KELLER

Soil remediation

- Chemical treatment
- Removal
- Immobilisation
- Containment

Remediation solutions for a wide range of industries

Soil remediation

Soil polluted with different contaminants, whether from industrial operations, landfill or improper waste disposal can cause considerable problems. Keller can apply various techniques to remove, treat or contain contamination and eliminate future risk for the environment and the people living within it.

Challenges we can solve

Our extensive geotechnical expertise accumulated over many years enables us to provide cost-efficient solutions and respond flexibly to a variety of challenging situations and conditions.

We use advanced technologies that allow the execution of highly complex works to remediate, immobilise, seal and/or strengthen the ground. These include wet and dry soil mixing, various types of piles, diaphragm walls, anchors and sophisticated types of grouting.

We take special care to keep disruption to a minimum, selecting technology and equipment to ensure operations can continue during the work.

We are also able to help develop and design all the laboratory tests required, helped by our close cooperation with leading academic and industry partners.

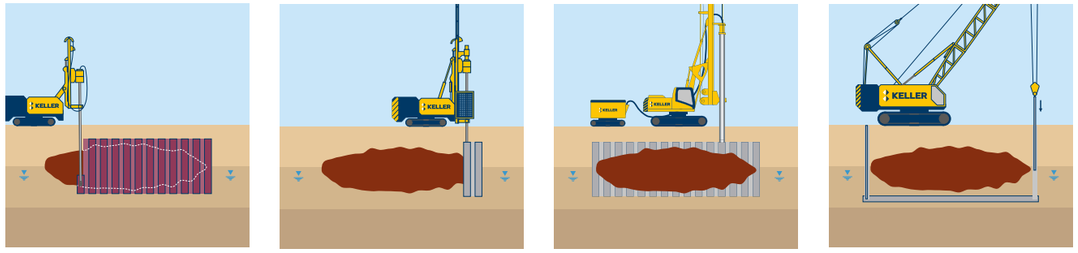
Health and safety

We believe no one should be harmed as a result of any work we do and our ultimate goal is zero incidents.

Health and safety is a priority for Keller and we have a proven track record of one of the lowest accident frequency rates in our industry. The commitment of leaders and employees to our Think Safe programme has earned us awards and recognition from industry bodies as well as our clients.

THINK SAFE
WORK SAFE, GO HOME SAFE

Possible approaches



Chemical treatment – chemical degradation by introducing remediating agents

- Halocrete® (In situ chemical oxidation/ reduction)
- Grouting and chemical grouting
- Deep soil mixing/ Mass mixing/ Soilcrete®
- Soilfrac®

Removal – extraction of polluted material

- Excavation and replacement
- Bored piles
- Soil washing

Immobilisation – binder incorporation into polluted soil

- Soilcrete®
- Grouting and chemical grouting
- Deep soil mixing/ Mass mixing
- Soilfrac®

Containment – enclosure around the contaminated zone

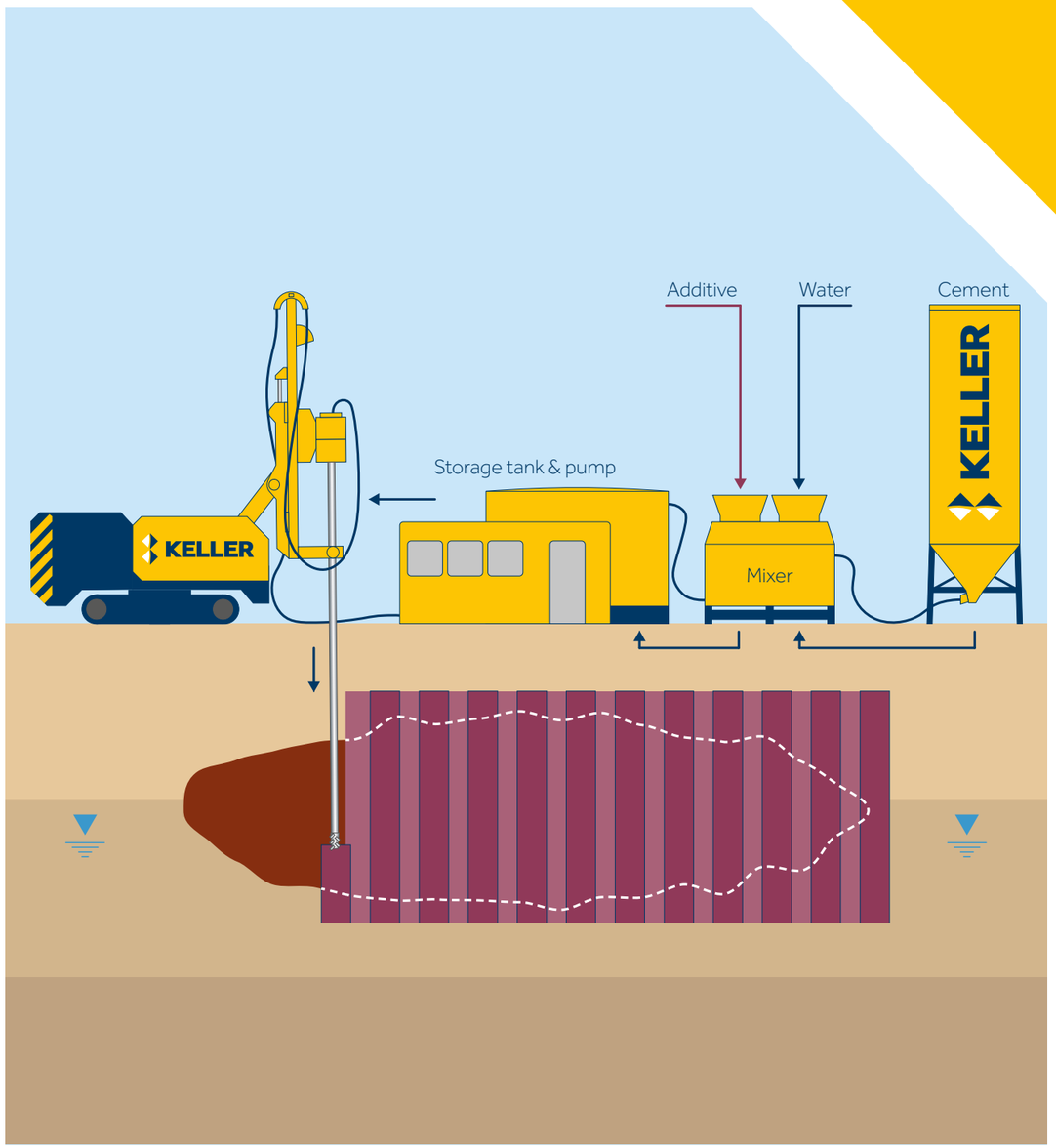
- Soilcrete®
- Grouting and chemical grouting
- Deep soil mixing/ Mass mixing
- Cut-off wall
- Slurry wall, optionally with a synthetic membrane

Chemical treatment, removal, immobilisation and containment techniques

Different techniques can be applied depending on the site characteristics, like the type and amount of contaminant, the groundwater conditions, various chemical parameters and the presence of sensitive structures around the treatment zone.

Advantages

- Minimal impact on people and existing structures
- Compliance with environmental regulations
- Solutions available for different contaminants (heavy metals, mineral oils, PAH (Polycyclic Aromated Hydrocarbons) chlorinated hydrocarbons etc)
- Efficient decontamination with minimal waste
- Monitoring with state-of-the-art instrumentation
- Close cooperation between owner, government/administration, environmental consultant and geotechnical contractor



Before execution:

- Site investigation to identify contamination type/source and plume extension
- Laboratory tests to determine the reaction behaviour between soil and slurry (agent)
- Definition of point of delivery

Treatment:

- Insertion of the remediating agent

  and/or
- Intensive mixing to evenly distribute the agent
- Supervision and testing of the degree of chemical treatment

Post treatment:

- Verification of columns for distribution and concentration of agent
- Continuous monitoring required as an integral part of all remediation projects

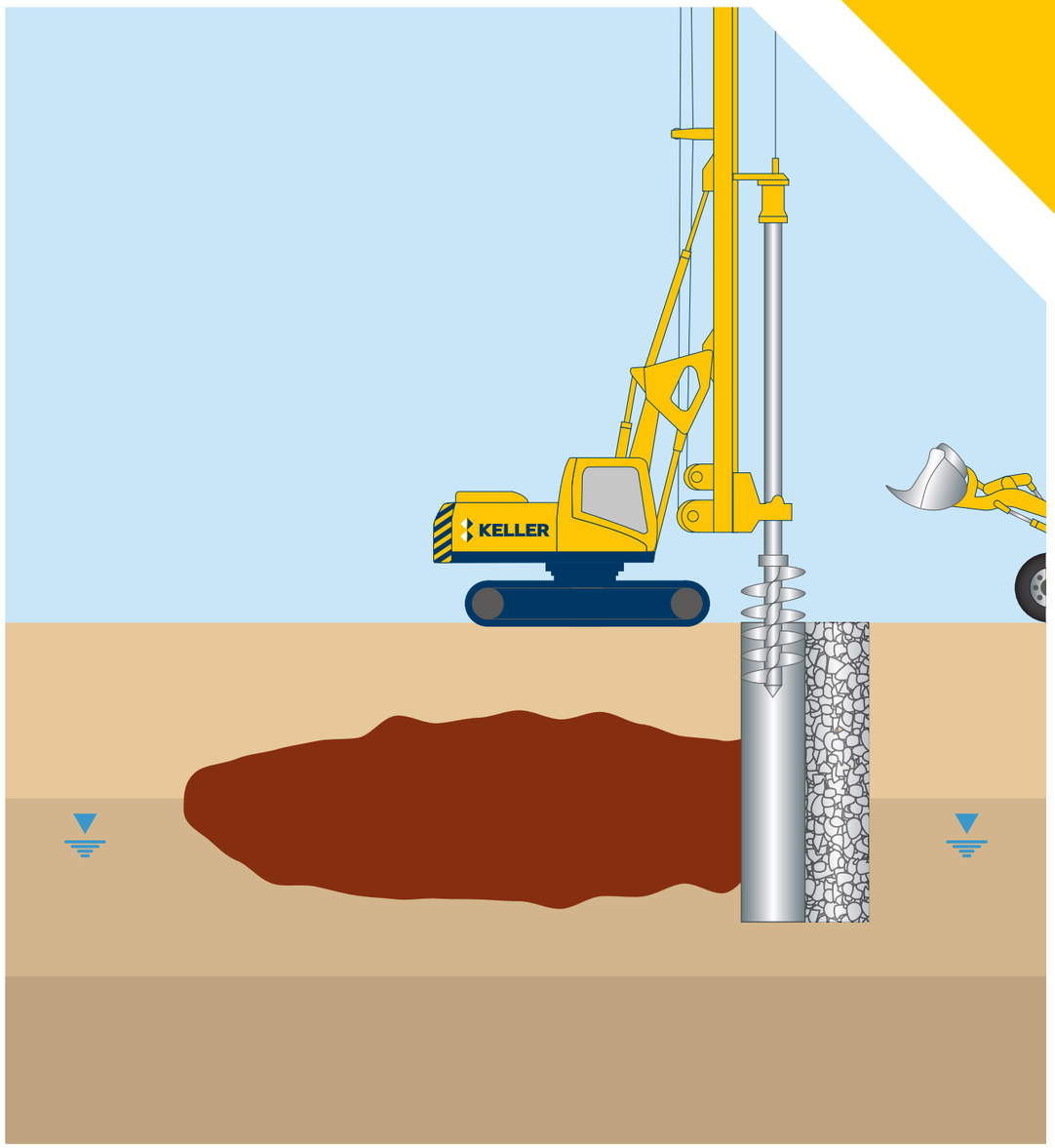
Chemical treatment

Keller has developed an in situ remediation method (HaloCrete®) using bespoke chemical agents, eg iron particles, which with our Soilcrete® technology or soil mixing, breaks down the contaminant through a chemical reaction.

In-house research and development

using HaloCrete® for example

- Developed in partnership with:
  AIT Austrian Institute of Technology,
  Graz University of Technology,
  Rohrdorfer Zement and others.
- Exhaustive laboratory tests in batch reactors for column experiments
- Large-scale field tests with extensive instrumentation and monitoring
- Chemical and mechanical analysis of soil samples, slurries and groundwater pre and post-treatment



Before execution:

- Site investigation to identify contamination type/source and plume extension
- Definition of point of delivery

Treatment:

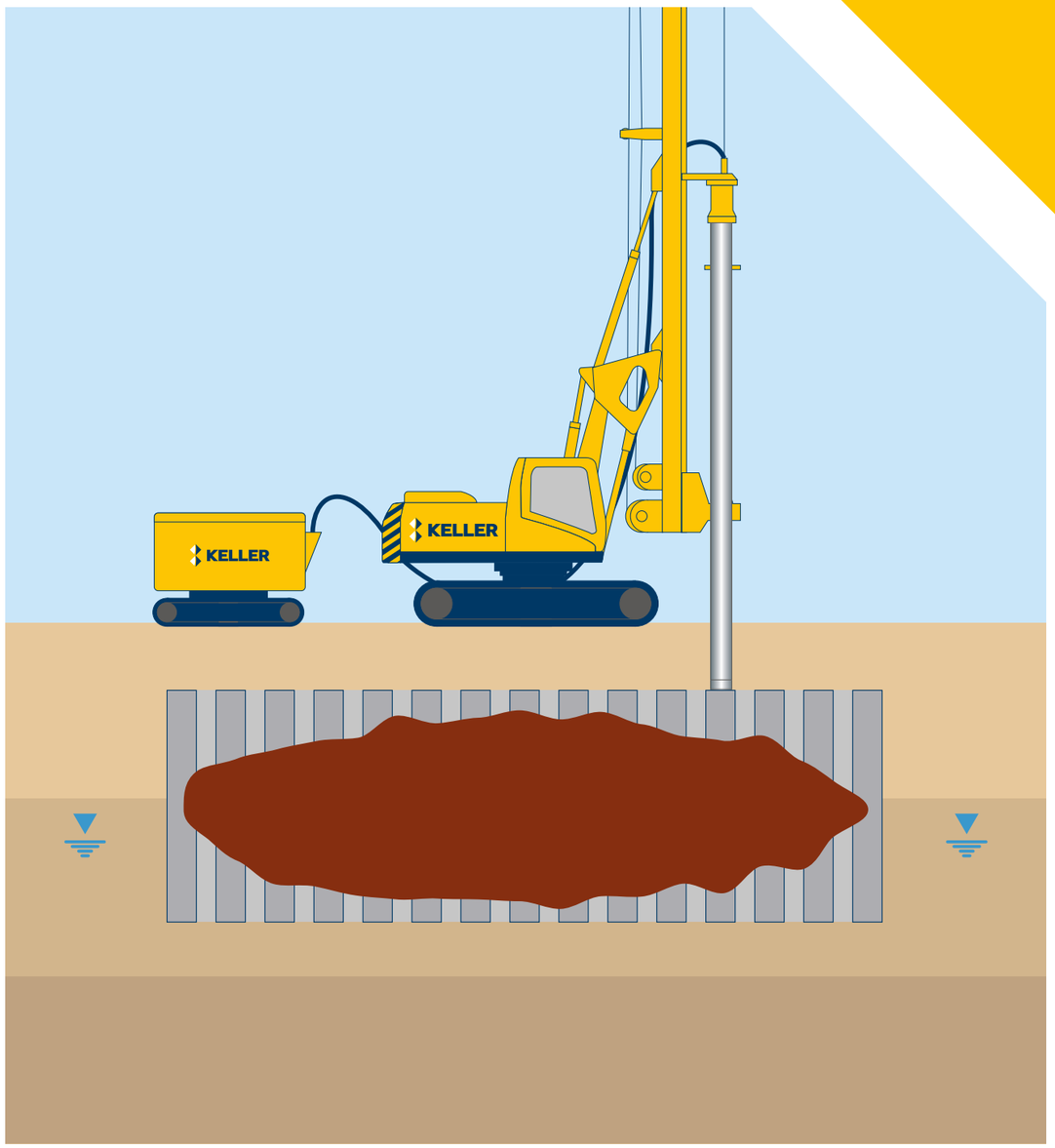
- Execution of cased drillings
- Separation and classification of excavated material
- Boreholes are filled with clean gravel or concrete

Post treatment:

- Continuous monitoring required as an integral part of all remediation projects

Removal

When contamination is too deep or too close to existing structures, bored piles can be used to enable excavation without the need for horizontal support.



Before execution:

- Site investigation to identify contamination type/source and plume extension
- Laboratory tests to determine the retention capacity

Treatment:

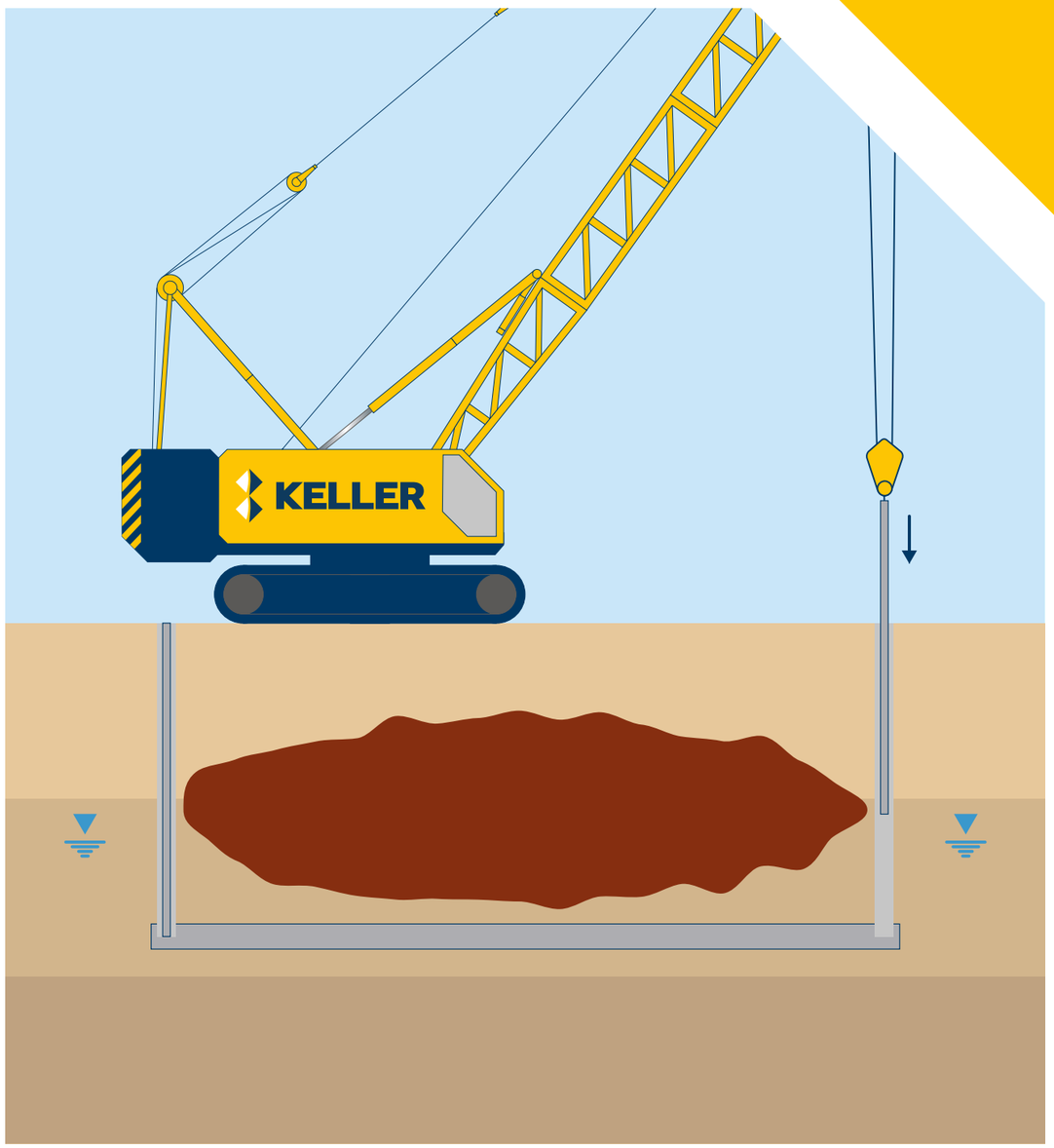
- Introduction of a hydraulic binder into the ground
- Disaggregation of the soil matrix containing the contaminant
- Formation of a body using the soil particles with the contamination as aggregate permanently fixing them in place

Post treatment:

- Verification of executed columns for position and inclination
- Continuous monitoring required as an integral part of all remediation projects

Immobilisation

Various methods are used to introduce a hydraulic binder into contaminated ground to replace or fill the pore volume and to fix the soil particles with the adhering contaminants permanently in one place.



Before execution:

- Site investigation to identify contamination type/source and plume extension
- If necessary, laboratory tests to prove the stability and durability of the barrier material against the present contamination

Treatment:

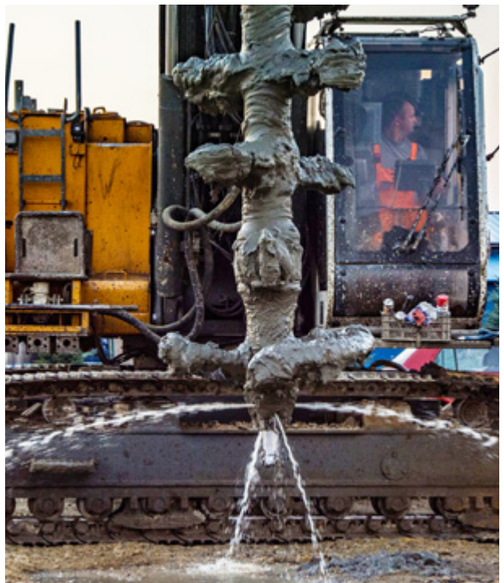
- Formation of an impermeable barrier around the contamination source and plume
- Verification of the thickness and hydraulic conductivity against the specified values

Post treatment:

- Verification of flow rates, distribution and concentration of agent inside and outside the barrier
- Continuous monitoring required as an integral part of all remediation projects

Containment via cut-off walls, deep soil mixing / mass mixing

Various geotechnical techniques can be used to install a technically impermeable barrier around a contaminant to stop the expansion of its plume, contain the contamination and its source. The barrier protects the surrounding area while the contamination is kept in place eliminating the need for its costly removal and disposal.



Case studies

2008 | Containment
Bottom seal with jet grouting and soil-bentonite cut-off wall at former gas plant – Salem, USA

2009 | Immobilisation
Municipal waste landfill – O69 (Räumung) Landfill Freistadt, Austria

2013 | Containment
Cut-off wall around landfill – Caloundra, Australia

2013 | Immobilisation
Deep soil mixing at former gas factory – Albury, Australia

2018 | Chemical treatment
Chlorinated hydrocarbons (PCE) under a former laundry – ST25 Putzerei Plachy, Ritterstraße, Graz, Austria

2018 | Excavation
Cased bored piles for mineral oil spill – MKW Vogelweiderstraße, Wels, Austria

Keller Group Plc

Geotechnical specialist contractor
www.keller.com

1000-20E_20