

# The Evolution of Two Remediation Methods: Combined In Situ Stabilization (ISS) and In Situ Chemical Oxidation (ISCO)

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## ISCO-ISS Overview

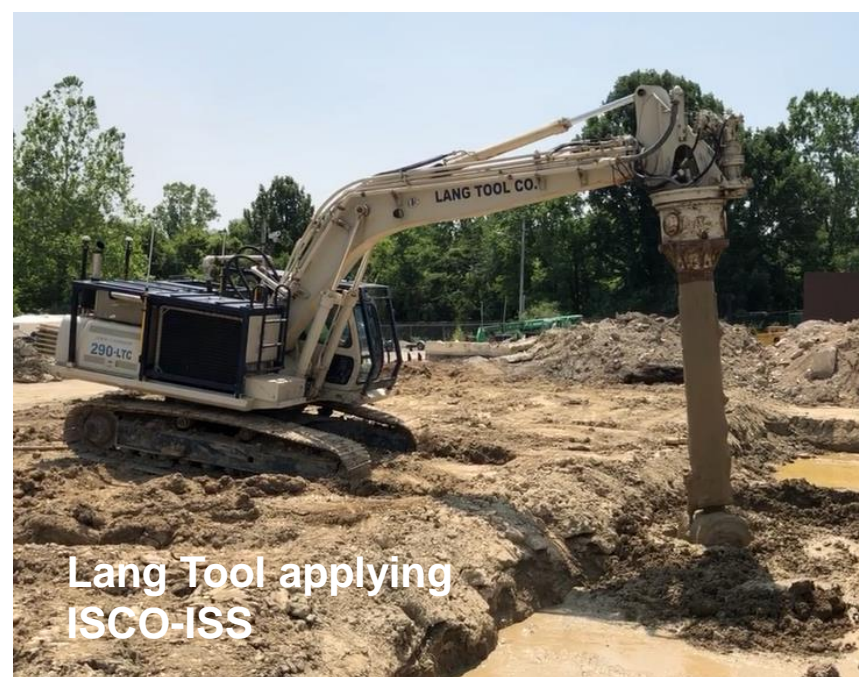
- In Situ Chemical Oxidation (ISCO) and In situ Solidification and Stabilization (ISS) are two established technologies that can be combined in a single soil mixing application.
- ISCO is a contaminant mass reduction and destruction technology that uses powerful oxidants to break down contaminants of concern into benign end products.
- ISS solidifies and immobilizes the contaminants within the final solidified soil structure.
- The most common blends include:
 

**KLOZUR® SP** plus Portland Cement / Blast Furnace Slag
- Common installation methods include large diameter augers, soil mixing using Lang Tool or excavator with soil mixing attachment



ISCO-ISS applied using large diameter augers (Photo courtesy of Ladurner)

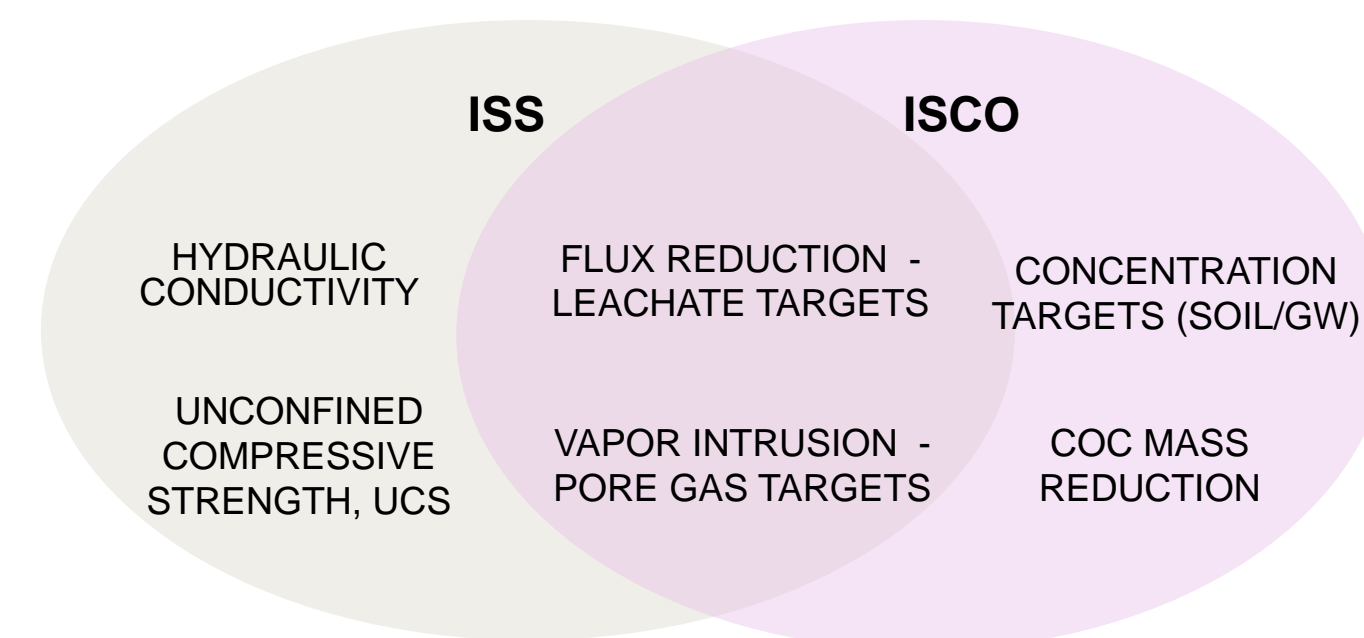
Combining the two technologies helps reduce site risks more cost effectively at highly impacted sites, with the more mobile portion of the contamination removed and residuals immobilized in the matrix.



Lang Tool applying ISCO-ISS

## Common Remedial Goals

ISCO and ISS are often used to accomplish separate remedial goals or, where there is overlap, an enhanced combined effect.



## Benefits of Combined Approach

### Benefits of adding ISS to ISCO applications:

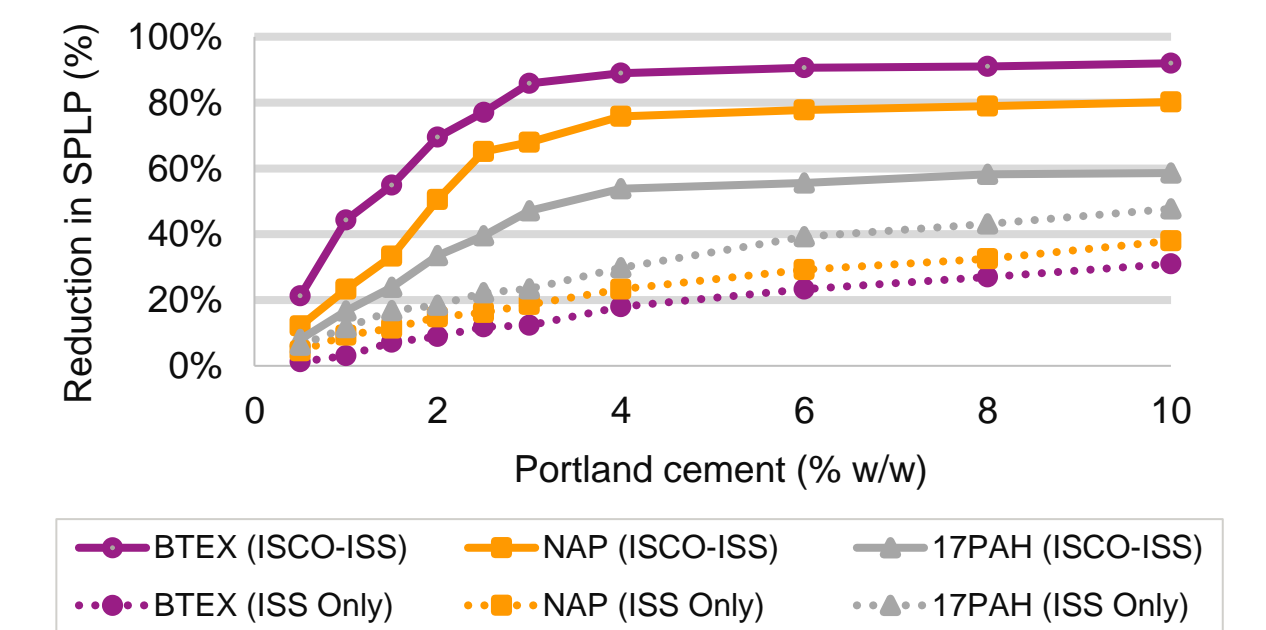
- Improved soil stability allowing for site activities and redevelopment soon after the application.
- Low-cost alkaline activators for Klozur® persulfate.

### Benefits of adding ISCO to ISS applications:

- Small additions of ISCO reagents can lower the amount of ISS reagents needed to reach UCS and K targets, resulting in less soil bulking and disposal costs.
- Lower long-term risk due to contaminant mass reduction.
- Faster plume reduction due to reduced flux.

## Leachate / Flux Reductions

Reduced leachate with combined approach for the same soils and ISS reagent dosages:



Reference: Srivastava, V.J., Hudson, J.M., and Cassidy, D.P., (2016b) "Achieving Synergy between Chemical Oxidation and Stabilization in a Contaminated Soil," Chemosphere, 154, 590-598

## Case Examples

### Former MGP site, Stockholm, Sweden



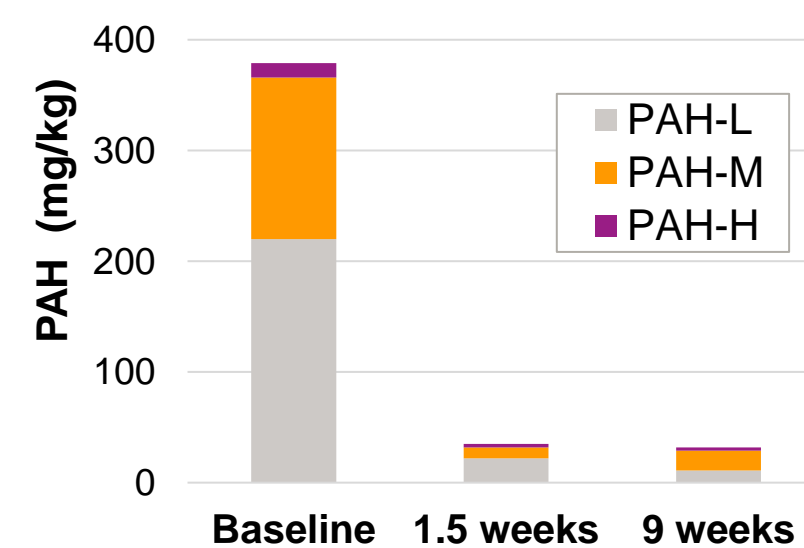
- Consultant: Golder, Elander, Sheeba
- Contractors: ARKIL A/S, PEAB
- PAH16 up to >2,700 mg/kg
- 50,000 m<sup>3</sup> clay layer

Reagent dose:  
1.8wt% Klozur SP + 4-8 wt% Cement

#### Results (% reduction):

- PAH-L ~95%
- PAH-M ~90%
- PAH-H ~80%
- All samples <250 mg/kg target

### Average PAH Concentration in Soil Before and After ISCO-ISS



Reference: Uppföljning av föroreningshalter i pelare efter stabilisering och kemisk oxidation av lera (ISS-ISCO), Golder, Jan 2022

### Former Dry Cleaner, Michigan, United States

- Consultant: Hamp Mathews & Associates
- Contractor: Lang Tool
- PCE (up to >1,000 mg/kg)
- 9,500 m<sup>3</sup> soil



Reagent dose:  
1-2 w% Klozur® SP  
4 w% Portland Cement

#### Result:

- 94% reduction in PCE mass
- Achieved solidification goals
- Underlying GW conc. reduced by 90 to 99%

