SOURCE TREATMENT FOR DENSE NON-AQUEOUS PHASE LIQUIDS

Dense Non-Aqueous Phase Liquids (DNAPLs) represent a significant source of groundwater pollution in the UK. In a review of pollution of groundwater published in 1996, the Agency identified chlorinated solvents to be one of the top three reported contaminants. Current experience in the US suggests that NAPL treatment is the next key challenge for remediation technologies. While natural attenuation is being applied to the remediation of the dissolved groundwater plume, a combined approach with source treatment is commonly viewed to be the more appropriate long-term solution where NAPL's are present.

New regulatory duties to protect soil and groundwater were implemented in 2000. This systematic approach to the identification of contaminated sites is likely to further our understanding of the extent of groundwater that has been or may potentially be contaminated by a DNAPL source. The Agency wishes to ensure that appropriate and cost-effective remediation technologies are available for dealing such contamination and groundwater pollution. This review will enable the Agency to influence the wider community in the use of appropriate remediation technologies, and also identify key challenges that need addressing, and so target resources for relevant R&D effectively.

This project reviews the range and effectiveness of existing and new approaches to source treatment of DNAPLs. Specifically the report covers:

- A review of current and novel approaches to identification and treatment of DNAPL sources below the water table in the US and Europe, and its efficacy;
- An assessment of the relevance of existing international experience and research to application of these technologies to the UK;
- Recommendations for future UK research and development requirements to further appropriate remediation technologies.

The report will primarily be used by technical Agency staff who are in a position to direct further in-house research and development in this subject, and also influence the wider community in dealing with groundwater remediation.

The approach to the project involved gathering relevant information from significant researchers in the field, in particular key players in North America and Europe, and a comprehensive literature search. The review covered the philosophical, regulatory, scientific and technical issues with respect to each source zone treatment identified.

In addition to a critical assessment of the remedial techniques, the review also covered the following:

- classes and properties of DNAPL likely to be encountered;
- the relevance of these properties to source treatment technologies;
- the nature of the UK aquifers with respect to the features that affect the applicability of any remediation technique and;
- the nature of DNAPL source zones.

The project categorised the technologies available or being developed by the way they tackle the DNAPL remediation:

- Migration control (e.g. pump & treat; barriers);

- Mass removal (e.g. Water, surfactant and alcohol floods; thermal wells; air sparging; steam flushing, excavation);
- In situ mass destruction (e.g chemical oxidation and reduction; enhanced biodegradation);
- Flux control (e.g. reactive barriers, monitored natural attenuation).

The researchers found that the most common techniques used in the UK are excavation, pump and treat, and containment barriers. In contrast, in North America, driven by strong liability laws and consequently large research budgets, techniques have been developed to destroy DNAPL rather than move or contain it.

The aquifer environment in the UK - typically deep and often dual porosity - and the regulatory constraints of the Waste Management Licensing regime, the requirements of the Groundwater Regulations 1998 and Water Resources Act 1991, were identified as factors which would affect the successful application of source zone DNAPL treatment in the UK.

Recommendations for future research and development have been listed for remedial techniques based on surfactants, alcohols, thermal wells, chemical oxidants, enhanced bioremediation, reactive barriers and reductive dechlorination. Further development in the characterisation of source zones for predicting mass distribution is also proposed.

This R&D Technical Summary relates to information from R&D Project P5-051 reported in detail in the following output:-

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