and then confirmed after 5 weeks.

Table 3. Cost comparison of various remediation options considered.

Treatment Method	Estimated Cost (SEK/m³)
Thermal	6500
Excavation & Disposal	5500
ISCO-ISS	1600

▲ *Reference: Wetterholm, 2023. In Situ Soil Mix TCE, Webinar, Renare Mark's Yearly Meeting.*

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