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CONTENTS - OVERVIEW

VOLUME 1

Contents (Volume 1 & 2)	ix
Conference Patrons, Committees	xli
Foreword	xlvi
Introduction	xlix
1 STRATEGIES AND POLICIES; LEGAL, ECONOMIC AND SOCIAL ASPECTS	
1.1 International, national and regional programmes	3
1.2 Legal, economic and social aspects	51
1.3 Short communications	117
2 RISKS	
2.1 Sources and behaviour of contaminants	153
2.2 Effects of contaminants	303
2.3 Risk assessment	349
2.4 Safety of workers	441
2.5 Short communications	473
3 MANAGEMENT	
3.1 Site investigation; surveying and sampling strategies	587
3.2 Remedial action plans and organisation	737
3.3 Control and monitoring	845
3.4 Reuse of cleaned sites and/or soil	871
3.5 Short communications	903
Addresses of first-named authors	li
Keywords	lxxvii

VOLUME 2

Contents (Volume 1 & 2)

4	STATE OF THE ART OF APPLIED REMEDIATING TECHNOLOGIES (CASE STUDIES, EXPERIENCES AND EVALUATION)	
4.1	Emphasis on: In-situ technologies	1007
4.2	Emphasis on: Ex-situ technologies	1093
4.3	Short communications	1133
5	RESEARCH AND DEVELOPMENT, EMERGING TECHNOLOGIES	
5.1	Emphasis on: Biological and chemical treatment	1219
5.2	Emphasis on: Ex-situ treatment	1287
5.3	Short communications	1369
6	PREVENTION OF SOIL CONTAMINATION	
6.1	Waste disposal and agricultural activities	1479
6.2	Prevention and Waste disposal	1511
6.3	Short communications	1543
7	WORKSHOPS	
Addresses of first-named authors		xli
Keywords		lxvii

CONTENTS

VOLUME 1

Conference Patrons, Committees	xli
Foreword	
<i>Popp, M.; Rörsch, A.</i>	xliv
Introduction	
<i>Arendt, F.; Harder, W.</i>	xlix

1 STRATEGIES AND POLICIES; LEGAL, ECONOMIC AND SOCIAL ASPECTS

1.1 International, national and regional programmes

Japan's policies on soil environment protection - history and present status <i>Gotoh, S.; Udoguchi, A.</i>	3
United States/German bilateral agreement on hazardous waste site clean-up projects <i>Sanning, D.E.; Stietzel, H.</i>	11
Large scale voluntary soil clean-up operation for contaminated industrial sites in the Netherlands now on its way <i>Holtkamp, A.B.; Gravesteyn, L.J.J.</i>	27
Priority setting in the administration of the Danish Act on contaminated sites <i>Højsholt, U.</i>	35
Guidance for construction on contaminated sites <i>Johnson, S.T.; Smith, M.A.; Harris, M.R.; Herbert, S.M.</i>	41

1.2 Legal, economic and social aspects

Legal regulations on soil conservation and rehabilitation of contaminated sites in the Federal Republic of Germany <i>Radtke, H.</i>	51
Establishment and further development of legal regulations concerning contaminated sites <i>Brandt, E.</i>	55
Property value and remedial action: the Danish approach <i>Welinder, A.S.</i>	63
Practicable ways out of the normative, financial, organisational and personel deficits in the mastering of contaminated soils in the Federal Republic of Germany <i>Wolf, K.</i>	69
Local management of contaminated sites - an extensive strategy for standard practice <i>Selke, W.</i>	81
Experiences and results of national and international standardization of soil investigation methodology <i>Hortensius, D.</i>	89
Reducing inconveniences for residents during remedial actions <i>Vusse, A.C.E. van de; Baas, H.J. de</i>	99
KOSAL - Cost of Remedial Action <i>Bracke, R.; Dreschmann, P.; Kötter, L.; Neuenhofer, B.</i>	107

1.3 Short communications

Creations of jobs by remediation in eastern Germany <i>Belitz, H.; Blazejczak, J.</i>	117
Decontamination responsibilities of local authorities in New South Wales, Australia <i>Berveling, S.</i>	119
Technical standards for the management of contaminated sites <i>Bremer, H.; Neundorfer, G.</i>	121
Management of soil remediation and treatment techniques <i>Friese, A.; Petzold, E.</i>	123
On the path to sustainability: the Rotterdam municipal port management policy on contaminated sites/soils <i>Hattem, W.A. van</i>	125

Jeopardising the credibility of political and economic decisions through the use of incorrect data as typified by the carbon dioxide controversy <i>Heyke, H.E.</i>	127
The problems involved in the investigation of contamination by old waste deposits for the instigation of criminal proceedings <i>Kemp, P.H.</i>	129
Assessment of soil contamination: general criteria and site-specific modifications <i>Keuzenkamp, K.W.; Roels, J.M.; Hoppener, C.</i>	133
Demolition concepts for former industrial sites: break-off strategy on the example of a former foundry facility <i>Kolb, W.; Rohou, P.; Kiefhaber, P.</i>	135
Contaminated sites and land use after remediation <i>Petzold, E.</i>	137
Economic strategies for avoiding waste and abatement of prior damages in Russia <i>Potravny, I.</i>	139
Evolution and transfer of environmental know-how <i>Ramsay, L.; Jørgensen, M.</i>	141
Contaminated soil as reflected in public planning and building laws <i>Schick, B.</i>	143
Education and training in the field of contaminated sites: a project of the EC-Comett-Program (Cb-Project) <i>Schneider, G.; Hentschel, A.</i>	145
Conflicts around construction projects on slightly contaminated subsoil in Hamburg <i>Schütz, M.; Schönwald, I.</i>	147
Japan's environmental quality standards for soil <i>Udoguchi, A.; Gotoh, S.</i>	149

2 RISKS

2.1 Sources and behaviour of contaminants

Attenuation of organic pollutants in redox zones of landfill leachate plumes <i>Christensen, Th. H.; Bjerg, P.L.; Lyngkilde, J.; Albrechtsen, H.J.; Heron, G.; Rügge, K.</i>	153
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Carrier influenced transport of pollutants in porous media: mathematical modeling <i>Knabner, P.; Kögel-Knabner, I.; Totsche, K.</i>	163
Polycyclic aromatic hydrocarbons (PAH) from atmospheric deposition in forest soils of the Ruhr area, Germany <i>Hofmann-Kamensky, M.</i>	173
Determination of pollutant release rates from contaminated aquifer materials <i>Grathwohl, P.; Gewalt, T.; Pyka, W.; Schüth, C.</i>	175
Total amount of production as an influential factor for environmental distribution of chemicals - a case study in Japan - <i>Kishi, H.; Hashimoto, Y.; Gotoh, S.</i>	185
Heterogeneity and contaminant transport modeling for the Savannah river integrated demonstration site <i>Chesnut, D.A.</i>	191
Applicability of simulation models for the risk assessment of landfills in protected potable water areas <i>Lichte, M.</i>	199
Sorption behaviour of chlorinated pollutants on soil in aqueous systems containing oil <i>Först, C.; Stieglitz, L.; Simon, H.; Andl, A.; Solloch, U.</i>	209
Natural production of chlorinated organic compounds in soil <i>Hoekstra, E.J.; Leer, E.W.B. de</i>	215
Non-linear and delayed responses of toxic chemicals in the environment <i>Salomons, W.</i>	225
The behaviour of heavy metals in tailings deposits and soils around old metalliferous mines <i>Merrington, G.; Alloway, B.J.</i>	239
Experimental determination of organic vapour fluxes from coal tar polluted soil <i>Lindhardt, B.; Andersen, L.; Christensen, T.H.</i>	247
Dissolution of heterogeneously distributed solvent residuals, a field experiment <i>Broholm, K.; Feenstra, S.; Cherry, J.A.</i>	257
Bio-geochemical investigations for the assessment of long-term stability of mineral sealings in waste disposal sites <i>Bracke, R.; Püttmann, W.</i>	267

Emissions from older household waste landfills with artificial underlying sealing. Comparison of four landfill sites in Northern German lowland
Entenmann, W. 277

Determination of the permeability in base liners of land-fills: simulation with modified triaxial tests - first results
Baumgartl, T.; Kayser, R.; Horn, R. 287

Investigation of contaminant plumes: Münchehagen Landfill
Fritz, J. 295

2.2 Effects of contaminants

Methodology for the derivation of toxicologically based soil pollutant levels
Kalberlah, F.; Hassauer, M.; Schneider, K. 303

Open problems in the derivation of soil quality criteria from ecotoxicity experiments
Straalen, N.M. van 315

Environmental medical and toxicological assessment of soil contamination
Eikmann, Th.; Kloke, A.; Eikmann, S. 327

Adsorption of polycyclic aromatic hydrocarbons (PAHs) by soil particles: influence on biodegradability and potential risk of contaminated sites
Weissenfels, W.D.; Klewer, H.J.; Langhoff, J. 337

Investigation of the influence of a heavy metal contaminated region on plants, animals and humans on example of the nickel plant St. Egidien, Saxony, Germany
Seifert, A.; Becker, U.; Barth, A. 347

2.3 Risk assessment

Risk assessment of contaminated soil: Proposals for adjusted, toxicologically based Dutch soil clean-up criteria
Berg, R. van den; Denneman, C.A.J.; Roels, J.M. 349

Soil guideline values in the UK: New risk-based approach
Ferguson, C.; Denner, J. 365

Do target values help to protect the soil?
Robberse, J.G.; Denneman, C.A.J. 373

Guide levels for the decontamination of polluted water and soil <i>Bremer, H.; Frerichs, H.; Rohweder, U.</i>	383
Bioassays to access treated (remediated) sediments <i>Velde, R.T. van der; Guchte, C. van de; Dillen, M.R.B. van; Poorter, L.R.M. de</i>	393
Use of Ecotoxicological methods for evaluating risks caused by contaminated soils <i>Deschamp, F.; Thybaud, E.; Le Calvez, J.P.; Bahurel, P.</i>	403
Concept of integrated evaluation of contaminated sites and basis of soil/groundwater contamination paths in the state of Saxony <i>Eckardt, A.; Luckner, L.; Muller, G.</i>	409
The API decision support framework: Software for risk assessment at USTS sites <i>Spence, L.; Salhotra, A.; Claff, R.; Bauman, B.</i>	421
Contaminated landfill sites in the canton of Berne, Switzerland - a risk assessment model <i>Schickor, G.; Andrini, M.; Würsten, M.</i>	431
 <u>2.4 Safety of workers</u>	
Liability and accountability in health and safety - practical examples from remediation of hazardous waste disposal sites - <i>Burmeier, H.</i>	441
Occupational safety at landfill sites - hazards and pollution due to landfill gas <i>Wilhelm, V.</i>	449
Assessment of dangers and on-the-job safety from the chemical-toxicological point of view <i>Lohs, K.; Spyra, W.</i>	459
Directives for working in contaminated areas - improving work and health safety <i>Baur, L.D.</i>	469
 <u>2.5 Short communications</u>	
Substrate value of landfill leachate polluted groundwater for microbial degradation under different redox conditions <i>Albrechtsen, H-J.; Lyngkilde, J.; Grøn, C.; Christensen, T.H.</i>	473

Geochemistry of groundwater in the Eocene Aquifer of Alonim Shefara'm in the period 1959-1977 <i>Azmon, B.</i>	475
A guide to safe working practices for contaminated sites <i>Barry, D.L.; Steeds, J.E.; Sheperd, E.</i>	477
Evaluation of contaminated soil - pragmatic handling with guide, threshold and trigger values <i>Becker, M.</i>	479
Human exposure to contaminated soil: a model (CSOIL) used for assessment of human-toxicological intervention values for soil clean-up <i>Berg, R. van den</i>	481
Cation migration in groundwater: a field experiment <i>Bjerg, P.L.; Christensen, T.H.</i>	483
Degradation of mineral oil hydrocarbons in a bioreactor <i>Blank-Huber, M.; Schuster, E.; Huber, E.; Huber, S.; Hutter, J.; Heiss, R.</i>	485
Microbiological examinations in soils from pilot tests for the restoration of a former metallurgical site <i>Bochem, P.; Heinrich, F.; Kohring, G.-W.; Giffhorn, F.</i>	487
3D/2D modeling of groundwater flow and contaminant processes - the simulation system FEFLOW coupled with GIS ARC/INFO <i>Diersch, H.J.; Kaden, S.; Michels, I.</i>	489
An internally consistent and critically reviewed thermodynamic database for geochemical modelling <i>Falck, W.E.; Read, D.; Thomas, J.B.</i>	491
Soil/solution distribution equilibria of lindane at different soil/water ratios and under non-saturated conditions <i>Gerth, J.; Bahlmann, M.</i>	493
Groundwater pollution from dredged material disposal: retardation of pollutants in natural barriers <i>Gröngroft, A.; Miehlich, G.</i>	495
Groundwater model study for the assessment of efficiency and long term effects of different safety measures for the major dump at Vorketzin <i>Hamer, H.; Gronemeier, K.</i>	497
Polycyclic aromatic hydrocarbons (PAH) in forest soils I: contents and dynamic in podzols <i>Hartmann, R.; Deschauer, H.; Zech, W.</i>	499

Polycyclic aromatic hydrocarbons (PAH) in forest soils II: concentrations in soil solution <i>Deschauer, H.; Hartmann, R.; Zech, W.</i>	501
Solubility of cadmium in polluted soil <i>Holm, P.E.; Andersen, B.B.H.; Christensen, T.H.</i>	503
Chemical and microbiological determinations during an on-site decontamination for a PAH-contaminated site <i>Hund, K.; Schenk, B.; Jacob, R.; Schulz-Berendt, V.</i>	505
Design and performance of vertical barriers to pollution migration <i>Jefferis, S.A.</i>	507
Gas chromatographic characterization of oil spills <i>Johannsen, J.; Krutz, M.; Thimm, A.</i>	509
The long-term behaviour of municipal solid waste incinerator bottom ash in monofills: a potential problem? <i>Johnson, C.A.; Lichtensteiger, T.; Belevi, H.; Baccini, P.</i>	511
Characterization of an old landfill as a source for groundwater pollution <i>Kjeldsen, P.</i>	513
Carrier-influenced transport of pollutants in porous media: experimental assessment <i>Kögel-Knabner, I.; Maxin, C.; Totsche, K.U.</i>	515
Modelling of heavy metal adsorption on the site of the Ellweiler uranium mill <i>Koss, V.; Bütow, E.</i>	517
Investigation of source and distribution of hydrocarbon contaminations in the subsurface of a former coal mine in the northern area of the Ruhrgebiet <i>Leischner, A.; Püttmann, W.; Langguth, H.R.; Lieser, U.; Schierwagen, U.</i>	519
Influence of multiple nonequilibrium sources on pesticide transport in soils <i>Lennartz, B.; Rambow, J.; Widmoser, P.</i>	521
Delayed effects of chemicals in soils and sediments: "chemical time bombs" <i>Meulen, G.R.B. ter</i>	523
Risk assessment for an inhabited disused landfill in Wuppertal-Varresbeck, Federal Republic of Germany <i>Mohs, B.; Hudec, B.; Günter, P.</i>	525

Hydrocarbon degradation in aerated soil fixed bed reactors: effect of homogenization <i>Müller-Hurtig, R.; Feige, I.; Wagner, F.</i>	529
In situ measurement of organic pollutant degradation in a leachate plume <i>Nielsen, P.H.; Christensen, T.H.</i>	531
Risk Assessment: Combining exposure models and statistics <i>Nijhof, A.G.; Okx, J.P.</i>	539
Evaluation of abandoned waste sites by regional evaluation commissions <i>Osterkamp, G.; Röhm, H.</i>	541
Determination of halogenated hydrocarbon contaminations and complex judgment of its danger potential <i>Paech, W.; Friedrich, G.</i>	543
Distribution and behaviour of heavy metals in soils, following different clean-up procedures <i>Petruzzelli, G.; Lubrano, L.; Giovannini, G.; Lucchesi, L.; Cervelli, S.</i>	545
Diffusion of trichloroethylene in a natural clay: a field experiment <i>Poulsen, M.M.; Johnson, R.L.; Parker, B.L.; Cherry, J.A.</i>	547
Aqueous solubility of coal-tar constituents under equilibrium conditions <i>Pyka, W.</i>	549
Effect of a non-singular adsorption assumption on the simulation of herbicide leaching in the water-unsaturated zone of soils <i>Rambow, J.; Lennartz, B.</i>	557
Horizontal remediation wells by remote sensed drillings <i>Sass, I.; Bayer, H.J.</i>	559
Origin and extension of propanthiol contamination <i>Schönwald, I.; Wagner, I.</i>	561
Investigations to risk assessment due to arsenic and aluminum contamination of the subsoil in ground-water veins <i>Schulz, W.; Toups, J.; Ertel, T.</i>	563
Dissolution and transport of coal-tar constituents and their impact on groundwater quality <i>Schüth, Ch.; Pyka, W.; Wilhelm, T.; Gratwohl, P.</i>	565

Transport of volatile organic chemicals in sand <i>Tenner, W.A.</i>	567
A framework for the assessment of the impact of contaminated land on groundwater and surface water <i>Towler, Ph.; Young, P.</i>	569
Leaching and bioavailability of inorganic compounds in contaminated and cleaned soils <i>Versluijs, C.W.</i>	571
Studies on the desiccation risk of cohesive soil liners for landfills due to thermally induced water movement <i>Vielhaber, B.; Melchior, S.; Miehlich, G.</i>	573
Modelling of contaminant transport from an urban dump site <i>Vrbka, P.</i>	575
Flowpaths of leachates into the groundwater and hydrogeological barriers <i>Vrbka, P.</i>	577
Hazard Ranking Criteria for contaminated sites <i>Wales, J.; Myers, K.; Vogt, Th.</i>	579
Soil/plant transfer of pollutants by cultivation of energy plants on waste water irrigated soils <i>Wilke, B.-M.; Metz, R.</i>	581
A strategy for disposal of dredged sludge <i>Wijland, R.</i>	583

3 MANAGEMENT

3.1 Site investigation; surveying and sampling strategies

Sampling strategies and the role of geostatistics in the investigation of soil contamination <i>Bosman, R.</i>	587
Sampling strategy guidelines for contaminated land <i>Ferguson, C.C.</i>	599
A site investigation strategy using moving window kriging and automated semivariogram modelling <i>Tooren, C.F. van; Haas, T.C.</i>	609

Problems of the investigation and restoration of abandoned contaminated areas in the chemical plants of the new federal states under the special aspect of the former lignite-based chemistry <i>Kunze, P.; Rausch, U.</i>	623
The use of in situ measurement techniques for soil pollution problems <i>Visser, W.; Olie, J.J.; Bremmer, C.; Heuvel, M. van den</i>	631
Investigations on the gas processes in industrial waste sites <i>Rettenberger, G.</i>	641
The use of bioassays for contaminated soil investigations <i>Sellner, M.</i>	649
On-site investigation of contaminated soil by GC-MS and EDXRF-techniques <i>Matz, G.; Schröder, W.; Flachowsky, J.</i>	657
Developing a software tool to support investigation strategies to tackle problems in the field of contaminated sites <i>Groh, H.; Pahl, A.</i>	665
Geotechnical investigations and considerations for the redevelopment of Bowman's harbour and adjacent land <i>Brocklebank, H.T.; Gahir, J.S.</i>	673
Soil monitoring networks: suitable tools for policy evaluation <i>Kleijn, C.E.; Leenaers, H.</i>	683
How to estimate costs due to contaminated sites: a prognostic method to permit initial risk considerations for industrial enterprises and real estate in the East German Länder <i>Bonnenberg, H.; Milde, G.; Grunewald, G.</i>	693
Examination of playgrounds and sport-fields in Northrhine-Westphalia concerning PCDD/F - containing copper slag methods and results <i>Alberti, J.; Bachhausen, P.; Brüll, U.; Plöger, E.; Stock, H.D.</i>	703
PAH field analysis - A field method for the analysis of PAH in soil samples at a semi-quantitative level <i>Vree, H.B.R.J. van; Lubbers, R.G.M.; Urlings, L.G.C.M.; Delft, R.J. van</i>	713

The application of geophysics to the exploration and
controlling of waste dumps - case histories
Seidel, K.; Seidemann, O.; Woitke, L. 717

Execution of a risk assessment for the major dump
at Vorketzin near Potsdam
Hamer, H.; Boehringer, A.; Gronemeier, K.; Voigt, H.J. 727

3.2 Remedial action plans and organisation

System for evaluating alternative techniques for
cleaning up contaminated sites in order to derive
a remedial action concept
Zarth, M. 737

Investigation and decontamination of soil and groundwater
at former soviet army bases in Czechoslovakia
Svoma, J. 747

The complexities of polluted site and derelict
land reclamation - interregional cooperation of
traditional european industrial regions
Ferber, U. 755

Cleaning up and clearing a dioxine-contaminated
metal smelting plant
Sonnen, H.D. 757

The research, development, demonstration, testing,
and evaluation program of the U.S. Department of
Energy Office of Technology Development
Anderson, Th.D. 769

Towards a spatially differentiated soil protection
policy within urban areas
Okx, J.P. 781

An experimental site to improve soil and groundwater
decontamination
*Arnaud, Cl.; Ducreux, J.; Muntzer, P.; Pottecher, G.;
Schäfer, G.* 789

Evaluation of treatment technologies using U.S. methods
for the remediation site Haynauer Strasse 58, Berlin
within the framework of the bilateral German-American
agreement
Berberich, G.; Argus, R.; Steffens, K.; Lewis, R. 799

The valuation of contaminated gasoline sites
Viveen, B.; Arnhem, P. van 807

Radiological registration, investigation and assessment of contaminated soil from past mining activities in the new German Federal States <i>Uhlenbruck, H.; Holzhauer, U.; Bachner, D.; Biesold, H.</i>	811
Assessment of remedial actions for contaminated sites <i>Neteler, Th.; Jessberger, H.L.</i>	819
Site clearance of the former dumping site Stade-Riensförde - Investigation of the dumping site <i>Hoins, H.; Tönjes, F.; Schmidt, U.</i>	829
Monitoring and evaluation for a low temperature thermal process that removes PCB's from soil - planning and quality assurance - <i>Steffens, K.; Scola, L.; Percin, P. de; Johnson, M.; Berberich, G.; Heuel, B.</i>	835
 <u>3.3 Control and monitoring</u>	
Control and Monitoring <i>Franken, R.O.G.</i>	845
Results of the long-term monitoring of different types of covers on the Georgswerder landfill (Hamburg, FRG) <i>Melchior, S.; Berger, K.; Vielhaber, B.; Miehlich, G.</i>	853
Results and experience of radiological measurements supporting recovery - shown on an recovery object <i>Lutze, H.; Horn, W.</i>	863
 <u>3.4 Reuse of cleaned sites and/or soil</u>	
Use of recycled soil for the regeneration of contaminated land <i>Fleming, G.; Thomson, L.</i>	871
Change of soil properties caused by thermal treatment in a rotary kiln at 1000°C <i>Goetz, D.; Holz, C.; Meyenburg, G.</i>	881
Requirements for the re-utilization of treated soil and material excavated from building sites - practical experience gained through a municipal recycling concept <i>Görtz, W.; Bantz, I.</i>	891

3.5 Short communications

Experience from investigations of the former warfare-related contaminated site of Stadtallendorf/Hessia <i>Albers, H.; Brozio, D.</i>	903
Sampling of natural and technical liners at the bottom of landfills and other contaminated sites - coring and sealing of the bore hole - <i>Baermann, A.; Neumann-Peters, W.; Neumann, P.</i>	905
Change of soilphysical values through oil-contamination <i>Berghausen, M.; Goetz, D.</i>	907
Study of the necessity and urgency of remediation of the nature reserve "Friesche Veen" <i>Bouwhuis, J.S.; Vries, P.O. de; Wetterauw, M.</i>	911
The fingerprint method - a practical tool in linking characterization and treatment of polluted soil and sediments <i>Bovendeur, J.</i>	913
Rapid determination of organic contaminations in soil by multilamp photoionization detection <i>Budovich, V.L.; Herrmann, F.P.; Polotniuk, E.B.</i>	915
In-situ determination of chlorinated hydrocarbons in ground waters using a fiber optic evanescent wave sensor <i>Bürck, J.; Conzen, J.P.; Klunder, G.; Zimmermann, B.; Ache, H.J.</i>	917
Isotope methods in environmental investigations <i>Dorr, H.; Gellermann, R.; Molitor, N.</i>	919
Strategy for developing soil cleaning guidelines: "How clean is clean" <i>Eckart, R.; Rutz, E.</i>	921
Developing soil cleaning guidelines: application to sites in an agricultural area <i>Eckart, R.; Rutz, E.; Wood, R.</i>	923
Securing of the hazardous waste site Münchehagen <i>Ermel, G.; Schnibben, V.; Höllger, D.</i>	925
Quality assurance programme for screening measurements of radium-226 in the environment <i>Genrich, V.</i>	927
Methodical experiences in data analysis <i>Glässer, C.; Prehn, M.</i>	929

Assessing heavy-metal contamination in soil applying a bacterial biotest and x-ray fluorescent spectroscopy <i>Gruiz, K.; Vodicska, M.</i>	931
Requirements of radiation protection for site clearance in case of radioactive contaminated soils <i>Guglhör, P.; Lehmann, K.H.</i>	933
Minimising ground contamination during factory closure <i>Harris, M.R.; Herbert, S.M.; Smith, M.A.</i>	935
Redox buffering capacity of aquifer sediment <i>Heron, G.; Pedersen, J.K.; Tjell, J.C.; Christensen, T.H.</i>	937
Draft of regulations governing fees for the compilation of expertises without sampling on former hazardous deposits and former hazardous sites <i>Hilbers, J.; Schönwald, I.</i>	939
Conversion products of explosives during combustion - analysis for risk assessment studies of open-pit burning areas <i>Holl, G.; Schneider, M.</i>	941
The assessment of the quality of measurements during the investigation of a contaminated site <i>Holst, C. von; Schlesing, H.</i>	943
Biosensor for quantitative determination of phenols <i>Kotte, H.; Strehlitz, B.; Ethner, K.; Stottmeister, U.</i>	945
Development of soil microbial activities, soil fauna and humic matter during remediation and recultivation of PAH-contaminated soil <i>Kraatz, M.; Emmerling, C.; Schröder, D.</i>	947
Development of a probe for in-situ monitoring of organics on potentially contaminated land <i>Langford, S.</i>	949
Project management by the construction authorities Rheinland-Pfalz for the in-situ decontamination of large fuel contaminated areas <i>Lupatsch, G.</i>	951
Sanitation plan for a former gasworks site in Hamburg-Barmbek contaminated with cyanide by a valuation matrix for a selection process <i>Mackeprang, M.; Schönwald, I.; Zarth, M.</i>	953
Decontamination of sewage fields by cultivation of different useful plants <i>Metz, R.; Wilke, B.-M.</i>	955

Considerations on the accuracy of sampling with regard to a waste dump <i>Mueller, H.; Butter, J.; Menzer, D.</i>	957
Experiences in the remediation of ground water contaminated by petroleum hydrocarbons in the vicinity of a former refinery property <i>Munk, C.</i>	959
Quality assurance of the isolation of a contaminated location <i>Pereboom, D.; Mulder, G.J.; Amelsvoort, G.F.M. van; Meurs, G.A.M. van</i>	961
Optimization of groundwater quality monitoring networks using SOLUTE <i>Pereboom, D.; Sellmeijer, J.B.; Mulder, G.J.; Kabos, R.</i>	963
Evaluation of different techniques to monitor bioluminescent microorganisms in soil or non-marine water samples <i>Petermann, A.; Schlobohm, I.; Mahro, B.</i>	965
The application of geophysical methods for the exploration of abandoned polluted areas <i>Pöppinghaus, K.; Holz, H.</i>	967
Organic contaminants in coal wastewaters and associated sediments - their analytical determination and interactions with humic organic matter <i>Pörschmann, J.; Stottmeister, U.</i>	969
The project "Kop van Zuid" in Rotterdam <i>Pulles, F.P.J.M.</i>	971
Investigation of subsurface contaminations by hydrocarbons, using CO ₂ -, CH ₄ - and O ₂ -measurements in soil gas <i>Pyka, W.; Weiss, H.J.; Erhard, B.; Grathwohl, P.; Seeger, T.</i>	973
Safety provisions at the technical examination of abandoned waste sites under the special regard of the risks caused by landfill gas <i>Rettenberger, G.; Gouverneur, U.</i>	975
The Hamburg utilization concept for excavated or treated soil, residual materials and recycled building materials <i>Rohweder, U.</i>	977
Advanced investigations on the warfare-related contaminated site Stadtallendorf <i>Schmüser, A.; Erlinghagen, K.P.</i>	979

Redevelopment of buildings in contaminated sites <i>Schramm, H.</i>	981
Exploration drillings below the hazardous waste site Münchehagen <i>Schröder, H.; Schnibben, V.</i>	983
Using PROSA to estimate the urgency of cleaning up potentially contaminated areas <i>Schröter, F.</i>	985
Methods and strategies for optimising the treatment of contaminated soils and contaminated sites within the framework of physical and environmental planning <i>Schwarz, J.; Pietsch, J.</i>	987
The use of vegetation studies in monitoring the surface cover system of the waste disposal site Georgswerder (Hamburg, Germany) <i>Seelig-Braker, A.; Neugebohrn, L.</i>	989
Hydrological monitoring of the surface covering system of the Hamburg-Georgswerder landfill <i>Sokollek, V.</i>	991
Amperometric Biosensor for nitrate analysis <i>Strehlitz, B.; Kotte, H.; Ethner, K.; Stottmeister, U.</i>	993
Use of information systems for the avoidance of waste in communes and as basis for waste economy concepts <i>Strehz, J.-R.; Flechsig, M.</i>	995
First results on the effects of direct thermal treatment on soil organic matter and availability of heavy metals <i>Tamis, W.L.M.; Lagas, P.; Berg, R. van den</i>	997
Problems and approaches related to the cleaning and safe storage of preparation residues from uranium ore mining in eastern Germany <i>Thein, J.; Hähne, R.; Klapperich, H.; Gross, U.</i>	999
Site investigation after PCB ground contamination in a west-german city <i>Wilken, M.; Jager, J.; Beyer, A.; Rakel, H.; Jager, E.; Zeschmar-Lahl, B.</i>	1003
Addresses of first-named authors	li
Keywords	lxxvii

VOLUME 2

4 STATE OF THE ART OF APPLIED REMEDIATING TECHNOLOGIES (CASE STUDIES, EXPERIENCES AND EVALUATION)

4.1 Emphasis on: In-situ technologies

- Remediation of contaminated soil; state of the art
and desirable future developments
Rulkens, W.H.; Grotenhuis, J.T.C.; Soczó, E.R. 1007
- Remedial operation for subsurface pollution due
to volatile organochlorine using soil ventilation
and groundwater extraction
Hirata, T.; Nakasugi, O. 1019
- In-situ soil remediation project for the rehabilitation
of low-permeability soil contaminated by carburettor
gasoline: consideration of reaction engineering aspects,
biodegradation tests and operating results
Greiner, D.; Schwartz, M.; Eckardt H. 1029
- Groundwater and soil remediation on the location of
the chemical plant Leuna - concept and first results
*Schneider, W.; Luckner, L.; Nitsche, C.; Kayser, J.;
Eichhorn, D.; Hensel, J.* 1037
- Biological in situ-remediation of sandy gravelly
gasworks subsoils
Gudehus, G.; Swinianski, J.; Würdemann, H. 1047
- Use of ion exchange and UV-light for removal
of complexed cyanides from groundwater
Aksay, B.; Kampf, R. 1057
- In situ bioremediation techniques of a site contaminated
with PAH - applying nitrate as an alternative oxygen
source - on laboratory and pilot plant scale
*Vree, H.B.R.J. van; Urlings, L.G.C.M.; Cuperus, J.G.;
Geldner, P.* 1065
- Cleaning up Goldbekhof in Hamburg
Marg, K. 1075
- In situ aquifer remediation from volatile or
biodegradable organic compounds, pesticides,
and nitrate using the UVB technique
*Herrling, B.; Alesi, E.J.; Bott-Breuning, G.;
Diekmann, S.* 1083

4.2 Emphasis on: Ex-situ technologies

- Trends in implementing innovative technologies in the U.S.
Kovalick, W.W. 1093
- Experience with different clean-up technologies at
an abandoned industrial site
Hilmer, E. 1101
- Soil washing, from characterization to tailor-made
flow diagrams, results of full-scale installations
Pruijn, M.; Groenendijk, E. 1109
- Documentation of an environmentally sound soil remediation
Munz, Chr.; Bachmann, A. 1119
- Soil decontamination centre Bochum
Törk, U. 1127

4.3 Short communications

- Investigation and remediation of an arsenic and
copper contamination
Altmayer, M.; Röder, R.; Rietzler, J. 1133
- Pilot and large scale experiences in the in-situ
bioremediation of an refinery-site polluted with
hydrocarbons
Battermann, G.; Fried, R.; Meier-Lohr, M.; Werner, P. 1135
- Kornharpen experimental landfill - balance-sheet of
a research project
Beckefeld, P. 1145
- Technical factors in the design of a programme for
ex-situ and in-situ bioremediation of a former oil
distribution terminal
Bewley, R.J.F.; Alexander, J.G. 1147
- Enhanced biotechnological remediation of oil polluted
soils with the CUM BAC® system by optimization and
modelling of the limiting factors
Brummeler, E. ten 1149
- Ebiox bioremediation of contaminated soil material
using vacuum heap technologies
Eiermann, D.R. 1151

Remediation of an acidic-tar-pond and contaminations of the surrounding soil with PAH, PCB, BTX and chlorinated hydrocarbons by immobilization <i>Ertel, T.</i>	1155
Extraction of heavy metals from contaminated materials by amino acids <i>Fischer, K.; Rainer, C.; Bieniek, D.; Kettrup, A.</i>	1157
Separation of uranium from polluted water with polyacrylamidoximes <i>Gohlke, U.; Otto, A.; Meyer, J.</i>	1159
Development of a full scale soil washing system for the King of Prussia Superfund Site, New Jersey, USA - a case study <i>Groenendijk, E.; Pruijn, M.</i>	1161
In-situ bioremediation of hydrocarbon in soil: pilot tests and field experiments <i>Gruiz, K.</i>	1163
The Preussag Anlagenbau approach to soil washing: optimized extraction of inorganic and organic contaminants <i>Härig, F.</i>	1165
Developments and operating experience in soilcleaning, a progress report on the developments in cleaning soils with chlorinated hydrocarbons, and operating experience in cleaning contaminated groundwater with biorotors <i>Hasselt, H.J. van</i>	1171
3D vertical circulation flows around groundwater circulation wells for aquifer remediation: numerical results <i>Herrling, B.; Stamm, J.</i>	1173
Concept of a redevelopment of a former gasworks plant area <i>Jaar, M.; Krebs, H.; Kilian, U.; Sauer, I.; Loock, R.; Mauck, P.</i>	1175
Testing and evaluation of soil and groundwater remediation process: ACT*DE*CON SM and MAG* SEP TM * <i>Johnson, D.O.; Edgar, D.E.; Wilkey, M.L.; Dunn, M.J.; Marlone, M.P.</i>	1177
Thermal soil cleaning plant Hochtief <i>Kimmel, H.</i>	1179

- In-situ bioremediation of underground storage tank sites using different IEG-circulation methods combining physiological and biological treatment techniques
Ligner, T.; Brinnel, P.; Lehr, C.; Blömer, R.; Adam, R. 1181
- The Geuzenhoek-project - Field tests of chemically interactive systems for containing highly contaminated dredging spoil
Loxham, M.; Eede, E. van den; Taat, J. 1183
- Treatment of contaminated soils by a combination of suitable, proven technologies
Mackenbrock, K. 1185
- Cost effective biological groundwater treatment
Marsman, E.H.; Vree, H.B.R.J. van; Bult, B.A.; Urlings, L.G.C.M. 1187
- Cleaning up a former industrial site with a soil washing system
Nickel, U. 1189
- Recycling biologically reclaimed soils
Oberbremer, A.; Petersen, R. 1191
- Inhibition of natural microbiological leaching processes
Ondruschka, J.; Glombitza, F. 1195
- Advanced stages of remediation on the property of the chemical factory Marktreidwitz (CFM) 1992-1995
Pedall, K. G. 1197
- Transfer of polycyclic aromatic hydrocarbons from contaminated soil in vegetables
Preusser, M.; Ruholl, H. 1199
- Air injection and in situ vapour extraction
Pijls, C.G.; Meer, J.A.M. van der; Heslinga, E.A.; Nijhof, A. 1201
- Investigations into the effect on the groundwater of deep compacting in the area of a former dump
Reichert, J.K.; Roemer, M.; Tillmanns, W. 1203
- Clean-up of contaminated industrial sites by directed soil air circular flow
Sick, M.R.; Alesi, E.; Borchert, S.; Klein, R. 1205
- Remediation of contaminated water by UV-Oxidation
Träxler, R. 1207

In situ removal of a decanoic acid spill below a storage tank at a large petrochemical site in the Netherlands <i>Visser, W.; Ree, C.C.D.F. van</i>	1209
Decontamination of polluted soil and waste water by ozone treatment <i>Voigtländer, R.</i>	1211
Immobilization of soil contaminated with lead <i>Wahlström, M.; Mäkelä, E.; Vahanne, P.; Paatero, J.; Talling, B.; Keppo, M.</i>	1213
In situ-bioreclamation of groundwater contaminated by chlorinated and nonchlorinated aliphatic and aromatic hydrocarbons - fundamental considerations and results of in situ-experiments <i>Wichmann, K.; Czekalla, C.; Cron, K.</i>	1215
 5 RESEARCH AND DEVELOPMENT, EMERGING TECHNOLOGIES	
<u>5.1 Emphasis on: Biological and Chemical Treatment</u>	
Capabilities and limitations in the performance of microbial remediation processes <i>Stottmeister, U.</i>	1219
Determining and predicting the degradative activity of a GEM in aquifer sediment microcosms <i>Egestorff, J.; Dwyer, D.F.</i>	1229
Carbon balance of a PAH-contaminated soil during biodegradation as a result of the addition of compost <i>Lotter, S.; Brumm, A.; Bundt, J.; Herrenklage, J.; Paschke, A.; Steinhart, H.; Stegmann, R.</i>	1235
Modelling and optimization of in-situ soil remediation <i>Cuperus, J.G.; Urlings, L.G.C.M.; Rulkens, W.H.; Keizer, M.G.</i>	1247
Mechanisms of microbial degradation of polycyclic aromatic hydrocarbons (PAH) in soil-compost mixtures <i>Mahro, B.; Kästner, M.</i>	1249
The vacuum-vaporizer-well (UVB): Basics, Karlsruhe testfield measuring results <i>Bürmann, W.; Wagner, H.</i>	1257
Application of specialized microorganisms for the bioremediation of soil and groundwater <i>Keuning, S.; Jager, D.</i>	1265

Pilot experiment on in-situ oxidation of propanthiol in the soil <i>Mackeprang, M.; Schönwald, I.; Wagner, I.; Zarth, M.</i>	1269
Different limitations affecting biodegradation of poorly water-soluble substrates <i>Plas, Chr.; Holubar, P.; Bauer, E.; Pennenstorfer, C.; Braun, R.</i>	1277
Use of ozone for soil remediation <i>Seidel, J.P.; Rothweiler, B.; Gilbert, E.; Eberle, S.H.</i>	1285
 <u>5.2 Emphasis on: Ex-situ treatment</u>	
Cleaning of contaminated soils - a treatment concept <i>Wömmel, S.; Calmano, W.; Heining, K.</i>	1287
Separation processes for the treatment of contaminated soil <i>Pearl, M.; Wood, P.</i>	1295
Cleaning of mercury contaminated soil by using a combined washing and distillation process <i>Hennig, R.</i>	1305
Soil remediation using microemulsions - concept and first results <i>Clemens, W.D.; Haegel, F.H.; Schwuger, M.J.; Stickdorn, K.; Subklew, G.; Webb, L.</i>	1315
Cleaning organically contaminated soil by steam extraction, results of semi-industrial tests <i>Hudel, K.; Forge, F.; Klein, R.; Schröder, H.F.; Tränkler, J.; Dohmann, M.</i>	1325
Ecotoxicological aspects of chemical pre-oxidation combined with subsequent microbial degradation of polycyclic aromatic hydrocarbons <i>Haeseler, F.; Stieber, M.; Werner, P.; Frimmel, F.H.</i>	1337
Biodegradation of TNT (2,4,6-trinitrotoluene) in contaminated soil samples by white rot fungi <i>Majcherczyk, A.; Zeddel, A.; Hüttermann, A.</i>	1345
Process for microbiological soil-remediation using gas/solid-fluidized bed <i>Grau, W.; Behns, W.; Ebenau, B.; Metzler, L.; Müller, M. Haida, H.; Friedrich, K.; Lakowitz, R.</i>	1353
Results of a feasibility study into the waste disposal at the Johannes Pit using the VerTech wet oxidation process <i>Daun, M.; Bitter, W.; Pönisch, J.</i>	1357

5.3 Short communications

- A combined remediation technique for soil containing organic contaminants: combined hydrocyclone separation, photochemical treatment and bio-remediation
Aksay, B.; Brummeler, E. ten; Bovendeur, J. 1369
- Soil washing including biological treatment of the contaminated silt/clay fraction
Beudert, G.; Kubler, P.; Schmid, K.; Hahn, H.H. 1371
- Bacterial degradation of PAH in mixed phase systems in airlift bioreactors
Bryniok, D.; Brunner, W.; Knackmuss, H.J. 1373
- Microemulsions for soil remediation
Clemens, W.D.; Haegel, F.H.; Nolte, P.; Stickdorn, K.; Webb, L. 1375
- Combined biological and chemical oxidation of the leachate of an industrial site in an experimental plant
Debus, O.; Krebs, H.; Hemmerling, L. 1377
- Biological treatment of silt taken from soil contaminated by organic substances in a 4-stage reactor cascade
Elias, F.; Wiesmann, U. 1381
- The conversion of gasworks contaminated soil into a carbonaceous adsorbent using a novel application of thermal treatment technology
Fowler, G.D.; Ouki, S.K.; Sollars, C.J.; Perry, R. 1383
- Microbial soil decontamination in a slurry reactor
Geerdink, M.; Hardevelt, E.; Schouten, I.; Loosdrecht, M. van; Luyben, K.Ch.A.M. 1385
- Remediation and re-urbanisation of derelict industrial sites - an alternative concept
Genske, D.D.; Klapperich, H.; Olk, C.; Noll, P. 1387
- Heavy metal removal from mineral soils with various extractants
Greinert, H.; Poprawska, B. 1389
- Soil contamination in the Pyrenees, a case study
Haar, A.J. van de; Roekel, G. van; Traspaderne, A. 1393
- Combined process for treatment of highly charged dump leachate
Hagen, K.; Scharff, K. 1399
- In situ treatment of groundwater in a solids-free zone
Haldenwang, L.; Eichhorn, D. 1401

Remediation wells equipped with porous polyethylen filters <i>Hötzl, H.; Sass, I.</i>	1403
Application of test systems for balancing and optimization of biological soil treatment <i>Hupe, K.; Heerenklage, J.; Lotter, S.; Stegmann, R.</i>	1405
Suitability of biological methods for the regeneration of loaded activated carbon using chlorobenzoic acid and thioglycolic acid as model substances <i>Jaar, M.; Krebs, H.</i>	1407
Microbiological remediation of oil contaminated soil in the bioStack-Flachbett-Bioreactor <i>Janzen, St.; Raphael, Th.; Knackstedt, H.G.; Bröcking, P.; Sprenger, B.</i>	1409
Electrochemical soil treatment <i>Jehring, H.; Jehring, R.; Rohde, R.</i>	1411
VEGAS: a new facility for large-scale physical modelling of in-situ remediation of contaminated groundwater and soils <i>Kobus, H.; Teutsch, G.; Koschitzky, H.P.; Cirpka, O.</i>	1413
Extraction of heavy metals from soil material, dust, cinders, mud and sewage sludge <i>Kretzschmar, R.</i>	1417
Physical, chemical and biological methods of in-situ treatment of soils contaminated with mineral oil <i>Müller, M.; Forge, F.; Liebeskind, M.; Schröder, H.Fr.</i>	1419
Investigations on the sealing of contaminated areas by grouting <i>Müller-Kirchenbauer, H.; Schlötzer, C.; Rogner, J.; Friedrich, W.</i>	1421
Extraction and modification of organic contaminations with supercritical water for the decontamination of soils <i>Nowak, K.; Brunner, G.</i>	1423
Mobilization of heavy metals in contaminated river sediments by bacterial leaching <i>Ondruschka, J.; Seidel, H.; Stottmeister, U.</i>	1425
A systematic procedure for the selection of solvents to be used in soil decontamination <i>Rebhan, A.</i>	1429
Investigations on the fixation and release of organic compounds in river sediments from the Leipzig region <i>Remmler, M.; Kopinke, F.D.; Stottmeister, U.</i>	1431

- In-situ biore Restoration of soil contaminated by mineral oil, PAHs and phenols in combination with extraction using non-ionic surfactants
Reusing, G. 1433
- Laboratory examination of heavy metal extraction from contaminated soils using organic complexing agents
Roos, H.J.; Forge, F.; Schröder, Fr.; Klein, R.; Dohmann, M. 1435
- Comparison between porous polyethylen filters and conventional slot-screens in soil gas extraction wells
Sass, I.; Frank, K.; Bruckner, F. 1437
- Biological remediation of the fine particle fraction of hydrocarbon-polluted hazardous sites in continuously fed bioreactors
Schmid, K.; Abbas, F.; Beudert, G.; Hahn, H.H. 1439
- Fixation of heavy metals in thermally treated mineralogical soil constituents
Schurgers, B.K. 1441
- Development and application of a combined soil cleaning plant for sanitation of mineral oil contaminated soils
Schuster, E.; Hutter, J.; Huber, E.; Huber, S.; Blank-Huber, M. 1443
- Warfare-related contaminated site Stadtallendorf/Hessen, actual stage of a research & development project for the soil remediation
Serwe, M.; Koch, W. 1445
- Comparative evaluation of in situ treatment of contaminated clay soils by vapor stripping, chemical oxidation and solidification
Siegrist, R.L.; Morris, M.I.; West, O.R.; Gates, D.D.; Pickering, D.A.; Jenkins, R.A.; Mitchell, T.J. 1447
- Biological treatment of an old deposit contaminated with chlorinated hydrocarbons: elimination and biodegradation
Sihler, A.; Bidlingmaier, W. 1449
- Remediation exhaust air purification by means of an absorption process
Sinz, S.H. 1451
- The potential use of surfactants in the field of physicochemical and biological soil clean up
Sobisch, T.; Reinisch, G.; Hubner, H.; Karg, A.; Niebelschütz, H. 1453

Microbial degradation of TNT in soil <i>Stoffers, H.; Grothkopp, A.; Winterberg, R.</i>	1455
Biological decontamination of gasworks soil in laboratory experiments with undisturbed samples <i>Swinianski, J.; Lund, Ch.; Gudehus, G.</i>	1457
Investigation of the contamination and treatment techniques for catcher sand in a military firing range <i>Thomas, A.</i>	1459
Application of the sulphur cycle for bioremediation of soils polluted with heavy metals <i>Tichy, R.; Grotenhuis, J.T.C.; Janssen, A.; Houten, R. van; Rulkens, W.H.; Lettinga, G.</i>	1461
Soil vapor extraction: limitations <i>Wehrle, K.</i>	1463
Methods of treating soil contaminated with chromium <i>Wernicke, G.; Wienberg, R.; Gerth, J.; Wilichowski, M.; Förstner, U.; Werther, J.</i>	1467
Possibilities for cybernetic control of fermentive on-site regeneration of soils contaminated by organic compounds <i>Wollner, H.</i>	1469
Investigation in parallel with remedial action, of the balance of materials and formation of metabolites involved in the application of a white rot clamp technique for cleaning up soil contaminated with PAH's <i>Zarth, M.; Elvers-Köhler, R., Wienberg, R.</i>	1471
Degradation of PCBs by white-rot fungi in solid phase systems <i>Zeddel, A.; Majcherczyk, A.; Hüttermann, A.</i>	1473
Membrane-photo-reactor for microbial degradation of volatile and toxic substances <i>Zenneck, C.; Märkl, H.</i>	1475

6 PREVENTION OF SOIL CONTAMINATION

6.1 Waste disposal and agricultural activities

Requirements for landfills in new German technical regulations according to the waste management act - A trial to avoid future hazardous problem sites - <i>Stief, K.</i>	1479
Landfill reconstruction investigations at the Schöneiche and Schöneicher plan landfills near Berlin <i>Heckenkamp, G.</i>	1487

Environmental provision and dump planning <i>Lieber, M.; Stolpe, H.</i>	1497
N-fertilization under consideration of ecological aspects <i>Körschens, M.</i>	1503

6.2 Prevention and Waste disposal

Coping with agricultural waste problems in an economic way <i>Sanders, J.P.M.</i>	1511
A sound and practical method to determine the quality of stabilization <i>Hinsenveld, M.</i>	1519
Preventive soil protection at industrial sites <i>Ruardi, P.A.</i>	1529
Safe management of mega amounts of inorganic residues from energy production and waste treatment <i>Pentinghaus, H.; Kienzler, B.</i>	1537

6.3 Short communications

Hydrological, geophysical and geochemical investigations for a future waste deposit site in Saxony <i>Beushausen, M.; Lange, G.; Krummel, H.; Hiltmann, W.</i>	1543
Estimation of emission for dumps according to the draft of the administration regulation "TA Siedlungsabfall" <i>Finsterwalder, K.; Mann, U.</i>	1545
Leaching of chromium from a disposal of the leather industry <i>Glombitza, F.; Ondruschka, J.</i>	1547
Studies of the immobilization of heavy metals from waste materials by solidification with hydraulic binders <i>Grosskurth, K.P.; Malorny, W.</i>	1549
Phosphate saturation and groundwater quality in sand soils in the province of Friesland <i>Hidding, H.; Vries, P.O. de; Hahn, A.; Veeningen, R.</i>	1551
Application of geophysical and hydrogeological methods at the abandoned waste disposal site "Eulenberg", near Arnstadt, Thüringen <i>Krummel, H.; Knödel, K.; Beushausen, M.</i>	1553
Ecology-minded production and waste utilization - necessary to save our waste disposal capacities <i>Lehmann, H.</i>	1555

Comparison of basic conceptions for repositories of radioactive waste and toxic waste <i>Rolle, A.; Schulz-Forberg, B.; Droste, B.</i>	1557
Leachate of waste in standard laboratory tests, in tests under landfill conditions and in a landfill <i>Steketee, J.J.; Tromp, W.F.T.; Urlings, L.G.C.M.</i>	1559
Setting standards for the quality and application of biogenic waste compost <i>Verloop, K.J.</i>	1561
The mineral base liner - a hydraulic and/or a geochemical barrier? <i>Wagner, J. F.</i>	1563
Optimization of biological pretreatment of residual waste <i>Wiegel, U.; Janikowski, G.</i>	1565
 7 WORKSHOPS	
Workshop in-situ soil remediation <i>Soczó, E.R.; Meeder, T.A.; Eijssackers, H.</i>	1571
Present state and assessment of environment and soil contamination in Czech Republic <i>Kuras, M.; Mikolas, J.</i>	1575
Soil contamination in Poland <i>Greinert, H.</i>	1581
Agro-environmental assessment and remediation. Case study in Hungary <i>Szabo, P.</i>	1593
Contaminated sites in Hungary <i>Takats, A.</i>	1603
Sustainable soil use <i>Palsma, A.J.; Diependaal, M.J.; Aelmans, F.G.; Hoekstra, E.J.; Leget, A.C.; Veen, H.J. van</i>	1609
Management framework for the surface cleanup of uranium milling wastes <i>Larson, N.B.; Lightner, R.G.; Bierley, D.</i>	1617
Characterization and physical separation of radionuclides from contaminated soil <i>Misra, M.; Neve, C.; Raichur, A.</i>	1623

A new fiber-optic sensor technology for rapid and inexpensive characterization of soil contamination <i>Milanovich, F.P.; Brown, S.B.; Colston jr., B.W.; Daley, P.F.</i>	1633
Containment and stabilization technologies for mixed hazardous and radioactive wastes <i>Buelte, J.L.</i>	1639
Radiological exposure assessment of the Fernald environmental management project <i>Eckart, R.E.; Wood, R.P.; Ijaz, T.</i>	1647
U.S. Department of Energy, Office of Technology Development, mixed-waste treatment research, development, demonstration, testing and evaluation <i>Berry, J.B.; Lurk, P.W.; Coyle jr., G.J.</i>	1655
National and international cooperation: the key to deployment of advanced technology for cleanup <i>Miller, D.F.</i>	1663
The need for a sound philosophical basis for environmental restoration for mixed wastes <i>Ahlquist, A.J.</i>	1673
Contaminated land treatment, derelict land reclamation in Europe <i>Böhm, H.R.</i>	1675
Derelict and contaminated land - policy and practice in Wales <i>Palmer, J.P.; Richards, I.G.</i>	1677
Addresses of first-named authors	xli
Keywords	lxvii

Further contributions

For technical reasons, the following contributions could be published in the German edition of these Proceedings (*Altlastensanierung '93*, ISBN 0-7923-2331-9) only.

2.5 Risks - Short communications

Leitfaden zur Erarbeitung von Konzepten zur Gefahrenabwehr
Beine, R.A.; Lassel, M.; Hoffmann, B.

3.3 Control and monitoring

Auffindung und Abgrenzung von Kontaminationen auf Altlasten, Deponien und Industriestandorten
Haupt, M.

3.4 Reuse of cleaned sites and/or soil

Vegetationsentwicklung auf dekontaminierten Böden - nach Pflanzensoziologischen Gesichtspunkten künstlich herbeigeführt.
Jochimsen, M.E.

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the German Federal Environmental Agency (UBA)

the Association of technical engineers for waste dump sites (ITVA)

the Technical University of Hamburg-Harburg

the Environmental Research Center Leipzig/Halle (UFZ)

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the Netherlands Ministry of Housing, Physical Planning and the Environment (VROM)

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the U.S. Environmental Protection Agency (EPA)

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Foreword

THE NEED TO ENCOURAGE SUSTAINABLE USE OF THE SOIL

Dr. M. Popp, Chairman of the KfK Board of Management
Prof.Dr.Ir. A. Rörsch, Member of the TNO Board of Management

Many in society have already come to recognize the importance of sustainable development. Yet, putting the concept of sustainable development into practice can be more difficult than might at first be thought. Before, for instance, the concept can be applied successfully to the soil, we need to know how this valuable resource can be used by the current generation, without restricting or seriously impairing any demands that may be placed upon the soil by future generations.

As we are sure you are aware, one of the most difficult elements in discussing this issue is the fact that we do not know what the requirements of future generations will be. Neither do we know which functions of the soil will be important. We therefore have no other option than to fall back on our existing knowledge and to take the current situation as our starting point. If the laudable aims of sustainable development are to be achieved, then the various functions that we now ascribe to the soil must be preserved for many years to come. This implies that we must refrain from activities that could irreversibly damage any such functions of the soil.

Acceptance of this view of sustainable development means that the soil should not only remain an important source of drinking water, but should also, for instance, be suitable for our children to play on. Following this train of thought, there should also be enough fertile soil on which to grow the crops needed by future generations, and it is implicit that the soil continues to play an indispensable role in sustaining complex ecosystems. Precisely because we do not know what demands future generations will make on the soil, we should attempt, wherever possible, to ensure that the multifunctional characteristics of the soil are not impaired. This implies, for example, that industrial land should never be allowed to become so contaminated as to effectively prevent it from being used for residential or recreational purposes in the future. Whenever serious soil pollution is detected, attempts must be made to restore the original quality for multifunctional use. This is the main task of soil contamination assessment and soil remediation, which have been the main topics of our four conferences. The definition of tolerable soil contamination criteria, at which multifunctionality for a sustainable

development is preserved, is the common field of soil protection and soil remediation.

All the indications are that society will want to use land more intensively in the coming years. This not only applies to agricultural operations, but it is also true of other activities. The demand for more space for industrial and residential premises continues to increase year by year, as does that for the transport infrastructure and for recreational purposes. Yet, one way around the increasing competition for space might be to place more emphasis on exploiting land as a three rather than a two dimensional resource. Underground transport is, for instance, an option which will clearly become more important in the years to come. It is interesting to note that technological expertise in this area is already quite advanced. A further way of exploiting the full potential of land resources is to promote greater use of underground storage, not only for dangerous materials, but also for energy sources. With these examples in mind, it is clear that, in the coming period, the use to which the soil is to be put will become increasingly important within the context of sustainable development.

At present, society is having to contend with the fact that previous generations did not fully appreciate the need for sustainable development. Since the turn of the century, pollution levels in the soil have increased significantly in the developed world. In the Netherlands, for example, the situation has now become so acute that only the most urgent problems can be addressed. It is clear that there are insufficient resources for an all encompassing soil remediation programme. Priority must be given to the decontamination of the most seriously polluted sites and to preventing the pollutants in question from dispersing. A well balanced and well planned set of measures must be taken over the next decades to restore most of today's polluted areas without excessive costs. Scientific results regarding processes in the soil, the evaluation of success and failure, and the further development of cost-effective remediation techniques will help to tackle this problem in an economical way.

Sustainable development requires that all operations that lead to irreversible contamination of the soil be stopped. However, this is a daunting task, as society produces so much waste and emissions that soil pollution is virtually unavoidable. Only when we are able to link the two halves of the manufacturing and consumption chain in such a way that uncontrolled material losses are eliminated, can we expect that further deterioration of the soil will be prevented.

TNO and KfK regard efforts to close material cycles as being particularly worthwhile. But equally well the organizations realize that there is still a lot to be done, if we are to solve many of the outstanding pollution problems that confront us today. Despite society's best efforts pollutants still

continue to enter the environment and continue to threaten the soil. We feel that the most effective way of organizing soil protection schemes is to adopt a differentiated approach, in which account is taken of the different uses to which land may be put. For example, it is not only unrealistic to expect that the same standards be applied to nature reserves as to industrial areas, but it is also unnecessary. At the same time, we should, however, take care to ensure that designating land for industrial purposes does not prejudice alternative uses in the future. It is also important to prevent any harmful substances present in more polluted areas from infiltrating protected zones.

When TNO first took the initiative to organize a conference on contaminated soil in 1985, a series of extensive soil surveys had already indicated that unpolluted soil had become a scarce commodity in the Netherlands. Since then, a similar picture has emerged in many other countries. As the extent of soil pollution problems has become more widely known, subsequent conferences have attracted even larger audiences. The importance of such events can never be overestimated. They provide a useful forum for researchers, policy planners, technologists and industrial representatives to meet and to discuss relevant problems.

A particularly interesting feature of the conferences on contaminated soil is the spirit of cooperation that has developed between German and Dutch scientists. While both countries are noted for having serious soil pollution problems, they have also managed to build up considerable reputations in the fields of soil remediation, soil protection and pollution prevention.

However, we should not delude ourselves with the belief that the scientific and technological knowledge that will be discussed at our Fourth Conference will be sufficient to realize the aims of sustainable development. These are merely the tools that will allow us to encourage sustainable use of the soil. It is also important to note that their deployment will not be without economic consequences. As a result, a series of difficult choices will have to be made by citizens, politicians, consumers and manufacturers. But equally well, these groups must be given realistic choices to make and they must be made aware of the consequences of choosing particular options. This places a special responsibility on researchers and technologists. Previous conferences have shown just what is possible in this area and we are confident that our present gathering will be no exception. We are convinced this conference will make an important contribution to encouraging sustainable use of the soil.

Introduction

F. Arendt, KfK (Conference chairman)
W. Harder, TNO (Conference co-chairman)

The 1993 Berlin conference on contaminated sites is the fourth in a series of meetings initiated by the Netherlands Organization of Applied Scientific Research (TNO) in 1985 and later continued with the Karlsruhe Nuclear Research Center (KfK) of Germany.

The present economic stagnation or recession in many countries is leading to various proposals to reduce the level of costly environmental activities: restricted funds are used for really urgent cases rather than precautionary measures. The level of soil contamination caused by the former centrally planned economies adds to this tendency. The Conference tries to broach this controversy by discussing once more the targets and strategies of soil remediation with follow-up use of the site as an important parameter. Both new regulations and modifications of existing lists for a tolerable level of contamination are reviewed alike. Immobilization and enclosure of pollutants are often less expensive than complete remediation and, consequently, may grow in significance. We consider the conference of great significance for demonstrating the experiences gained with management and remediation of contaminated sites internationally, among others to avoid mistakes and excessive costs.

Two new types of soil contamination became apparent after the end of the cold war. Many military sites, airfields and training grounds are being abandoned. After decades of use, large sections and hot spots of these sites are polluted to a high average level. The quantity and diversity of such problems seem to be particularly widespread in Germany, and the federal and state authorities, together with the former users, are developing strategies for a proper management of these sites. Countries such as the United States and Russia are facing problems created by the presence of nuclear material and the production of nuclear weapons. Enrichment plants, reactors, reprocessing facilities and production sites have often been used for more than 40 years leaving mixed radioactive and hazardous substances in the soil. Special targets, strategies and technologies for remediation such as in-situ vitrification should be applied. Mixed contaminations are also found in uranium-mining regions such as the Wismut sites of Saxony and Thuringia.

Lectures and workshops cover topics of regulations and

contaminations by former military use along with the "classical" subjects. The workshops were found to be a valuable opportunity for in-depth discussion and are continued. Topics of the workshops are preceded by an introduction in the proceedings; results will be presented later.

More than 120 lectures are given in plenary and parallel sessions, and more than 200 poster exhibits are presented. The length of the written contributions was strictly limited to eight pages for lectures and two pages for posters to keep the proceedings to two volumes and to maintain their character as a reference publication. The papers in the proceedings are arranged by subject. The first volume contains papers on the subjects 'Strategies and policies', 'Risks' and 'Management', the second one on the subjects 'State of the art of applied remediating technologies', 'Research and development, emerging technologies', 'Prevention of soil contamination' and workshop papers.

We gratefully acknowledge the authors' efforts to deliver their papers in high standards and on time, the indispensable conditions for a successful conference. Many authors have delivered their papers in both English and German, giving us the opportunity of publishing the proceedings in both languages. We thank the Scientific Committee, who has carefully selected lectures and posters among the abstracts received and has advised on the set-up of the conference programme; the TTS Translation Service in Hamburg and several editors at KfK, who have helped in completing the papers in both languages; the Maurits Groen office in Amsterdam for the handling of the publications. Finally, we would like to thank G. Annokkeé, R. Bosman and Jan van den Brink of TNO for their cooperation, and the latter also for the editing of the proceedings; and Mrs. H. Hoogervorst of Kluwer Academic Publishers for the production of these proceedings in a really very short time.

We are grateful for the organization of the Conference by the members of the Organizing Committee: Judith Tesser of TNO and her colleagues of Van Namen & Westerlaken Conference Services, who carried the bulk of the preparations; and U. Nickel of IWS Berlin with B. Mathes, H. Blume und R. Grimm of KfK, who arranged the local organization and technical tours.