NICOLE-CLARINET Workshop on Natural Attenuation

Copenhagen, 9 June 1999

Workshop Summary

Introduction and aims

Natural Attenuation (NA) of contaminants in groundwater has been the subject of much research and many field studies over the last 10 years. It is now increasingly recognised as a common phenomenon, particularly for hydrocarbons, but also for other contaminants such as chlorinated solvents.

The workshop was designed to provide technical information on the latest research and knowledge on NA, supported by case studies of European sites where this technology has been successfully utilised. The aims of the workshop were to:

- Provide timely and accurate information on the state-of-the-art of monitored natural attenuation for ground water remediation illustrated with European case-histories
- Introduce some of the techniques used in evaluating, demonstrating, and documenting natural attenuation, including available guidance documents and protocols
- Provide a forum for discussion and information exchange

What is natural attenuation?

Natural attenuation is the combination of naturally occurring processes that act without the need for human intervention or enhancement, and result in reduced risks posed by contamination in soil and groundwater. A good working definition is that of the US Environmental Protection Agency (EPA) Office of Solid Waste and Emergency Response:

> "*The 'natural attenuation processes' that are at work in such a remediation approach include a variety of physical, chemical, or biological processes that, under favorable conditions, act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in soil or groundwater. These in-situ processes include biodegradation; dispersion; dilution; sorption; volatilization; and chemical or biological stabilization, transformation, or destruction of contaminants*."

Natural attenuation is not a "do-nothing" approach. Rather, it is based on careful and extensive initial validation and appropriate follow-up monitoring designed to demonstrate that natural attenuation is occurring and that it will remain protective of both human health and the environment. Hence the term "monitored natural attenuation" is often used.

When can NA be applicable?

NA is an appropriate remedial option when risk-based site management is employed, and risk assessment demonstrates that NA is protective of human health and the environment. This requires that NA is evaluated, implemented and monitored with at least the same rigour applied for other remedial technology. It is clear that appropriate monitoring is required to ensure that the performance of NA remains acceptable for the duration of the remedial process.

The potential for NA should generally be evaluated at any site because it may offer a less intrusive, efficient approach to protection of human health and the environment. It can be cost-effective, may result in less environmental impact than active remediation technologies, may be less disruptive to site operations than other remediation technologies, and can enable a fuller understanding of contaminant fate and transport in the subsurface relevant to any type of remedial measure.

There are cases where natural attenuation is the only remedial process necessary; however, there will also be circumstances where natural attenuation will be applied as part of a combined treatment train. This combination may be either in time (e.g., to treat residual contamination after more active remediation techniques have been used), or space (e.g., to treat different parts of the same site). There will also be sites where NA is not applicable.

Understanding when NA is and is not appropriate, evaluating that it is taking place on a site, and appreciating the work necessary to implement this approach are all issues which are closely linked with the efforts of NICOLE and CLARINET.

What contaminants may be amenable to natural attenuation?

NA has been most widely studied and documented for petroleum hydrocarbons, particularly BTEX (benzene, toluene, ethylbenzene and xylenes). NA of chlorinated solvents, particularly chlorinated ethenes, has also been widely studied. Other contaminants have been less thoroughly studied, although a large range can be amenable to remediation by NA. Examples include phenols, haloaromatic compounds, and pesticides.

To date, most cases reported relate to NA in ground water, although there is increasing recognition that NA can also be important as a remedial technique for vadose zone (unsaturated soil).

Scope of presentations

The main intention of the workshop presentations was to describe the basis of monitored natural attenuation, particularly of hydrocarbons and chlorinated ethenes, and how this knowledge has been applied in practice with particular reference to case studies in Europe.

Available guidance documents and protocols, and the data necessary to support them for site evaluation and NA application, were also reviewed.

An additional presentation provided the perspective of one representative regulator (Environment Agency (England & Wales)). This gave a UK view of NA, its potential role and its limitations.

Key conclusions/issues from the workshop

The following key conclusions and discussion points arose during the workshop:

- There is significant variability in legislation and how NA is viewed. This is true both between countries and, in some cases, within different parts of the same country.
- There was debate over whether groundwater should be considered a pathway/resource, or a receptor. In the classic risk assessment sense, groundwater, while potentially a very valuable resource, is considered a pathway. However, there is no consensus here, and national legislation differs. In some cases the legislation is prescriptive, in others it may take a case-by-case approach.
- NA fits closely with risk assessment of contaminated sites.
- Much can be learned from experience outside of Europe, and there is no need to repeat applicable research when it already exists. It was not a goal of the workshop to identify specific research needs, but information on specific European hydrogeological systems and European case studies were noted as desirable.
- The need to combine source removal with natural attenuation was questioned. So far, there are only few cases reported that could help in this type of evaluation.
- Regulators and owners representatives need a level of technical understanding to interpret NA cases. Questions on how to achieve the required level of education and the need for European guidance/technical manuals and tools in this area were discussed.
- NA needs quality data, careful interpretation, and appropriate monitoring, often long-term. Challenges include cost-effectively achieving these goals and verifying quality.
- How to manage the potential time-scale and liability issues implicit in many NA cases is an unanswered question for the various stakeholders. The ability of institutional controls to be guaranteed over these time-scales must be determined.
- Pan-European collaboration involving all stakeholders is necessary to advance understanding and share experience with NA.

These points provide a useful framework for further consideration and discussion.

• Workshop Contents and Outputs

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