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Seminar on Analysis, Methodology of Treatment  
and Remediation of Contaminated Soils and Groundwater

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Paris, 13-15 March 2001

## **REPORT ON THE SEMINAR**

### Introduction

1. The Seminar on Analysis, Methodology of Treatment and Remediation of Contaminated Soils and Groundwater was held in Paris (Villepinte) from 13 to 15 March 2001 at the invitation of the Government of France and under the auspices of the ad hoc Group of Experts on the Chemical Industry of the United Nations Economic Commission for Europe (UN/ECE). It was co-organized by the Association for the International Exhibition of Chemical and Process Engineering (Association Interchimie) of France.

2. Participants from the following UN/ECE member States attended the Seminar: Albania, Austria, Belgium, Canada, Czech Republic, Estonia, Finland, France, Germany, Hungary, Italy, Kazakhstan, Latvia, Lebanon, Lithuania, Netherlands, Poland, Portugal, Romania, Russian Federation, Slovakia, Slovenia, Spain, Switzerland, Ukraine, United Kingdom of Great Britain and Northern Ireland, United States of America and Uzbekistan. Participants from Ghana, the Libyan Arab Jamahiraya, Morocco and Tunisia participated under Article 11 of the Terms of Reference of UN/ECE.

### Opening of the Seminar

3. The Seminar was opened by Mr. Howard Hornfeld on behalf of Ms. Danuta Hübner, Executive Secretary of UN/ECE. Following the wishes of the Executive Secretary he gave special thanks to the Government of France

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and to Association Interchimie for once again hosting and co-organizing this large-scale Seminar, and to the French Organizing Committee, chaired by Mr. Vincent Limousin, for the extremely efficient and extensive efforts made in the preparation of the event. He also gave thanks to the many people who contributed their skills, knowledge and energy in many different ways, including that of chairing and moderating the several sessions and participating in the four round table discussions. He also welcomed the many speakers, poster authors and listeners, noting the wide range of countries represented, which confirmed the importance the environment plays within the chemical industry.

4. Mr. Hornfeld then presented a short synopsis of the activities of UN/ECE and of the ad hoc Group of Experts on the Chemical Industry. He stressed that changes occurring in central and eastern Europe were providing new opportunities for enhanced scientific and industrial cooperation throughout the UN/ECE region. The present Seminar acts in that spirit, setting a forum for the exchange of both ideas and practical technologies in the soil decontamination industry. He described UN/ECE's continuing interest in the area of soil decontamination, but that limited resources may have a negative effect on the activity in the future. He described the affiliations UN/ECE has built with other United Nations agencies in this context, and while UN/ECE's work is unique within the United Nations system, these other agencies have shown serious interest in cooperation in further related activities and pursuit of current tasks.

#### Election of officers

5. Mr. Hornfeld next proceeded to the election of the Chairman of the Seminar, to which post Mr. Pierre Fillet, General Commissioner of the Association Interchimie was unanimously elected. Mr. Fillet then welcomed the participants and thanked them for his election. He outlined the overall programme of the Seminar and the discussion to be held at the end of the Seminar on 15 March.

6. Mr. Fillet then introduced two representatives of the Government of France: Mr. Maurice Cotte, Chief of the Industrial Manufacturing Service of the Ministry of Economy, Finance and Industry and Mr. Philippe Vesseron, Chief of the Major Risks Service of the Ministry of National and Regional Development and the Environment, as well as Ms. Martine Clément, President of the Engineering Industries Federation (FIM) of France. They noted that pollution of soils from industrial activity is found in all industrialized countries, and that world awareness of this is evidenced by the interest UN/ECE had shown in cooperating with the Government of France and Association Interchimie in organizing the Seminar. They commented that France had initiated detailed multi-step efforts to remedy these problems: first, by identifying and classifying such sites; second, treating these sites; third, dealing with financial and legal aspects of remediation; fourth, developing a strategic methodology in dealing with polluted sites; fifth, supporting research and standards on an international scale for such remediation; and sixth, by informing the public and training the relevant authorities in the need for remediation.

#### First session:

#### **Evaluation of health and environment risks**

#### Discussion leaders:

**Michel Nominé**, Director of Research, INERIS (France)  
**Annette Guiseppe-Elie**, DuPont Engineering (United States)

#### Documentation:

TRADE/CHEM/SEM.2/S.1; S.2; S.3; S.4

7. This initial session illustrated the need for and the complexity of risk assessment, as it must take into account not only human health aspects but also the quality of groundwaters. The complexity was increased by the different approaches throughout Europe in national standards and regulations, which, although starting from similar general principles, have evolved differing regulatory systems.

8. The session demonstrated the progress accomplished and the questions still remaining in current risk analysis methods, considering the varied goals envisaged: man, the ecosystem and groundwaters. The opening paper placed that confrontation in the forefront concerning the concept of risk-based decision-making for the remediation of polluted sites, and reviewed the current developments, pointing out those areas where efforts are being concentrated on clarifying the methodologies to be used. The next paper reviewed the risk analysis methods in use in France and emphasized the areas where doubts about the validity of results still provide uncertainties for decision-makers. Some concrete examples of risk analysis of clean-up of sites polluted with traces of explosives followed, which described experimental trials based both on laboratory and field tests. This resulted in a method to determine soil quality criteria considering protection of the overall ecosystem. The final paper in the session was not presented.

#### Second session: Investigation Strategies

Discussion leaders: **Jerome Costil**, UPDS (France)  
**René Goubier**, Chief Polluted Soils Department, Agence de l'Environnement et de la Maitrise de l'Energie, Ademe (France)  
**Lubomír Procházka**, President, OVAH (Czech Republic)

Documentation: TRADE/CHEM/SEM.2/S.5; S.6; S.7; S.8; S.9

9. This session logically followed on the previous session, concentrating on the quantitative evaluation of risks as a critical tool for the management of polluted sites and their remediation. The first contribution reviewed the variety of measurement techniques available, while the two following papers elaborated in more detail the use of these tools in particular cases: one covered the case of pollutants dissolved in water and the other examined the case of light non-aqueous contaminants. An example of the use of a portable measurement instrument - a chromatograph - used on site was followed by a study of the uncertainties of point measurements by geostatic tools.

#### Third session: Treatment Methods: Industry and Pollution Control Standpoint

Discussion leaders: **Frank Karg**, UPDS (France)  
**Lubomír Procházka**, President, OVAH (Czech Republic)

Documentation: TRADE/CHEM/SEM.2/S.11; S.12; S.13; S.14; S.15;

10. The first paper in the session discussed phytoremediation, a gentle but slow procedure which is relatively simple to use - it is essentially farming. It is generally limited, however, to heavy metal contamination principally on or near the surface. The next contribution described several techniques, and in particular a rather novel process which generated substantial interest from the participants, using metallic sodium to dehalogenate highly chlorinated contaminants such as PCBs. The following report described two biotechnological techniques and showed the growing importance particularly of

bioventing. Depollution by surface-active agents, or detergents, was described as being very effective and rapid for domestic fuel-contaminated aquifers, but at a certain elevated cost. Another contribution was made concerning permeable reactive iron barriers for treatment of anaerobic relatively slow-moving groundwaters contaminated with chlorinated ethylene, and finally there was a presentation of a process utilizing permanganate in a basic medium for oxidation of organic pollutants, which under favourable geologic conditions could prove rapid and economic.

Fourth session:                    **Exposure Eradication Measures**

Discussion leaders:            **Michel Monzain**, Union des Industries Chimiques (France)  
**Rae Crawford**, NICOLE Network (United Kingdom)

Documentation:                TRADE/CHEM/SEM.2/ S.16; S.17; S.18; S.19

11.        The session concentrated on natural attenuation, or more correctly on monitored natural attenuation, and on measures for the monitoring; three contributions were made on this subject. The procedure appears to be a practical and satisfactory solution for certain specific problems in certain specific conditions, but clearly it is not universally applicable, and failures can easily occur. One can only undertake the process after having carefully analysed local geologic, thermal and hydrodynamic conditions and the extent of contamination, and then determining the likelihood of natural attenuation taking place under those local conditions. A description of NICOLE (Network of Industrially Contaminated Land in Europe) was also provided at the opening of this session.

Fifth session:                    **Rehabilitation Strategies**

Discussion leaders:            **René Goubier**, Chief, Polluted Soils Department, Ademe (France)  
**Harald Kasamas**, CLARINET (Austria)

Documentation:                TRADE/CHEM/SEM.2/S.20; S.21; S.22; S.23; S.24; S.25

12.        The session treated the choice criteria and the methods for actually putting in place the chosen techniques to accomplish remediation and the measures employed to assure their safety. Following that theme, a presentation was made of the CLARINET project, operating under the aegis of the European Union, which described the exchanges of experience and cooperative development projects funded and coordinated by the several project working groups. The subsequent papers elaborated the different elements which need to be considered in choosing a remediation strategy: integration with urban or regional planning goals, establishment of priorities in selecting several sites out of the many hundreds in the areas, choosing a suitable technique using - among other tools - a realistic economic analysis. Two specific case studies were presented, one advanced case in central Europe, and the other in western Europe, which is in the late planning stages.

Sixth session:                    **Legal, Financial and Communication Aspects**

Discussion leaders:            **Patrick Nollet**, Directeur Général, Entreprises pour l'Environnement (France)  
**Jane Piggott**, Winston and Strawn (United States)

13. With panelists from Austria, France, Germany, Switzerland and the United States, and active participation from the auditorium, the session permitted a discussion of all routes covered during the past three years in the subject areas.

14. The principal driving forces are presently the concerns about preservation of water resources and the establishment of industrial standards. Increasingly, legislation and remediation policy are based on risk assessment. This takes into account the individual conditions at individual sites in order to adapt treatment to the eventual usage of the site and not simply to satisfy strict regulatory standards. This results in improved control of the costs of remediation and better adaptation to the local land use policies.

15. The "polluter pays" principle is broadly adopted by all countries, but it is generally the State which must intervene financially when it is not possible to identify the polluter or when the polluter is not financially solvent. Generally speaking, it is recognized that the "innocent" owner of the site should not be required to pay more than the market value of the land.

16. Of course, this implies that there is good communication with the public concerning the solutions which have been applied to the treatment of the problems, and that there is an efficient and secure method to respect the restrictions of use which are imposed on the site.

#### Seventh session: Experience in Soil Decontamination in Countries in Transition to a Market Economy

Discussion leader:        **Howard Hornfeld, UN/ECE**

17. The session included representatives from Albania, Czech Republic, Hungary, Latvia, Poland, Russia, Slovakia and Slovenia (with specific apologies for absence from Estonia, Ukraine and Uzbekistan), and illustrated the systems in place in each of the countries, including research capabilities (institutes, universities and enterprises), financing clean-up (domestic and international sourcing of funds, government versus private funding, aid programmes) and specific case histories in each country. It is clear that the problems are very difficult, and that cooperation with western countries and technologists is recognized and desired. Some locally developed technologies were described such as the use of zeolites for heavy metals decontamination and the use of biodegradation of oil residues with specific microbes. Case histories included problems of mercury pollution at a chlorine-PVC facility. Several other cases were described, some of which are included in the UN/ECE Pilot Project. Risk assessment is a major concern, but frequently sampling is difficult as site owners are not always cooperative! A major result of the Round Table was communication: people met each other and exchanges occurred. It was felt that such exchanges are extremely useful and should be extended.

#### Conclusions and recommendations of the Seminar

18. At the close of the technical sessions the Chairman summarized the overall results of the Seminar and formulated a number of recommendations:

(a) The principal conclusion and recommendation of the Seminar was that it should continue to be a regular biennial affair, with the fourth edition to take place in Spring 2003. Clearly the fact that more than 700 registrations were received from over 30 countries indicated the widespread interest in

the subject matter. Interchimie should immediately begin preparations for the next Seminar with its partners UN/ECE, the ministries of industry and of the environment of France, UPDS, ADEME, INERIS, Entreprises pour l'Environnement, Pôle de Compétence "sites et sols pollués".

(b) As there was significant interest shown in the problems of groundwater, preservation of the groundwater systems should receive added emphasis as a high priority subject.

(c) It was considered very important that numerous countries in transition attended the Seminar, that they be encouraged to attend future Seminars in this series, and that financial assistance be sought for their participation.

(d) Similarly, as some interest has already been generated by participants from the Mediterranean Basin as well as North America, these regions should receive particular attention.

(e) The quality of the Seminar, considering its success, should continually be reinforced in four particular directions:

- scientific and technical levels of the papers
- relevance of the topics
- competence of the participants
- more widespread geographic distribution of the oral presentations.

(f) The image and widespread publicity for the Seminar needs improvement:

- the next Seminar should have a proper, easily recognized name
- an effective website should be generated
- English, French and Russian should be retained
- wide distribution - perhaps by sale - of the report of the Seminar should be made
- the importance of the subject matter should be communicated to the public as a whole, by professional press relations.

(g) The financial aspects of the Seminar should be adapted to the new conditions related to its success.

#### Close of the Seminar

19. Mr. Howard Hornfeld of the UN/ECE secretariat thanked the Government of France and the Association Interchimie for the excellent arrangements that had been made, as well as for the warm hospitality that had been enjoyed by all. He suggested that the Seminar entrust the secretariat with the task of writing the final report on the Seminar, which was unanimously accepted.

20. Mr. Pierre Fillet, Chairman of the Seminar and General Commissioner of the Salon Interchimie, thanked the participants and especially the authors and discussion leaders for their important contributions to the Seminar, as well as the UN/ECE secretariat for its organizational support.

Annex**LIST OF PAPERS****First session: Evaluation of health and environment risks****Tuesday 13 March**

- S.1 Current trends/emerging issues in risk assessment for environmental control  
*Annette Guiseppi-Elie*
- S.2 Launching health risk assessment procedures: initial results  
*Roseline Bonnard, Corinne Hulot, Sandra Levêque and Michel Nominé*
- S.3 Development of soil quality criteria for explosives: laboratory and field approaches  
*Geoffrey I. Sunahara, Pierre Yves Robidoux, Ping Gong, Jalal Hawari, Sonia Thiboutot, Guy Ampleman, Jason M. Weeks and Agnès Y. Renoux*
- S.4 A risk assessment methodology for contaminated sites: a case involving redox processes in a shallow aquifer  
*Emmanuel O. Landat and Alain C.M. Bourg*

**Second session: Investigation strategies**

- S.5 Analysis of investigative methodologies for detailed risk assessment  
*Pierre Colin*
- S.6 Probabilistic and conditional approach to estimations of the extent of a soluble pollutant cocktail affecting groundwater  
*Thierry Blondel, Michel Garcia and Roland Froidevaux*
- S.7 Spatial distribution and estimation of the volume and the modelisable portion of light products in the non-aqueous phase in soils based on sampling data  
*Michel Garcia, Thierry Blondel and Pierre Colin*
- S.8 Usage and contributions of portable gas phase chromatography in association with interpretation software during analyses of sites and soils susceptible to pollution  
*Marie-Christine Fourcade, Jean-Marie Fournion and L. Fataccioli*
- S.9 Geostatistical concepts for uncertainty assessment  
*Chantal de Fouquet*

**Third session:****Wednesday 14 March****Treatment methods: industry and pollution control standpoint**

- S.10 Green clean-up of heavy metal contaminated soils with plants: Phytoremediation  
*Markus Puschenreiter, Wolfgang Friesl, Maria Tesar and Othmar Horak*
- S.11 Complex decontamination of soils which contain organic substances  
*Lubomír Kašák, František Kaštánek and Meěislav Kuraš*
- S.12 Field monitoring and evaluation of two different technical approaches to bioventing at a petroleum hydrocarbon contaminated site  
*Johan Gemoets, Dirk Springael, Bart Vandervelpen, Siegfried D'Haene and Filip DeNaeyer*
- S.13 Depollution by surface-active agents of an aquifer contaminated with domestic fuel  
*Jean-Marie Come, Vincent Riou and Jean Ducreux*

- S.14 Evaluation of the use of a permeable reactive iron barrier for treatment of groundwater highly polluted with TCE  
*Leen Bastiaens, Miranda Maesen, Johan Vos, Ludo Diels and Stephanie O'Hannesin*
- S.15 *In-situ* chemical oxidation methods: promising or transient techniques ?  
*Véronique Croze*

**Fourth session: Exposure eradication measures**

- S.16 NICOLE – Network for Industrially Contaminated Land in Europe. Main activities of NICOLE  
*Paolo Cortesi*
- S.17 Natural attenuation or treatment? : First, an understanding  
*Pierre Scherrer*
- S.18 Monitored natural attenuation in Europe: industrial experience through a collaborative NICOLE project  
*Roger Jacquet*
- S.19 Flexible emission control: a process-like approach  
*Gerard A.M. van Meurs, Margot P.T.M de Cleen, Jan Taat and Erik Schurink*

**Fifth session: Rehabilitation strategies**

**Thursday 15 March**

- S.20 CLARINET: a European network on the sustainable rehabilitation of contaminated land  
*Harald Kasamas*
- S.21 Polluted soils: a challenge for urban renewal  
*Marc Kaszynski*
- S.22 Objectives for remediation of polluted sites of disused gas plants  
*Dominique Saint-Royre*
- S.23 Economics of rehabilitation projects of polluted soils and sites  
*Annie Jacq, Claude Lacour and René Goubier*
- S.24 Techniques of remediation processes dealing with old environmental loads at the Synthesia a.s. site in the Czech Republic  
*Viktor Mejstřík, Lubomir Procházka and Alena Polenková*
- S.25 Sustainable remediation of large hazardous waste sites in Switzerland: where digging is cheaper than sealing/isolating  
*Christoph Wenger and Urs Ziegler*

**Sixth session: Legal, financial and communication aspects**

**Seventh session: Experience in soil decontamination in countries in transition to a market economy**



**Poster presentations**

- S.26 Assessing risks from contaminated sites: policy and practice in 16 European countries  
*Harald Kasamas*
- S.27 A multidisciplinary approach to determining the history of environmental risks from and feasibility of remediating former steel works sites contaminated by metals  
*Danielle Venditti, Sylvain Durécu, Jean-Marc Strauss and Jacques Berthelin*
- S.28 Urban industrial pollution from the nineteenth century  
*Laurence Lestel*
- S.29 Energy dispersive X-ray fluorescence method for determination of trace metal in seawater  
*Genci Luarasi, Ramazan Bukli and Ali Gjebrea*
- S.30 Pollution monitoring as a means of implementing an effective state policy  
*Olga P. Apatenko*
- S.31 Measurement of the inhibition of TTC-Dehydrogenase activity of contaminated soil with *pseudomonas fluorescens* test  
*Roberta Guerra, Antonella Iacondini, Federica Abbondanzi, Rita Antonellini, Valentina Caroli and Luigi Bruzzi*
- S.32 Leachability of B and Ba from the soils of a nearby liquidated chemical plant  
*Katarzyna Bojarska and Zbigniew Bzowski*
- S.33 Coupling of a thermobalance and a gas-phase chromatograph with detection by mass spectrometry to define the conditions for remediating contaminated soils by thermal desorption  
*Camille Dutheil, Jean Carré, Jean-Marie Letoffe and Lyliane Faure*
- S.34 Methods of containing, decontaminating and revegetating contaminated soil  
*S.V. Mikheikin, P.G. Ogulnik, L.V. Pronina, A. Yu. Smirnov, V.P. Simonov, A.B. Zezin, T.N. Bolysheva, G.P. Glazunov and A.D. Fless*
- S.35 International networks on contaminated land  
*Harald Kasamas*
- S.36 Molecular and isotopic tools for pollutant studies  
*Eric Lichtfouse*
- S.37 Monitoring of pollutants in the soil/groundwater system  
*Yevgueniy P. Buravlev*
- S.38 Predictability of results of *in situ* bioremediation experiments using short-term *ex situ* slurry experiments  
*Suzanne De Cort and Hubert Verachtert*
- S.39 Large scale lysimeters: evaluation of methods for remediation of contaminated soils  
*Andreas Krenn and Johann Riesing*
- S.40 Chelate mobilisation and phytoextraction of heavy metals from contaminated soil  
*Helena Grèman and Domen Leštan*
- S.41 Interparticular contaminant exchange for soil cleaning  
*Johannes Dück, Roman Breiter and Thomas Neeße*
- S.42 Development of a plant cover to optimise the activity of methanotrophic microorganisms in landfill cover soils  
*Thomas Reichenauer*

- S.43 Removal of metals from soil  
*Laurent Rizet and Daniel Daviller*
- S.44 A sulphite-hydrogen chloride process for declogging and maintaining groundwater wells in the event of contamination of the water by manganese and manganobacteria  
*Frank Clanet*
- S.45 Microbiological remediation of PAH contaminated construction debris by alkaliphilic consortia  
*Bernhard Gemende, Marion Bittner, Gerhard Mueller, Roland H. Mueller and Wolfgang Babel*
- S.46 Selective mobilization of heavy metals in polluted soils  
*Martin Kubal and Mecislav Kuraš*
- S.47 Reduction of Fe(III) by sulphate-reducing bacteria with a view to bioleaching of toxic metals associated with iron  
*Fabienne Battaglia-Brunet, Catherine-Dorothee Loiseau, Ioannis Ignatiadis and Dominique Morin*
- S.48 Bioremediation of soils contaminated by heavy metals with a biometal sludge reactor (BMSR)  
*Ludo Diels, Mark De Smet, Liliane Hooyberghs, Luc Kinnaer, Philippe Corbisier and Gunther Brox*
- S.49 Demonstration of a new bioreactor for on-site treatment of groundwater for COD and AOX removal  
*Ludo Diels, Sandra Van Roy, Kurt Peys, Manfred Schleifenheimer, Thomas Schumann, Klaus Nitsche, Karl Heinz Eckhold and Dieter Frense*
- S.50 Demonstration of biological treatment, soil washing and coal agglotation for on-site remediation of MGP sites  
*Johan Gemoets, Leen Bastiaens, Dirk Springael, Nathalie Leys, Liliane Hooyberghs, D. Van Houtven, I. Janssen and Ludo Diels*
- S.51 *In situ* bioprecipitation of heavy metals in groundwater  
*Ludo Diels, Daniel van der Lelie, Johan Gemoets, Dirk Springael and Leen Bastiaens*
- S.52 Soil remediation using zeolites  
*Barbara Gworek and Marek Borowiak*
- S.53 Extraction mechanisms of hydrocarbons and heavy metals by organic acids from soils of an disused oil refinery  
*Rosa Galvez-Cloutier and Eric Torres*
- S.54 Destruction of PCBs in soil polluted by mineral oil  
*Krystyna Cedzynska and Z. Kolanskiński*
- S.55 Natural attenuation of chromate ( $\text{CrO}_4^{2-}$ ) in rice-field irrigation water and soil  
*Ioannis Ignatiadis, Sandro Gail, Marie Christine Dictor and Fabienne Battaglia-Brunet*
- S.56 Chemical treatment in reducing conditions of metals and arsenic in the soil of industrial or mining sites  
*Sylvaine Tellier and Christine Gleyzes*
- S.57 Electrokinetic decontamination of PAH-contaminated soil  
*Charlotte Hurel and Sylvaine Tellier*

- S.58 Study on a semi-industrial pilot scale of continuous thermal desorption for remediation of contaminated soil  
*Vivien Renauld, Guy Fraysse, Véronique Risoul, Sylvain Durecu, Gwénäelle Trouvé and Patrick Gilot*
- S.59 MPPE: a technology for removing dispersed and dissolved organic compounds from groundwater  
*Daniel Billet and Daniel Boutet*
- S.60 Economic and ecologically favorable destruction of polyhalogenated pollutants using DMCR technology (DMCR = Dehalogenation by MechanoChemical Reaction)  
*Volker Birke*
- S.61 Process for stabilizing and solidifying solids and liquids contaminated by arsenic and arsenic derivatives when other polluting and toxic substances are present  
*Robert Loignon*
- S.62 Study of horizontal and vertical distribution of oil products and oil shale oil in different type soils and groundwater  
*Arvo Käär*
- S.63 Soil and groundwater remediation: optimization of the 2-phase™ extraction technology for the accelerated treatment of chlorinated solvents  
*José Fernandez*
- S.64 Phytoregeneration of land damaged by industrial activity in the Urals  
*Tamara Chibrik*
- S.65 Heavy metals in soil: contamination and phyto-remediation  
*Ekkehard Petzold and Eva Maria Lüring*
- S.66 *In situ* metal inactivation and revegetation of contaminated soils  
*Daniel van der Lelie, Philippe Corbisier, Ludo Diels, Nele Spelmans, Herman Clijsters and Jaco Vangronsveld*
- S.67 Technology of utilization of recycled clays treated with absorbed oils  
*Abdusamak A. Kadyrov*
- S.68 Real and potential ability of soils to protect natural water from pollution  
*Galina Motuzova*
- S.69 Development of technologies using the activity of sulphate- and metal-reducing bacteria (SMRB) to remove heavy metals and metalloids from ground waters and soil – Metalbioreduction  
*Ioannis Ignatiadis, Fabienne Battaglia-Brunet, Mireille Bruschi, Alain Dolla, Bernard Olivier, Jean-Louis Garcia, Franz Glombitza, Yannis Fessas, Martin Marggraff, Niels Van der Lelie, Ludo Diels, Ioannis Paspaliaris, Nymphodora Papassiopi, Angelos Nefeloudis and Andreas Efstathiou*
- S.70 Study of the change of phase of a liquid in soil  
*Ali Chammari, Bruno Cousin, Jean-Claude Bénet and Thierry Ruiz*
- S.71 Rapid diagnosis of polycyclic aromatic hydrocarbons (PAH) in soils  
*Evelyne Touraud, O. Cloarec, C. Gonzalez and Olivier Thomas*
- S.72 Minimizing the environmental impact of oil exploration and exploitation by remediation of oil-sludge lagoons: several case studies  
*Thierry Minguet*
- S.73 A case of accidental pollution of drinking water by pesticides  
*Genci Luarasi, Ramazan Bukli and Ali Gjebrea*

- S.74 Remediation of a rural site contaminated with organochlorine derivatives  
*Laurence Amalric, Henri Molleron and Roger Jeannot*
- S.75 Remediation of contaminated sites: environmental impact assessment  
*François de Tarragon*
- S.76 Remediation by stabilization: two examples from industrial sites  
*François de Tarragon*
- S.77 Soil and groundwater protection in Germany: joint principles for common targets  
*Claus G. Bannick, Wolfgang Leuchs, Reinhard Röder and Joachim Ruf*
- S.78 ANCORE: Academic Network on CONTaminated land Research within Europe  
*Martin Bittens and Georg Teutsch*
- S.79 Feasibility of *in situ* bioremediation  
*Julien Troquet*
- S.80 Soil and subsoil contamination in Romania: state of affairs and socio-economic issues  
*Lazar Avram and Julien Troquet*
- S.81 Hydrocarbon plumes and approaches for evaluating natural attenuation at petroleum-release sites  
*Norman J. Novick*
- S.82 Large scale R&D program of the German Federal Ministry for Education and Research: applying reactive barriers and treatment zones in Germany  
*Volker Birke, H. Burmeier and D. Rosenau*
- S.83 Methodological and experimental approach to the feasibility and assessment of the performance of soil remediation technology  
*Emmanuel Vernus, Philippe Revin, Laetitia Patton, Nadine Dueso and Yves Perrodin*
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- S.85 Concept for the ecological and socio-economic rehabilitation of the radiation-contaminated areas: information on the process of dealing with the consequences of the disaster at the Chernobyl nuclear power plant  
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- S.86 Contaminated site cleanup: prospects for Poland, Hungary and the Czech Republic  
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*Jirina Machácková, Ferdinand Hercík, Stanislava Prokšová, Jan Masák and Vladimír Jirků*
- S.88 New Hungarian legislation for the protection of groundwater  
*László Balásházy and Eva Deseö*
- S.89 Financing the remediation of contaminated sites: legal issues according to Swiss law  
*Marco Zaugg*
- S.90 The German soil protection law as seen by German industry  
*Antonius Hamers*
- S.91 Community relations – key to successful cleanup  
*Barbara Maco*