NICOLE 2000

Network for Industrially Contaminated Land in Europe

February 2000

NICOLE grows up

Paolo Cortesi, Chairman of NICOLE

After 3 years of the DGXII support, NICOLE has shown that it can be self-sufficient. Last year was a transition year, the first in which NICOLE had neither the financial support nor the guidelines of the contract with DGXII. It was our challenge to continue. The shadow Steering Group, under the leadership of the chairman designate, Cees Buijs, with the support of all industry members, took up the challenge with great enthusiasm and a clear vision of what NICOLE should become.

The three main objectives for the new phase of NICOLE are to:

- operate as a self-funded network
- enhance information exchange activities
- increase effectiveness in promoting collaborative ventures.

NICOLE, together with its "sister" network CLARINET, seek to promote a better basis for contaminated land management, based on sound eco-efficient and cost-effective principles of risk based site management. Last spring, I took over the role of NICOLE chairman, as a part of the renewed commitment to NICOLE of ENI Group. The new structure for the management of the network was already established.

All the initiatives planned for 1999 were successfully realised and, very importantly, within the agreed budget.
In 1999 the NICOLE community:

- strengthened its relationship with CLARINET. (The joint workshop on Monitored Natural Attenuation, held June 1999 in Copenhagen, is a good example of this)
- put major effort into supporting the first call of the Fifth Framework Programme, having already advised on its technical content where it related to contaminated land. (Several projects were submitted with a good rate of success, showing the positive influence of NICOLE in promoting effective R & D co-operation)
- held two technical workshops including the *VEGAS*/NICOLE joint workshop on *in situ* technologies and the role of networks on improving the management of contaminated land. (Heartfelt thanks go to Hans-Peter Koschitzky for organising this event which provided a real opportunity to promote NICOLE in Germany)
- upgraded the NICOLE web site, for better communication both within the network, and between the network and the outside world.

Today NICOLE has a sound financial situation that, if membership renewals are confirmed, will allow a very interesting programme in 2000 (*see pages 3 and 12)*.

Join us

I invite all the readers of this newsletter who are not already members of NICOLE to consider the advantages of membership.
The fee is still 3,500 EURO for companies and 150 EURO for academics, with various incentives for SMEs and members who bring new members.
It is really very little for an organisation that has already done such a lot, and can do a lot more, on behalf of Industry and all citizens for a better society.

Paolo Cortesi

I believe that all members of the Steering Group,
Patricia de Bruycker, Solvay, Belgium
Cees Buijs, HBG, The Netherlands
William Hafker, ExxonMobil, UK
Harald Kasamas, CLARINET
Hans-Peter Koschitzky, University of Stuttgart/*VEGAS,* Germany
Joop Okx, Tauw, The Netherlands
have done a great job in order to make the continuation of NICOLE possible. NICOLE has compensated for the financial restriction resulting from the end of the DGXII contract with additional personal effort and a lot of enthusiasm (remarkably delivered free of charge). I would also like to thank Marjan Euser and Johan van Veen for their intelligent and valuable secretariat activity and Paul Bardos and his colleagues for their work on the web site, meeting reports and newsletter.

Also in this issue

Contents	Page

NICOLE membership

Marjan Euser and Johan van Veen

In 1999 NICOLE had a total of 109 members. This membership can be divided into the following subgroups:

a) industry - 24
b) technology developers/service providing companies/consultants - 8
c) academic sector/research community - 60
d) other categories (research planners, funding organisations, colleague networks) - 17

Compared to the year 1998, there has been a decline in membership of the academic sector. This probably can be attributed to the fact that from 1999 onwards academics have had to pay a registration fee. This was not the case for the period 1996-1999. However, the number of members from service providers has doubled compared to 1998.
The overall conclusion is that NICOLE has a stable membership over the years.

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Note: Throughout this newsletter the sign [www] indicates that more information about the item is available on the NICOLE web site.

1999 accomplishments at a glance

Marjan Euser and Johan van Veen, NICOLE Secretariat

In 1999 the following activities were completed by NICOLE:

Date	Event
• 2 February 1999	Meeting of the Industry Subgroup, hosted by Ford Motor Company, Cologne, Germany
• 20-21 May 1999	NICOLE network meeting “Industrial land contaminated by heavy metals”, co-organised with Labein, Bilbao, Spain (*see page 7)*
• 7 June 1999	Joint NICOLE Industry Subgroup meeting with PERF, at ELF, Lyon, France
• 8 June 1999	Meeting of the Industry Subgroup, hosted by ELF, Lyon, France
• 9 June 1999	Workshop on “Monitored natural attenuation”, Copenhagen, Denmark *(see page 8)*
• 30 September 1999	*VEGAS*/NICOLE network meeting “The role of networks, R & D and technology transfer towards an eco-efficient/cost-effective management of contaminated land”, Stuttgart, Germany (*see page 6)*
• 1 October 1999	Meeting of the Industry Subgroup, hosted by *VEGAS*, Stuttgart, Germany

NICOLE delegates attended the meetings of the CLARINET network. In addition the NICOLE Steering Group met 4 times in 1999. The information exchange within the network has been improved by the use of an advanced web site and by the e-mailing service of the NICOLE Secretariat.

NICOLE's plans for 2000

In 2000 two general network meetings are planned along with a joint meeting with CLARINET. The dates are:

- **22-23 May 2000 "Source management", Helsinki, Finland**
- **9-10 November 2000 "Brownfields", The Netherlands**

In addition a joint session of CLARINET and NICOLE will take place at the ConSoil conference in Leipzig (half a day in the week of 18-22 September 2000). Three meetings of the NICOLE Industry Subgroup are scheduled: one on 17-18 February at VHE in London, UK, one on 24 May in Helsinki and one in Autumn. Apart from the Industry Subgroup, a second subgroup is being developed for the service providers/technology developers and consultants within NICOLE. This group will have its first meeting in Spring 2000. The coming year is likely to see increasing information exchange *via* the web site and e-mail as a natural consequence of the electronic developments in society.

NICOLE projects [www]

In September 1997 at the NICOLE "Topic Development Meeting", a number of projects were initiated (*NICOLE News V2 N2 p6* **[www]**). The international nature of these projects is one of the many positive outcomes of NICOLE's activities. On-going and completed projects are listed below. Some of these are described in more detail later *(see page 4).*

	Project	Leader	Funding participants
Completed	**Natural Attenuation: Guidelines for Acceptance** (completed)	A. Sinke (TNO)	BP-Amoco, Elf Aquitaine, Ford Werke AG, ICI, Fortum Oy Port of Rotterdam, Powergen, Solvay, Shell
Completed	**Risk Communication** (completed)	A. Weenk (TNO)	Shell, Dow, Solvay
Completed	**Model for Comparing/Optimising Remediation Technologies** (completed)	J. P. Okx (TAUW)	Solvay, ICI Chemicals and Polymers, Port of Rotterdam, BNFL, Ford, Welsh Development Agency, UK Environment Agency, NOBIS
Completed	**Bioavailability of Lead and Mercury in Contaminated Soils and Sediments** (completed)	B. J. Alloway (University of Reading)	ICI, Solvay
On-going	**Rapid Site Assessment for Petroleum Contaminated Sites**	W. R. Hafker (ExxonMobil)	Akzo Nobel, Port of Rotterdam, GeoDelft, BP-Amoco
On-going	**Exposure Assessment Tools for use in Risk Based Decision Making at Contaminated Sites**	W. R. Hafker (ExxonMobil)	Exxon, Shell, ICI
On-going	**Good Survey Practice**	J. P. Okx (TAUW)	Akzo Nobel, Solvay, BNFL, Port of Rotterdam,
On-going	**Beneficial Applications** (continuing under the aegis of 'exSite')	D. N. Edwards (VHE)	BG plc, Barclays Bank plc, VHE Holdings plc, Corus plc, Shanks Waste Solutions Ltd, Shell Global Solutions Ltd, Welsh Development Agency, UK DETR, UK Environment Agency, UK Transport Research Laboratory, Parkman Environment Ltd

Rapid site assessment for petroleum contaminated sites

The objective of the joint PERF/NICOLE project, Rapid Site Assessment for Petroleum Contaminated Sites, is to evaluate, develop, apply and transfer technology and information that will assist cost-effective characterisation of petroleum contaminated sites. Contributions to the project consist primarily of site assessment research conducted by the US participants and a field study conducted by the NICOLE group. At this time, Unocal, Exxon and Phillips have signed the participation agreement and several others have indicated that they are ready to sign. The project was originally scheduled to terminate at the end of 1999, however, it has been extended to June 2000 to allow additional time for other participating companies to sign up.

A field study for evaluating the geoprobe/Membrane Interface Probe (MIP) tool has begun in the Netherlands.

A novel approach of coupling the probe with a mass spectrometer(MS) system to obtain identification and quantification of volatile contaminants was also tested. Specific points for improvement were identified and passed back to the probe designer in the UK who is now upgrading the tool.

This study is managed and funded by three companies participating in NICOLE (Akzo Nobel, the Port of Rotterdam, and GeoDelft). BP is involved as a PERF member. The final consortium member is the probe designer Subadra. If additional funds are available, the group hopes to conduct an additional field study at a site in the UK. It is expected that these will commence at the end of March 2000.

For further information about this project please contact:

Andy Woerner, ExxonMobil Research & Engineering
E-mail: acwoern@erenj.com

Exposure assessment tools for use in risk based decision making [www]

A European exposure factors sourcebook

Risk assessment is an integral component of the overall risk based decision making process. It uses considerations of exposure, hazard, and dose-response. Exposure factors are the variables used to describe the human contact portion of the calculation. These include variables related to human activities (e.g. time indoors *versus* outdoors, weekly hours at work) and physiological parameters (e.g. inhalation rates, body weight, skin surface area). Appropriate values to use for exposure factors will vary, depending upon cultural and geographic factors that influence behaviour. Existing handbooks for exposure factors (USEPA Exposure Factors Handbook; American Industrial Health Council Exposure Factors Sourcebook) focus on US data. Three member companies of NICOLE are sponsoring the development of a user friendly sourcebook of European exposure factors.

This document will include information for a number of European countries, with primary emphasis placed upon the UK.

For each exposure factor, a point value representative of a population average or median is provided. For exposure factors with sufficient data, appropriate data distributions are also provided for use in probabilistic exposure assessments. The information to be provided in this document could be used to develop more realistic estimates of exposure than those calculated using single point values based upon extreme exposure scenarios. The resulting exposure estimates could form the basis for better informed risk management decisions.

The draft document is currently undergoing external review. The final document is expected to be available in early 2000.

For additional information, please contact:

Rose Zaleski, Exxon Biomedical Sciences
E-mail: rtzales@erenj.com

Beneficial applications

exSite Research, a field demonstration programme inspired by NICOLE members in 1998, is currently consulting with industry and other stakeholders on its next stage of development.

It has been suggested that exSite should integrate an *in situ* remediation demonstration programme into its activities in the near future.

exSite would welcome views of NICOLE members on this potential development. We would be particularly interested to know if there are any organisations that would foresee themselves becoming actively involved with exSite. It is anticipated that this consultation will end on 29 February 2000.

If you wish to comment, please contact:

David Edwards, exSite
E-mail: exSite@btinternet.com

NICOLE chemical barriers project 2000

Development of a proposal on chemical barriers was initiated during the NICOLE meeting at Bilbao. We have been co-ordinating this process. We have received responses from eight NICOLE members. The responses varied widely. To formulate a joint project, we suggest starting with the following European reviews:

- An inventory of large-scale industrial soil pollution with inorganic compounds (This overview should give an impression of categories of industries with typical inorganic problems)
- An inventory of bulk (waste) materials which could be used in active barriers (This overview should give an insight into the possible use of cheap materials depending on the type of pollutants).

The combination of inventories should indicate where possible solutions exist for particular problems. This analysis may be the basis of a proposal in the Fifth Framework Programme.

For more information about this project please contact:

Derk van Ree, GeoDelft Environmental Department
E-mail: ree@geodelft.nl

A new NICOLE proposal: Natural attenuation - case of metals and metalloids

Remediation of sites polluted by metals and metalloids by natural attenuation has received less attention than that for organic pollutants. Nevertheless, the important phenomenon of the sorption of metals to the solid phase of soil has opened interesting new perspectives for contaminated site management.
Inorganic species behave according to their physico-chemical properties and the characteristics of the soils in which they are present. Moreover, inorganic pollutants in soils can have multiple forms (speciation) whose physico-chemical properties are very different. This large range of properties affects the behaviour of metals in soil.
The aim of the project proposed here is to develop an experimental evaluation using both laboratory and field data of the principal factors in natural attenuation of metals in soils and/or sediments. The project would focus on metals which are mobile at high pH, such as: selenium, copper, arsenic, boron, chromium; and also metals mobile at low pH such as nickel, zinc and cadmium.
The programme would include:

- studies of speciation of metals in soils
- ecotoxicity measurements on earthworms, plants and bacteria
- a study of the impacts of indigenous plants and micro-organisms on the mobilisation and immobilisation of metals
- a modelling study
- comparison of laboratory and field data.

A consortium of research providers has offered a detailed proposal to industry members. Currently the consortium and partners are:
Westlakes Research Institute, UK; University of Sheffield, UK; Power Technology Centre, UK; INERIS, France;
CNRSSP, France; ETU, Poland; TAUW, NL; University of Paisley, Scotland; University of Complutense, Spain; FORTH-ICE/HT, Greece; National Technical University of Athens, Greece; IWACO, NL; LABEIN, Spain.
Two meetings are planned in April and September 2000.

If you would like either more information about this project or to participate please contact:

Pascal Barbe, CNRSSP
E-mail: barbe@cnrssp.org

New starts which have emerged from the network (1) PhytoDec

"PhytoDec" aims to build a Decision Support System (DSS) to quantitatively assess the practical applicability of phytoremediation within the spectrum of remediation approaches. Both heavily polluted industrial sites and diffusely polluted areas will be included in the assessment.

The project will start by addressing the most important process-related knowledge gaps affecting the practical applicability of phytoremediation. These include:

- long term cost/benefit relationships;
- the importance of environmental side-effects;
- effective monitoring of phyto-stabilisation effects;
- prediction of phyto-extraction duration, based on soil chemical and plant physiological processes.

During the development of the DSS extensive attention will be given to its validation and algorithms. Algorithms will be related to mesocosm experiments and field trials. Involvement of end-users will start early in the project, making use of all partners' scientific, political and potential end-user networks, including NICOLE. At the end of the project a workshop will be organised, to present the DSS to a representative and influential group of end-users at a European level.
End-users might include:

- policy makers and local governments
- owners of polluted sites, both industrial companies and governments
- commercial companies involved in soil remediation and soil management.

The consortium members, all members of NICOLE, are:

- Alterra (former SC-DLO, AB-DLO) - co-ordinator Wageningen, the Netherlands
- CNRSSP, Douai, France
- ICT-CNR, Pisa, Italy
- LABEIN, Bilbao, Spain
- GAIKER, Bilbao, Spain
- CEA, Cadarache, France
- IETU, Katowice, Poland

If you would like more information about this project please contact:

Jan Japenga, Alterra, NL
E-mail: j.japenga@ab.dlo.nl

(2) Biodegradation of chloroaliphatic and chloroaromatic compounds

In the Fifth Framework Programme, a project has been initiated focussing on the molecular characterisation of biodegradation of chloroaliphatic and chloroaromatic compounds. Many of these components are fairly persistent in the environment but can biodegrade, given suitable conditions. The aim of the project is to develop methods for the specific detection and enumeration of bacteria performing these biodegradation activities. Laboratory methods will be transformed to standardised, easy-to-use methods that ultimately will become available as kits (PCR-methods) or DNA chips (DNA-DNA hybridisation methods).
The tools developed are intended as biosensors
a) to predict if a contaminated site is susceptible for bioremediation, and
b) to assess by which *in situ* and on-site remediation technologies contaminants may be removed.
Several partners in the NICOLE network will contribute to the project with samples from contaminated sites. The research consortium, consisting of several European universities and companies, will start its activities early 2000.

For more information, please contact:

Jaap van der Waarde, Bioclear, NL
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NICOLE/*VEGAS* workshop

20 September 1999 [www]

Over 120 participants attended the workshop, whose objectives were to: review the role of networks, R & D, and technology transfer in establishing eco-efficient and cost-effective management of contaminated land. Welcome speeches were made by Helmut Kobus, Director of the Institut für Wasserbau, University Stuttgart; and Stefan Gloger, Ministry of Environment and for Transport, State of Baden-Württemberg. Paolo Cortesi, Chairman of NICOLE, then opened the workshop. Dr Jürgen Büsing, CEC, DGXII, reported that a high proportion of the proposals related to contaminated land submitted to the Fifth Framework Programme have progressed to the contract negotiation stage. Dr Baldur Barczewski gave a detailed review of *VEGAS.* The technical content of the workshop was as follows. More information is available on the NICOLE web site.

General themes discussed were:

- Contaminated land - problems and the development of solutions
  Andreas Bieber, Germany
- Contaminated land problems - a policy perspective
  Joop Vegter, The Netherlands
- General management view of partly contaminated properties from Deutsche Bahn AG
  Jens-Uwe Fisher, Rolf Gerhardt, Germany
- Elements and processes of cost-effective management and design for the remediation of contaminated land
  Harald Burmeier, Germany
- Source *versus* plume remediation
  Georg Teutsch and Peter Grathwohl, Germany

Two NICOLE projects were described:

- exSite Research - adding confidence to innovation
  David Edwards, UK
- Monitored natural attenuation
  Anja Sinke, The Netherlands

Finally information on a number of emerging techniques was presented:

- Large scale experiment on LNAPL and DNAPL behaviour and mass transfer in the groundwater
  Gerhard Schafer, Paul Muntzer, Germany
- Surfactant enhanced hydraulic subsurface remediation
  Reinhold Josef, Germany
- Microemulsions: application for *in situ* soil remediation
  Günter Subklev, Germany
- Remediation of DNAPL contamination in the saturated zone by alcohol flooding
  Cor Hofstee, Germany
- Consideration of enhanced PAH-degradation in bioreactive barriers
  Peter Werner, Germany
- Steam enhanced soil vapour extraction: technology and field application
  Hans-Peter Koschitzky, Germany
- Brownfield redevelopment: new interdisciplinary challenges
  Christian Juckenack, Germany

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CLARINET update

Harald Kasamas

CLARINET – the Contaminated Land Rehabilitation Network for Environmental Technologies – has now reached its half-way stage. Substantial progress has been achieved in the project during the past 18-months. Comprehensive surveys of contaminated land legislation have been carried out for 16 European countries. State-of-the-art reports analysing strategic and technical aspects on topics such as Brownfield Redevelopment, Groundwater Protection and Rehabilitation, Decision Support Systems, and Remediation Technologies in Europe are currently being drafted.

Based on these reports CLARINET will investigate integrated concepts for improved solutions and identify further R & D needs. In order to investigate the opportunities for such international R & D collaboration, a strategic analysis of current EU and national R & D Programmes relevant to contaminated land is underway. Multidisciplinary R & D initiatives will be co-ordinated with EU and national R & D Programmes. In the forthcoming project phase, CLARINET will analyse the results achieved in the individual working groups by taking the different conceptual considerations in Europe into account.

Fruitful collaboration has been established with NICOLE. Joint workshops have increased the exchange of information and discussion between the various stakeholders involved in contaminated land management. Joint R & D initiatives are being prepared for the Fifth Framework Programme of the European Commission. Both networks co-operate in distributing information on contaminated land through publications and their web sites.

The CLARINET web site is at *http://www.clarinet.at.* This web site aims to be a major information source on contaminated land issues. It includes information on policy approaches and R & D programmes in different countries, and information about on-going international networks and initiatives, available methods and technologies. It also includes a comprehensive link collection to relevant web sites and recently published key-papers can be downloaded from the “library” section.

If you want to receive regular information about recent updates of this web site, please send a note to:

Irene Montag, Austrian Environment Agency
E-mail: montag@ubavie.gv.at

Industrial land contaminated by heavy metals [www]

The objectives of the NICOLE meeting held in Bilbao, 20-21 May 1999, were to review the problem of industrial land contamination by heavy metals; to progress and research findings to date; identify further research needs and to develop new project proposals to address these needs. Over 50 members from 14 different countries attended the meeting.

The venue was apt because the Basque country has many metal contaminated sites. 3,830 have been identified. The country's mountainous geography means that only a small proportion of its total area is suitable for development. Therefore re-use of former industrial sites is particularly important.

In his opening address Paolo Cortesi, Chairman of NICOLE, summarised the main technical and scientific issues for land contamination by metals. He argued that industry must use its resources cost-effectively. He concluded that only a site-specific risk based approach can ensure an optimal balance between environmental benefit and the efficient use of financial resources.

The first day of the meeting included papers on human risk assessment, characterisation, and remediation.

Human risk assessment

- Analysing risk for human health and ecosystem function in metal contaminated soil
  Arantzazu Urzelai, Spain
- (Bio)availability of metals
  Chris Zevenbergen NL

The first paper proposed a step by step strategy for risk assessment. In this exposure risk assessment is made only after the receptors at risk have been defined and a hazard analysis carried out, based on the bioavailability of heavy metals in the soil matrix. The second paper reviewed the various factors that govern bioavailability of heavy metals in soils/sediments. It suggested that bioavailability of heavy metals in soils/sediments should be expressed in terms of their pore water concentration, because of the higher toxicity and mobility of free metals ions present in pore water.

Characterisation

- The behaviour of heavy metals in contaminated soils
  Brian Alloway, UK
- A geostatistical study of a site in France
  Chantal de Fouquet, France
- Speciation *Ramses van Rijssen, Belgium*
- A geostatistical study of a site in France
  Chantal de Fouquet, France
- Industrial land contamination: a general overview of contamination by heavy metals in the Basque autonomous community
  Ana I. Alzola Echazarra, Bilbao

These papers emphasised the complexity of heavy metal behaviour in soil. Mobility and bioavailability of heavy metal contaminants can be affected by the properties of the contaminant, the soil or the matrix, on a site-specific basis. It is possible to change the mobility and bioavailability of heavy metals by adjusting, for example, soil pH, redox, or sorptive capacity.

Speciation studies can help understanding of the behaviour of heavy metals in soil but are too expensive to be useful as a general tool. It is also difficult to compare data from different speciation tests. There is a need not only for harmonisation of sampling, and sample preparation but also of analytical procedures.

Remediation

- Design and Installation of geochemical barriers
  Derk van Ree, The Netherlands
- Remediation of heavy metals contaminated soils by sulphate reducing bacteria
  Paolo Carrera, Italy
- Contaminated soil remediation/contaminated soil containment using electro-kinetic methods. Laboratory and pilot experiences
  Alberto Bonilla, Spain
- *In situ* treatment *Joop Okx, The Netherlands*
- Treatability studies on solvent extraction technologies in contaminated soils with organic wastes and heavy metals
  Inaki Susaeta, Spain

A number of remediation techniques were discussed. Some techniques able to deal with metals, such as passive barriers, are well-established. Others, such as the use of sulphate reducing bacteria to transform heavy metals to less soluble/toxic forms and electro-kinetic methods, may require further testing to confirm their applicability at full scale.

There are few *in situ* treatments for the remediation of heavy metals. Some *ex situ* treatments such as bioleaching may be feasible as *in situ* techniques, but may need to be proven by further pilot scale trials. A two phase solvent extraction process for the co-extraction of heavy metals and HCH from soil was described in the final paper in this section.

Three short presentations were made by new members of NICOLE.

- Immobilisation of heavy metals in soil and the measurement of bioavailability decrease
  Ludo Diels, Belgium
- Introduction of current research interests at the University of Hertfordshire
  Corinne Allimann-Lecourt, UK
- Hydrometallurgical purification of soil polluted with heavy metals and characterisation of metal binding forms
  W. Calmano, Germany

Future needs [www]

During the second day, projects and proposals for future activities were developed in "workshop" sessions. Nine new project areas were identified and a contact person nominated for each. Further details of these future activities are on the NICOLE web site.

Workshop on natural attenuation [www]

Phil Morgan, Eutech, UK

In June 1999 the Danish EPA hosted a joint NICOLE/CLARINET workshop on the subject of natural attenuation. 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
- to introduce some of the techniques used in evaluating, demonstrating, and documenting natural attenuation, including available guidance documents and protocols
- to provide a forum for discussion and information exchange.

When can natural attenuation be applicable? Natural attenuation is an appropriate remedial option when risk-based site management is employed, and the risk assessment demonstrates that natural attenuation is protective of human health and the environment. Natural attenuation must be evaluated, implemented and monitored with the same rigour as that applied to other remedial technologies.

The potential for natural attenuation 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, and may result in less environmental impact than active remediation technologies. It may be less disruptive to site operations than other remediation technologies, and can enable greater understanding of contaminant fate and transport in the subsurface relevant to any type of remedial measure.

Natural attenuation needs quality data, careful interpretation, and appropriate monitoring, often long-term.

In some cases natural attenuation will be 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 temporal (treating residual contamination after more active remediation techniques have been used), or spatial (treating different parts of the same site). There will also be sites where natural attenuation is not applicable.

What contaminants may be amenable to natural attenuation? Natural attenuation has been most widely studied and documented for petroleum hydrocarbons, particularly BTEX (benzene, toluene, ethylbenzene and xylenes). Natural attenuation 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 natural attenuation. Examples include phenols, haloaromatic compounds, and pesticides.

Most cases reported to date have related to natural attenuation in groundwater, although there is increasing recognition that natural attenuation can be important as a remedial technique for vadose zone (unsaturated soil).

Scope of presentations The workshop presentations described 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. Guidance documents and protocols, and the data necessary to support them for site evaluation and natural attenuation application, were reviewed. One regulatory view was given by a representative of the Environment Agency (England and Wales).

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

1) There is significant variability in legislation and how natural attenuation is viewed. This is true both between countries and, in some cases, within different parts of the same country.

2) There was debate about whether groundwater should be considered a pathway/resource or a receptor. 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.

3) Natural attenuation fits closely with risk assessment of contaminated sites.

4) 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.

5) Regulators and owners representatives need a level of technical understanding to interpret natural attenuation cases.

6) The management of the potential time-scale and liability issues implicit in many natural attenuation cases is an unanswered question for the various stakeholders. Can institutional controls be guaranteed over the time needed for natural attenuation?

7) Questions on how to achieve the required level of education and the need for European guidance and technical manuals, and tools in this area were discussed.

8) Much can be learned from experience outside Europe.

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.

Natural attenuation needs quality data, careful interpretation, and appropriate monitoring, often long-term. Challenges include achieving these goals cost-effectively and verifying quality.

Pan-European collaboration involving all stakeholders is necessary to advance understanding and share experience about natural attenuation. NICOLE and CLARINET will continue to work together to promote this.

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The new NICOLE web site at http://www.nicole.org

Paul Bardos, r³ Environmental Technology Ltd

The past couple of years has seen rapid development in web site technology, not to mention a proliferation of web services and web based information. NICOLE has maintained a web site since 1998. Over 1999 we have been developing the web site to take full advantage of these recent developments.

A web based NICOLE News Service, to replace the twice yearly *NICOLE News* magazine. has been established. This is more "sustainable" as it reduces NICOLE's use of paper. It allows more rapid transmission of news and a greater volume of information.

We have worked hard on the look of the site. The importance of this is not only to make the web site more pleasant, but also to convey a professional image of NICOLE's work to non-members who might visit us *via* the Internet. It is now easier to find information on membership, and to contact NICOLE from the web site. All publications and downloads on the web site have been converted into a secure *Adobe Acrobat* file format.

It is the members' web site and your participation is needed for it, and the news service, to thrive. Please use them. The more you use them the better they will be!

The information gateway

Some brand new facilities to the NICOLE web site have been added. Part of the web site is an information gateway. This is a range of services intended to give access to the most authoritative information on contaminated land on the Internet. These include:

- A fully searchable listing of web links by country, with outline descriptions of each web site listed
- A fully interactive **web board** where you can post your own messages to the web site, for example:
  - ◊ to promote a conference you might be organising
  - ◊ to tell NICOLE members about a new facility or service in your organisation
  - ◊ to request for research or other collaborative partners, including looking for a job or publicising a vacancy
  - ◊ a unique feature of this web board is the ability to directly post your own web link
- the NICOLE News Service
- A searchable publication list for NICOLE linked to *Adobe Acrobat* downloads of all NICOLE publications
- A training and education page offering access to NICOLE courses, including downloads and publications for some past courses
- A listing of our membership, providing web links and automatic e-mail contacts where the member concerned has agreed.

Each month the NICOLE Secretariat will e-mail you with a list of the new items in the NICOLE web site's News Service. Don't forget if you have news to tell, e-mail us so we can publish it.

Further ideas

Some further ideas we are considering are to offer a photograph gallery, "proposal development zones" and a web publication service. Are you interested? If so we need your help!

- How many times have you needed a slide for a presentation and not been able to get hold of the right one? Perhaps by sharing a few of our pictures we could set up a NICOLE photograph gallery of contaminated land management
- We have some pictures of NICOLE meetings we can put up so you can find yourself on the web (let us know if you have an objection to this!)
- The Bilbao meeting identified a number of project development areas, and NICOLE also has a Fifth Framework Programme proposal and current projects. Any co-ordinator who would like their own zone on the web site, password protected if necessary, should contact me.
- Would you like NICOLE's web site to include secure *Adobe Acrobat* downloads of any keynote papers that you have written?

On a more formal note, we have to be very careful about the legal issues surrounding the web site and news service. Please read the terms and conditions for their use. You may use the web site and news service only if you agree to these terms and conditions.

The budget for the web site is quite limited so we are restricted in what we can offer. However, if you have any suggestions or can help please contact me.
I would love to hear from you!

Paul Bardos, NICOLE web master
E-mail: paul@r3environmental.co.uk

Industry Subgroup - some highlights of 1999

Lida Schelwald-van der Kley and William Hafker (ExxonMobil)

1999's new start for NICOLE has shown the interest of industry in supporting NICOLE and its work. NICOLE no longer benefits from EC funding. Instead income has had to be found from membership. The 24 industrial members of NICOLE provide the vast majority of this income and their enthusiasm to contribute actively is greater than ever.

The Industry Subgroup (ISG) met three times in 1999. Learning from fellow industry colleagues has been one of the major benefits for those taking part. ISG members have also been able to hold open discussions on strategy with colleagues in a "safe" environment. Regular agenda items included: liaison with CLARINET; ISO's activities; progress of on-going NICOLE projects; and event planning and co-ordination.

For Industry Subgroup members

"…learning from fellow industry colleagues has been one of the major benefits…"

Time is set aside for members to present company case studies and discuss them with fellow colleagues. A joint meeting was held with the Petroleum Environmental Research Forum (PERF) in Lyon. PERF has had great success in bringing forward leveraged R & D projects. This has encouraged ISG members to play a more active role in the initiation of projects; to become project champions. Not surprisingly, several ideas for new projects were presented by the ISG members. One of these was to create a shared demonstration site database on Monitored Natural Attenuation (MNA). This idea attracted a number of companies willing to share results on planned MNA projects, and is now in the process of starting as a NICOLE project. A PERF project on ecological evaluations for upstream site remediation programs has also attracted participation by NICOLE members.

During the last year NICOLE has put a major effort into preparing two large proposals for the EC Fifth Framework Programme. Of these the PURE project has obtained EC funding. PURE investigates *in situ* protection of groundwater resources at industrially contaminated sites. NICOLE's other proposal on Brownfields, was less fortunate. One can't have it all...

Strategic discussions have become more popular during Industry Subgroup meetings. For example, the last ISG meeting's topic was "How to turn a liability - *i.e. a contaminated site* - into an asset?". Several companies described their experience with the integration of remediation *and* redevelopment activities. This topic will now go forward as a special session at one of NICOLE's full meetings in 2000.

The new millennium provides the Industry Subgroup with a renewed impetus to develop, discuss and implement innovative solutions for contaminated land management. Its first meeting in 2000 will be hosted by VHE Holdings in London on 17-18 February. This 2-day meeting will include a site visit to a full scale soil-washing contract at the Royal Arsenal site in Woolwich. Time will also be spent focusing the energies of the ISG on the most pressing issues and initiatives to advance the field of risk based industrially contaminated land management in Europe.

Lida Schelwald-van der Kley
Secretary to the NICOLE Industry Subgroup
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A new NICOLE project initiative: Risk assessment of heavy metals contamination

NICOLE's meeting in Bilbao *(see page 7)* recognised that there can be a gap between scientists and practical risk assessors. Although various, often complex, models have been developed to determine and quantify risks there is a need to harmonise risk assessment models and methods internationally. Currently no pragmatic heavy metals risk assessment approach exists that covers the needs of European Industry. We aim to provide one.

The project would be in three phases:

- Phase 1: Pre-selection of methods and models and evaluation of existing initiatives
- Phase 2: Evaluation and validation of selected models and methods
- Phase 3: Development of harmonised risk assessment principles for use throughout Europe.

The deliverables would include state-of-the-art overview of risk assessment in relation to heavy metals contamination; description of available models; a matrix of models *versus* parameters at different levels (order of confidence/detail); strengths *versus* weaknesses for the different models; an overview of new developments in risk assessment methods; comparison of selected models on contaminated reference sites in different European countries; and guidelines for a pragmatic and uniform risk assessment approach (Best Practice principles).

First reactions to the project have been favourable. If you would like to contribute to this project in any way, please contact:

A.W.A. Oosterbaan, Tebodin Consultants & Engineers
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PURE: Protection of groundwater resources at industrially contaminated sites *Anja Sinke*

A project proposal "Protection of groundwater resources at industrially contaminated sites (PURE)", formulated by NICOLE participants was favourably evaluated by the first call of Fifth Framework Programme.

PURE is aimed at preventing contamination of groundwater from industrial sites by priority pollutants such as recalcitrant chloro-organics, BTEX and heavy metals providing innovative, comprehensive, widely applicable approaches.
The PURE objectives can be summarised as follows:

- to develop a set of tools: based mainly on biosensors, fuzzy logic and modelling to reduce the costs of sampling/characterisation of sites, both in the source area and in the plume
- to develop a risk-assessment methodology based on evaluation of cost and benefits, to optimise selection of remedial actions
- to develop remediation techniques for saturated and unsaturated zones contaminated by recalcitrant chloro-organics, BTEX or mixtures of these
- to develop an on site/*in situ* anaerobic/aerobic process for the degradation of recalcitrant chloro-organics (chlorobenzenes and DDT) and the immobilisation of heavy metals (Hg and As) in the soil, and a treatment to co-remediate chloro-organics and BTEX
- to develop an *in situ* microbial co-metabolic technology to remediate chloro-organics in the plume.

The innovative results obtained will be of wide applicability being validated on four different sites.
PURE includes two specific sub-projects:

- SICHAMORE, developing cost-saving solutions for site characterisation and monitoring of remedial actions, using biosensors, advanced modelling and fuzzy logic; risk assessment methodologies will also be developed
- TREES, developing preferably *in situ* methods to treat firstly, the pollution source in the soil and to prevent contaminants migrating to groundwater, and secondly the plume.

Project partners are:
EniChem SpA ,Italy, (Project co-ordinator); EniTechnology ,Italy; TNO, The Netherlands, (Scientific co-ordinator); EAWAG, Switzerland; University of Konstanz, Germany; University of Cranfield, UK, University of Stuttgart/*VEGAS*, Germany; Yeditepe University, Turkey; Akzo Nobel, The Netherlands; Ford Werke AG, Germany; VHE Technology, UK; Aquater SpA, Italy; and ICI paints, Germany.
The project is expected to start by 1 March 2000. The duration of the project will be three years.

The total costs of the project are around 4.9 MEuro (of which 2.9 MEuro will be provided by the European Commission and 2 MEuro from the partners).
Progress on PURE will be reported on a regular basis to the NICOLE community.

SUSTECH 10

SUSTECH^{TM} (Sustainable technologies) is an initiative of the Association of the European Federations of the Chemical Industries (CEFIC). It was launched six years ago with the aim of enabling companies to address jointly long-term R & D issues which they all shared, in particular those related to environment and sustainability. Its main objective was to create a forum, open to other processing industries and academia, where different experiences, skills and resources could be combined as collaborative R & D projects.

SUSTECH organises, once or twice a year, a 2-day conference, with a large attendance from academia. Both plenary sessions and parallel, mono-thematic workshops are scheduled to allow presentations on subjects of general interest. Focused discussions also take place among smaller, specific interest groups. Representatives from DG XII are always invited to give information and advice about on-going and future EC programmes and calls for proposals.

SUSTECH gave birth to NICOLE!
At the1995 SUSTECH event "Contaminated Land" was proposed by ICI as a topic suitable for multi-sectorial co-operative research. Dale Laidler and Martin Bell (with help from Dr Jürgen Büsing from DG XII) did a great job to create NICOLE as a Concerted Action. NICOLE has been an example for other "clusters" focused upon other issues.
SUSTECH 10, the tenth conference in the SUSTECH series, was held on 30 November and 1 December 1999 in Brussels, with the opening plenary session entitled "Success through collaboration". NICOLE was the subject of one of the three invited key-note papers. The emphasis of the NICOLE presentation was the successful collaboration between industry (NICOLE) and regulators (CARACAS until 1998 and now CLARINET). The results of this collaboration (the Joint Statements of 1997 and 1998 on R & D needs, Risk Assessment and Fitness for Use) and the joint workshop on Monitored Natural Attenuation are just the "tips of the iceberg" of a (almost) daily practice of working together. The wide acceptance at EU level, although not in all Member States, of the site-specific/risk assessment based approach confirms the effectiveness of this co-operation.
For further information about PURE and SUSTECH please contact:

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E-mail: paolo.cortesi@enichem.it

The outlook for 2000

Paolo Cortesi, Chairman of NICOLE

We have an exciting programme for 2000. This year NICOLE faces the challenge of expanding its membership to reach a greater European dimension. Our other goals are to increase our influence and to become more effective in communicating our position on contaminated land. While principally an industry initiative NICOLE's great strength is the breadth of the community its views are drawn from: industry, academe, business and the wider research community.

NICOLE's goals are to:

- to continue to be a forum for information and best practice
- to work on improving dialogue with regulators, at local and central level, in order to understand their views and needs
- to make our communication with them appropriate to their understanding of the problems and scientific background
- to be more effective in promoting our messages on risk assessment and fitness-for-use based approach
- to develop co-operation with other stakeholders, in particular those, such as developers, planning authorities, and insurance providers, etc. who may contribute substantially to the rehabilitation and economic exploitation of derelict land.

The activities planned for year 2000 are consistent with these goals. NICOLE needs a flexible strategy to achieve its goals and respond to the evolution of contaminated land issues. Its programme aims to develop the industry's knowledge and strengthen the links with other networks.

NICOLE - Spring meeting

This meeting (22-23 May, Helsinki) will be focused on "source management". This subject still requires more technological development, but general agreement on what should be a sound approach (for instance source removal *versus* plume control) is also needed. In this context a debate on Monitored Natural Attenuation (MNA) is very appropriate.

R & D performers and services providers will bring their experiences and innovative ideas, while regulators from CLARINET will illustrate the different approaches in the EU countries. Of course industry representatives will contribute actively to the debate.

DGXII Workshop

The aims of DGXII's workshop (21-23 June) in Venice are to monitor the projects related to the Key Action 1 "Sustainable Management and Quality of Water", in particular with respect to sections 1.4.1 "abatement of pollution from contaminated land, sediments and landfills" and 1.4.2 "combating diffuse pollution", approved in the first call of the Fifth Framework Programme. The joint statements by NICOLE/CARACAS (1997) [**www]** and NICOLE/CLARINET (1998) [**www]** had a great influence on the text of these sections.

NICOLE and CLARINET have been invited to chair several sessions of the workshop. The two networks will be able to check how R & D needs and gaps are covered by on-going projects. They may also have the opportunity to give appropriate inputs to DGXII for revising future calls.

NICOLE - Autumn meeting

This meeting will focus on the management, financial and communication aspects of brownfield development. It will offer a chance to all the stakeholders involved to bring in their view and needs. It will be held in The Netherlands on 9-10 November. The aim is that the conclusions from the workshop should become the basis for the NICOLE recommendations for a European approach on "how to turn a problem into an asset".

ConSoil 2000

NICOLE and its members will be active at the ConSoil conference in Leipzig in September. NICOLE and CLARINET will organise a joint session within the EU session. The programme is still in preparation, but it will be centred on a multi-media, problems and solutions debate with contributions from all over Europe.

NICOLE project report

"Monitored Natural Attenuation: review of existing guidelines and protocols."

Authors: Anja Sinke and Isabelle le Hecho.

This report is now available from the NICOLE secretariat *(contact details page 2)*.

Price per copy: NICOLE members 45 Euro
non-members 65 Euro

***NICOLE** 2000* is published by r^3 Environmental Technology Ltd., P O Box 58, Ware, Hertfordshire, SG12 9UJ, UK ("r^3")
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Editors: Paul Bardos and Jacqui Marsh
Printed by TNO, The Netherlands