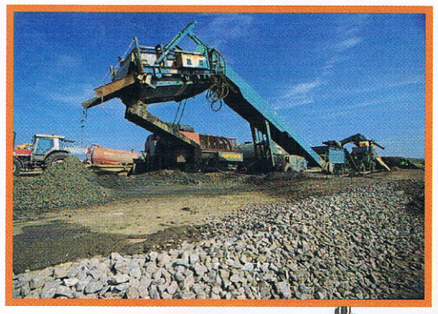
operation

CLEAN-UP

Environmental historian Raymond Smith takes a look at new ideas in contaminated land treatment.



At the end of the 20th century an increasing awareness of environmental damage and the demand for land of an increasing population has encouraged the clean up of contaminated land.

Back in the 1950s the occasional remediation might be no more than a pump-and-dump approach to groundwater contamination.

Since then dig-and-dump has become standard practice and is still widely used – and widely criticised. But new alternatives continue to be developed, and these are often intended to be quicker and cheaper, as well as more environmentally sustainable.

Bio-slurry reactors can be seen as adaptations of the activated sludge process used in sewage disposal since the early 20th century.

Advantica (formerly BG Technology) has demonstrated that bio-slurry reactors can be used at a commercial field scale to break down polycyclic aromatic hydrocarbons, as encountered at gasworks. They found reactors to be more effective and faster than land-farming.

A typical gas-works soil could be brought down to Inter-departmental Committee on the Redevelopment of Contaminated Land (ICRCL) standards for buildings (but not domestic use) in about 12 days, working with 45t batches of slurry. However, the presence of toxic heavy metals does inhibit the action.

Compared to land-farming it is more effective with the larger and more toxic coal-tar molecules.

By contrast Response Environmental Services is aiming to engineer conventional land-farming with consistent nutrient and air supplies and even temperature, so the 'biopiles' work as bio-reactors, potentially reducing treatment time by 70% compared to land-farming.

The use of cut-off walls to prevent the migration of contaminated plumes through groundwater became established during the 1990s, although the grouting techniques often used can be traced back to dam engineering in the 1870s.

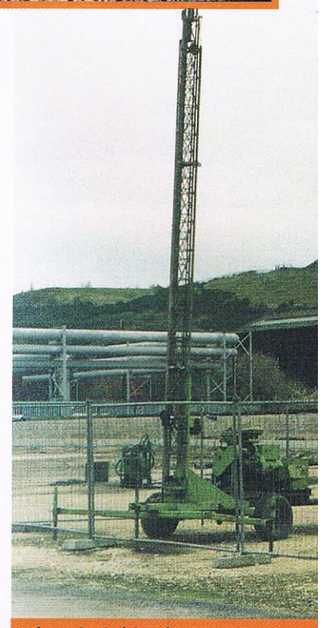
These walls however, require the continual expense of pumping and treating the groundwater confined behind them. Permeable reactive barriers are an alternative that removes this cost.

These barriers allow groundwater to pass through on its natural route, but should clean out contaminants. Permeable reactive barriers can be included within existing cut-off walls to form 'funnel and gate' systems. Some barriers have been constructed, but more work is needed to investigate their long-term reliability over their anticipated 10-to-20-year lifespan. The European Union is funding research on reactive barriers.

Within the barriers, metallic iron can remove halogens from many organic compounds. Iron salts on the other hand are one of several reactants that can break down aromatic compounds by oxidation.

Oxidation has its risks however, for example remobilising heavy metals into groundwater. Where heavy metals are already a problem, some can be immobilised as phosphates. They can also be absorbed into zeolite minerals. Zeolites can also be adapted to remove some hydrocarbons. Non-chlorinated organics can be absorbed by any carbon-rich substance, but especially by activated carbon.

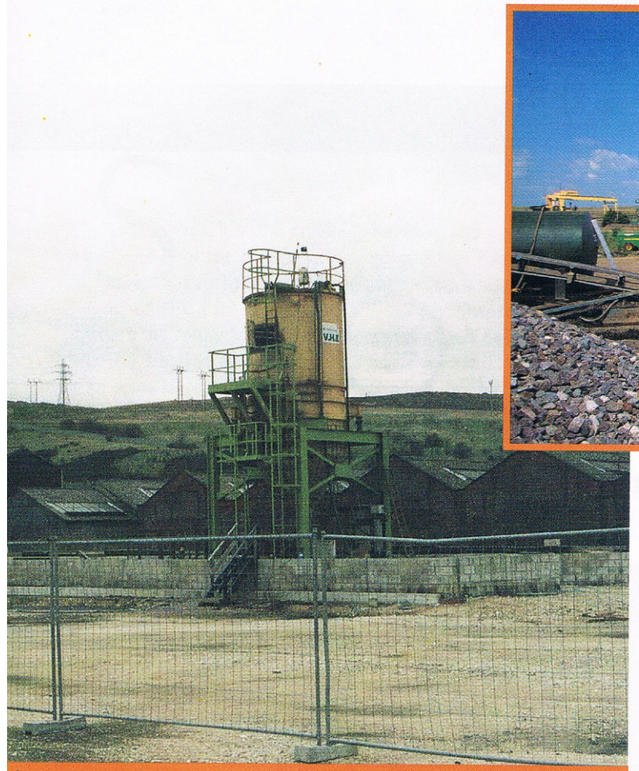
Pressure injection of reagents may be an attractive option on some sites, although care is needed to ensure the integrity of the barrier and avoid leakage. Bio-barriers grown from injected bacteria may provide a relatively inexpensive way to treat, divert or contain organic contaminants. It may prove possible to adapt established jet-cutting procedures for the installation of slurry walls to create permeable barriers.



Advantica's bio-slurry reactor on si be used on small sites.

CL:AIRE (Contaminated Land: Applications in Real Environments) is a charity intended to encourage cost-effective investigation and clean up of contaminated land. It has more than 20 sites available for field scale experiments, and technical reports are expected within the next few weeks on its first two projects. One investigated low-temperature thermal desorption, using a 40t sample of hydrocarbon contaminated soil.

Soil washing is a well established procedure in the mining industry, which is now being increasingly used for cleaning contaminated soil, although it was seen as highly innovative only a few years ago.



former gasworks. It's mobility and small footprint means it can easily



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CL:AIRE's second report is a retrospective one, on the first large-scale (200,000t) use of soil washing in the UK, at Basford Gasworks, in 1998. A new stage has been introduced into soil washing by Shanks, in association with Pronatur, using a cleaning agent derived from orange skins – a source of general cleaning agents that the bio-technology industry has enthused about for years.

Some researchers advocate the use of phosphate to immobilise heavy metals in the soil and so reduce their bio-availability and toxicity. There are long-term risks however, that changing soil conditions could remobilise the metals. It would need a change in regulatory thinking from assessing the total content of a metal in a soil, to considering its accessibility. There are also potential dangers of the excess phosphate giving rise to eutrophication of adjacent controlled waters. Phosphate could be used however, as a belt and braces measure when the most heavily-contaminated portions are segregated and encapsulated on site.

Attempts to solve one problem potentially leading to another are not confined to phosphate treatments. US researchers are considering the genetic modification of bacteria that decompose organics, with genetic material from other bacteria which are resistant to heavy metals. There may, however, be regulatory opposition, or subsequent market resistance to sites that have been exposed to GM organisms.

The chancellor has now confirmed tax relief for the clean up of contaminated land, but it remains to be seen whether this encourages the application of innovative and better treatment processes. ■