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ORNL

FOREIGN TRIP REPORT

ORNL/FTR-3848

DATE: January 8, 1991

SUBJECT: Report of Foreign Travel by Robert L. Siegrist, Group Leader,
Geosciences Section, Environmental Sciences Division

TO: C. A. Hall

FROM: Robert L. Siegrist

PURPOSE: To (1) attend the 3rd International KfK/TNO Conference on Contaminated Soil for the purpose of making oral and poster presentations as well as gathering and exchanging information about the characterization and remediation of contaminated soil and sediments and (2) discuss and finalize the results and conclusions of a collaborative research project on humic substance formation in wastewater-amended soils with researchers at the German Institute for Water, Soil and Air Hygiene (GIWS&AH), and the Norwegian Institute for Soil and Environmental Research (NIS&ER).

SITES VISITED:

12/10-13/90	KfK/TNO International Conference	Karlsruhe, Germany	F. Arendt M. Hinsenveld
12/14/90	GIWS&AH NIS&ER	Langen, Germany	Z. Filip R. Smed-Hildmann

ABSTRACT: The traveler attended the 3rd International Conference on Contaminated Soil, held in Karlsruhe, Germany. The Conference was a status conference for worldwide research and practice in contaminated soil assessment and environmental restoration, with more than 1500 attendees representing over 26 countries. The traveler made an oral presentation and presented a poster.

At the Federal Institute for Water, Soil and Air Hygiene, the traveler met with Dr. Z. Filip, Director and Professor, and Dr. R. Smed-Hildmann, Research Scientist. Detailed discussions were held regarding the results and conclusions of a collaborative experiment concerning humic substance formation in waste-amended soils.

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SUMMARY OF ACTIVITIES:

International KfK/TNO Conference on Contaminated Soil: At Karlsruhe, Germany, the traveler attended the 3rd International Conference on Contaminated Soil. The conference was a status conference for worldwide research and practice in contaminated soil assessment and environmental restoration, with more than 1500 attendees representing over 26 countries. The traveler made an oral presentation describing the development and implementation of environmental quality criteria for contaminated sites, and he presented a poster describing methods for measuring volatile organic compounds in contaminated soils and sediments. During four days of attendance, the traveler exchanged information regarding the science and engineering of contaminated sites with existing colleagues and new contacts from research institutions, academia, private industries, and governments from throughout the world (e.g., Germany, The Netherlands, Denmark, Finland, Norway, the United States, and Poland).

The scope of the conference was quite broad, as evidenced by the technical sessions which included the following:

- A1. Strategies and policies in industrialized countries;
- A2. Newly industrialized and developing countries;
- A3. Legal, economic, and social aspects;
- B1. Risk assessment;
- B2. Behavior of contaminants;
- B3. Effects of pollutants;
- C1. Strategies of the sanitation of waste dumps;
- C2. Case studies of completed projects;
- C3. Reuse of cleaned sites;
- C4. Problems and remediation of polluted sediments;
- D1. Investigation and control;
- D2. Remedial action techniques;
- D3. Safeguarding techniques, and
- D4. Prevention of future site contamination.

The oral presentations were quite short (i.e., 15 minutes), and there were several concurrent sessions. The oral and poster presentations were published in a proceedings (approximately 1450 pages in length) that was distributed at the beginning of the conference. It is impossible to summarize the Conference in this Foreign Trip Report. However, several general observations were derived on the basis of participation at the Conference.

First of all, the level of interest and the state of knowledge and practice are growing at an increasing rate in the area of contaminated soils and sediments. In addition to theoretical and laboratory research and development, there is an increasing data base of full-scale project experiences. Several research and academic institutions in Europe have had very active research and development programs in contaminated soil and sediments for many years and will continue to be important in the advancement of this field. Perhaps most notable are two institutions in

The Netherlands: The Netherlands Organization for Applied Scientific Research (TNO) and the National Institute for Public Health and Environmental Protection (RIVM). These institutions have comprehensive programs in site characterization, assessment, and remediation technologies.

Efforts to transfer information across national boundaries are growing. This is evidenced by this international conference, the ongoing North Atlantic Treaty Organization (NATO)/Committee for Challenges to Modern Society (CCMS) project demonstrating remedial technologies for contaminated soil and groundwater, and the increasing number of cooperative arrangements between institutions in different countries.

Increasing recognition of problems with contaminated soil and sediments has begun to change societal views of soil as a resource. Whereas contaminated soil programs in the United States have generally been geared to site cleanup to reduce risk (and perhaps liability), many European nations have broad-based soil protection programs within which the contaminated soil programs operate. Europe as a whole has focused on "sustainable development," with The Netherlands and Germany leading the movement. These soil protection programs consider soil as an essential resource and have the goal of maintaining its viability for all its critical functions. Research and development programs and remediation efforts then operate within this context.

Contaminated soils and sediments are increasingly recognized as a major environmental problem. In nations with well-established programs in contaminated soil as well as in those without them, increasing efforts are expended on identifying, inventorying, and assessing the nature and extent of contaminated soil and sediments. Considerable discussion and debate ensued regarding the assessment of contaminated sites with regard to their public health effects, and there was growing interest in ecotoxicological effects. The Netherlands is completing an analysis of its "C-values" or cleanup criteria limits based on risk assessment that includes public health as well as ecotoxicological analyses. This work is expected to be published within the next several months. There was general consensus, albeit somewhat reluctantly given, that environmental quality criteria must be developed to facilitate site assessment, environmental restoration, and soil protection in general. Considerable progress has been made in developing such criteria in The Netherlands, and work is ongoing here as well as in Germany, Denmark, and Canada. While they have been reluctant to support this concept until now, representatives of the United States are showing growing interest and support as well. A simplified model for site hazard assessment has been developed under the sponsorship of an industrial consortium, ECETOC, in Brussels, Belgium. Discussions with the project manager from Shell Development International revealed a just-completed report about the model. The model considers nine exposure pathways and enables simplified calculations of allowable soil and groundwater contamination levels on the basis of variables concerning acceptable daily intake and acceptable risk, among other factors. Because the model looks interesting, a copy has been ordered.

The traveler had detailed discussions with researchers, industry representatives, and regulators regarding the status of efforts to develop and implement environmental quality criteria for contaminated soils and sediments. There was clear consensus throughout the symposium that such criteria were an essential part of the contaminated site environmental restoration process. The traveler initiated discussions with several key individuals from Germany, The Netherlands, Canada, Norway, and the United States regarding this topic. Great interest was shown in the proposed research concepts, and informal agreements were made to coordinate research. The traveler proposed and discussed the possibility of ORNL's hosting a national/international symposium on this topic with representatives from the U.S. Department of Energy (DOE), the U.S. Environmental Protection Agency (EPA), Environment Canada, and The Netherlands. The traveler plans to explore this topic further and perhaps initiate planning for such a gathering.

Special problems exist within Eastern European nations, such as the former German Democratic Republic (GDR), Poland, and Hungary. In many cases, enormous problems were caused by years of unchecked industrial emissions, mining activities, military operations, and chemical waste disposal activities. Such problems include (1) thousands of holes from lignite mining filled with wastes and (2) millions of cubic meters of uranium mill tailing piles adjacent to residential areas in the former GDR. Work is just beginning to address problems such as these, but there is concern that adequate resources--both in personnel, equipment, and money--are unavailable for this enormous challenge. Clearly, the expertise and experience within the DOE national laboratories could benefit the effective characterization and resolution of massive problems such as these. A unique opportunity exists due to the massive nature of some of these problems. Information on biogeochemical cycling processes exists to varying degrees within the Eastern Bloc nations, but it could probably be enhanced by more-sophisticated data analysis and interpretation methods as well as by additional monitoring and measurements. Much knowledge could be gained by conducting comprehensive epidemiological studies of large human populations as well as studies of ecosystems exposed to widespread and significant contamination over a relatively long time period. Some regional agreements are already in place (e.g., Germany, Poland, Hungary, and Czechoslovakia), and others are being established to develop and implement regional solutions to widespread problems as well as to foster exchange of expertise and information.

Considerable research is beginning to be undertaken in contaminated sediments. The Netherlands has established a significant program in this area. Discussions about a potential visit to ORNL during 1991 were held with the manager of the program.

Technologies for sampling and analyses centered on innovative developments for field screening and analyses, as well as for improved laboratory methods. The use of subsurface probing technologies as opposed to conventional drilling techniques continues to gain ground, and its benefits were demonstrated in several applications.

One site-characterization issue that was discussed is related to the delineation of the site concentration terms which are fit into models of transport/fate and risk assessment. There was no clear consensus on how to measure and compute these terms.

The oral presentations and poster sessions as well as the vendors in the exhibition presented numerous technologies for site cleanup. In general, no new technologies were discussed, apart from those familiar to the traveler. However, information was gained regarding design and performance, process optimization, and project experience. Several technologies offer promise for many DOE sites where problem soil and sediment conditions exist (e.g., wet, clay soils). Electrokinetic reclamation has been demonstrated in The Netherlands as a viable option for site cleanup, especially for heavy metals. This technology is offered by at least one commercial vendor, Geokinetics. Hydrofracturing permeable soil with low permeability has been accomplished at several test sites by EPA and can facilitate remediation technologies in these materials (e.g., vacuum extraction and in situ bioremediation). A German company has accomplished in situ soil slurrification followed by pumping and ex situ soil washing at a coal-gasification site.

Discussions were held with numerous technology vendors regarding their technologies and experiences. None of the vendors contacted had any projects in the United States, although they were interested in that market. Some expressed concern about working with radioactively contaminated soils and sediments such as occur at the DOE sites. Interestingly, discussions with F. Arendt, Project Director at the Karlsruhe Nuclear Research Center, indicated that there were no serious problems with radioactively contaminated soils or sediments in Germany. However, he did indicate that scientists were becoming involved in such problems in Eastern Bloc countries. One vendor indicated that his company was involved in the cleanup of a large fuel spill at a U.S. military base in Germany, apparently related to Operation Desert Shield.

The traveler's perception, as well as that of many others at the conference, was that a continuing need exists for rigorous field-scale demonstrations of innovative technologies, particularly with multiple technologies operated side by side for comparative purposes. Without such opportunities for trial and error at real sites, progress will continue to be slow. The NATO/CCMS pilot study on remediation technologies for contaminated soils is perhaps the only international forum for accomplishing this task. This project was cofounded by the United States, The Netherlands, and Germany in 1987. The traveler participated as an expert guest in the Oslo meeting in 1990. The pilot study project is nearing the end of its five-year duration. Because of the success in demonstration and technology transfer during the first five years, the project participants are planning to petition NATO to sponsor another five years. However, no similar project is in place for monitoring and measurement technologies. The lack of a similar project hampers the effective evaluation and transfer of technologies across national boundaries where methods vary dramatically. The United States appears to

be a leader in the standardization of monitoring and measurement methods. With representatives of several nations, the traveler discussed the concept of a similar NATO/CCMS project on contaminated site monitoring and assessment.

Federal Institute for Water, Soil and Air Hygiene: Detailed discussions were held with Dr. Z. Filip, Director and Professor, and Dr. R. Smed-Hildmann to review and finalize the results, interpretation, and conclusions of a cooperative experiment completed with them and Dr. P. D. Jenssen of the Norwegian Institute for Soil and Environmental Research during 1989 and 1990. This research was initiated to study the role of humic substances in land-based wastewater treatment processes. Accumulation of organic matter by filtration and sorption followed by synthesis of humic substances has been proposed as a process that could contribute to soil pore clogging and reduced permeability as well as enhanced purification. In contrast, humic substances have been shown to facilitate transport of contaminants in some environments. The primary purpose of this work was to determine if humic substances could be formed in soils under conditions typical of those present during wastewater infiltration. A secondary purpose was to gain insight into the role of these substances in soil pore clogging processes as well as in general flow and transport processes. Results of this experiment suggested that humic substances can be formed during wastewater infiltration and may effectively contribute to soil clogging and very possibly other soil processes. It was agreed that a final research report as well as an open-literature publication (senior author, R. L. Siegrist) can now be prepared. Further cooperative research and development were discussed, and further interactions are planned for early 1991.

SUMMARY EVALUATION AND RECOMMENDATIONS:

International KfK/TNO Conference on Contaminated Soil: This International Conference served as an excellent forum for interacting with the worldwide scientific community regarding contaminated site characterization, assessment, and remediation. The conference was truly an international one, with more than 1500 attendees from over 26 countries. The numerous and diverse oral and poster presentations, as well as the personal interactions and discussions, provided broad, in-depth understanding of the state of knowledge and practice in science and engineering aspects associated with contaminated soil and sediments. It also provided new insight into the problems confronting Eastern Europe and developing countries.

Perhaps the greatest value derived from attending the Conference was in the personal interactions with conference attendees (Appendix B). Extremely valuable interactions were held with Scandinavian and European colleagues, with whom ties were established when the traveler was a Visiting Senior Scientist in Norway during 1988 and 1989. Many new contacts were made as well. Moreover, there were valuable interactions

with personnel from the DOE Office of Technology Development and from the EPA Office of Emergency and Remedial Response.

The benefits derived from the conference were, without question, worth the cost of attending. In particular, awareness of the international state of knowledge and practice was valuable to validate technology demonstrations planned within the environmental restoration program at several DOE sites as well as to validate research and development topics under consideration by the traveler. It is clear that contaminated soil and sediment constitute a global problem and that its effective resolution will depend, in part at least, on information and technology exchange on an international basis.

Direct results of conference participation and anticipated future personal interactions include the following:

1. Detailed information on innovative approaches and technologies for application to environmental restoration problems and projects within the DOE system.
2. Further interaction with commercial vendors located in The Netherlands, Germany, and Denmark regarding integration of their innovative technologies for contaminated soils and sediments into the U.S. marketplace at DOE sites. Examples of technologies of particular interest include
 - in situ electrokinetic processes for removing polar contaminants (e.g., metals and polar organics) from low-permeability clay soils;
 - an ex situ extraction process for removing organics from waste materials and contaminated soils that have contaminated tars and sludges in them; and
 - in situ jet-washing of contaminated soils.

The traveler will discuss the acquired information and contacts during upcoming meetings with Dr. Don Alexander, Program Manager for the International Technology Exchange Program within the DOE Program Support Division (EM-53).

3. Discussions about the possibility of having several foreign researchers visit ORNL during 1991 as part of study tours of the United States (e.g., Dr. Thomas Christensen, Technical University of Denmark, research into bioremediation of organics and metal speciation and transport; Dr. Steen Vedby, Phonix Miljo, extraction process for contaminated tars and sludges; Ms. M. R. B. van Dillen, The Netherlands Institute for Inland Water Management and Waste Water Treatment, contaminated sediment program; and Dr. Z. Filip, Institute for Water, Soil and Air Hygiene, humic substances).

4. Invitation to participate in an EPA Technology Transfer seminar series on contaminated soil treatment technologies planned for 1991.
5. Further interaction with DOE and EPA regarding research into development, implementation, and evaluation of environmental quality criteria for contaminated sites. Continued discussion and planning for hosting a national/international symposium at ORNL on criteria for environmental quality at contaminated sites.
6. Further interaction with the DOE Office of Technology Development and the EPA Risk Reduction Engineering Laboratory and Environmental Monitoring Systems Laboratory regarding cooperative research into methods development for characterizing volatile hydrocarbons and in situ treatment processes for contaminated soils.
7. Further interaction about cooperative research with The Norwegian Institute for Soil and Environmental Research, The Netherlands Organization for Scientific and Applied Research, and The Karlsruhe Nuclear Research Center.

Federal Institute for Water, Soil and Air Hygiene: Detailed discussions with collaborative researchers have facilitated the completion of a research report and the preparation of an open- literature publication during early 1991.

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APPENDIX A

TRIP ITINERARY

December 9-10, 1990	Travel from Oak Ridge, Tennessee, to Frankfort, Germany, and on to the conference site in Karlsruhe, Germany.
December 10, 1990	Arrival in Karlsruhe. Conference registration and poster presentation preparations. Opening session of conference. Informal discussions with conference sponsors and attendees.
December 10-13, 1990	Attend conference presentations. Discussions with numerous technology vendors. Informal discussions with colleagues from North America, Europe, and Scandinavia.
December 14, 1990	Travel to Langen, Germany, and meetings with the Federal Institute for Water, Soil and Air Hygiene.
December 15, 1990	Return to Oak Ridge, Tennessee.

APPENDIX B

PERSONS CONTACTED TO A SIGNIFICANT EXTENT

Canada

Dr. E. L. Hoffman, Hazardous Contaminants Branch, Ontario Ministry of the Environment, 135 St. Clair Avenue West, Toronto M4V 1P5, Canada.

Ms. C. Gaudet, Environment Canada, Ottawa, Ontario K1A 0H3, Canada.

Denmark

Dr. T. H. Christensen, Technical University of Denmark, Department of Environmental Engineering, 2800 Lyngby, Denmark.

Dr. P. Kjeldsen, Technical University of Denmark, Department of Environmental Engineering, 2800 Lyngby, Denmark.

Dr. S. Vedby, Phonix Miljo, 6600 Vejen, Denmark.

Finland

Mr. T. W. Assmuth, National Board of Waters and the Environment, Technical Research Office, 00101 Helsinki, Finland.

Mr. A. Seppanen, Ministry of the Environment, Waste Management Branch, 00121 Helsinki, Finland.

France

Dr. P. Renaud, Lyonnaise des Eaux Research Centre, 78230 Le Pecq, France.

Germany

Mr. F. Arendt, Chairman, Conference Scientific Committee; Project Leader, Karlsruhe Nuclear Research Center, Karlsruhe, Germany.

Dr. Z. Filip, Director and Professor, Federal Institute for Water, Soil and Air Hygiene, Langen, Germany.

Dr. V. Franzius, Director, Federal Environmental Agency, Berlin, Germany.

Dr. R. Smed-Hildmann, Research Scientist, Federal Institute for Water, Soil and Air Hygiene, Langen, Germany.

Dr. K. T. von der Trenck, Landesanstalt fur Umweltschutz, 7500 Karlsruhe, Germany.

Norway

Mr. H. Solberg, Norwegian State Pollution Control Authority, 0032 Oslo, Norway.

Poland

Dr. H. Greinert, Polytechnic Institute, Zielona Gora, Poland.

The Netherlands

Ms. M. R. B. van Dillen, Research Manager, Institute for Inland Water Management and Waste Water Treatment, Lelystad, The Netherlands.

Dr. F. A. M. de Haan, Professor, Agricultural University, Wageningen, The Netherlands.

Mr. M. Hinsenveld, Conference Scientific Committee Co-Chair; The Netherlands Organization for Scientific and Applied Research, Delft, The Netherlands.

Dr. R. Lageman, Director, Geokinetics v.o.f., Delft, The Netherlands.

Dr. C. L. M. Poels, Shell International, Health, Safety and Environment Division, The Hague, The Netherlands.

Ms. J. G. Robberse, Ministry of Housing, Physical Planning and the Environment, Technical Soil Protection Committee, 2260 MB Leidschendam, The Netherlands.

Dr. J. J. Vegter, Ministry of Housing, Physical Planning and the Environment, Technical Soil Protection Committee, 2260 MB Leidschendam, The Netherlands.

Dr. F. B. de Walle, Director, Information Center for Environmental Research, The Netherlands Organization for Scientific and Applied Research, Delft, The Netherlands.

United Kingdom

Dr. P. Bardos, Department of Trade and Industry, Warren Spring Laboratory, Stevenage, Hertfords, United Kingdom.

Mr. M. A. Smith, Clayton Environmental Consultants, Birmingham, United Kingdom.

United States

Mr. E. D. Barth, Risk Reduction Engineering Laboratory, U.S. Environmental Protection Agency, Cincinnati, Ohio.

Dr. P. L. Bishop, Professor and Head, Department of Civil and Environmental Engineering, University of Cincinnati, Cincinnati, Ohio.

Mr. E. Koglin, Manager, Site Monitoring and Measurement Program, U.S. Environmental Protection Agency, Environmental Monitoring Systems Laboratory, Las Vegas, Nevada.

Dr. W. W. Kovalick, Jr., Director, Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C.

Mr. B. K. Means, Chief, Health Effects Program, Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C.

D. F. Miller, Science Advisor, Office of Technology Development, U.S. Department of Energy, EM-50, Washington, D.C.

Mr. S. A. Schulhof, President, Center for Hazardous Materials Research, University of Pittsburgh; Director, Environmental Research Center, General Electric Company, Schenectady, New York.

Dr. N. Z. Shilling, Manager, Environmental Projects, Environmental Research Center, General Electric Company, Schenectady, New York.

Mr. J. F. Vorbach, Contaminated Soil Program, Office of Solid Waste, U.S. Environmental Protection Agency, Washington, D.C.

Mr. J. C. Tuttle, Field Analytical Support Project (FASP), Ecology and Environment, Inc., Arlington, Virginia.

APPENDIX C

LITERATURE OBTAINED

Arendt, F., M. Hinsenveld, and W. J. van den Brink (eds.). 1990. Contaminated Soil '90. Proceedings, Third International Conference on Contaminated Soil, 10-14 December 1990, Karlsruhe, Federal Republic of Germany. Kluwer Academic Publishers, Boston. 1454 pp.

Meent, D. van de, T. Aldenberg, J. H. Canton, C. A. M. van Gestel, and W. Slooff. 1990. Desire for levels: Background study for the policy document, "Setting Environmental Quality Standards for Water and Soil." Report No. 670101 002, National Institute for Public Health and Environmental Protection, Bilthoven, The Netherlands. 131 pp.

Statements of capabilities and experience by several technology vendors from The Netherlands, Germany, and Denmark.

END

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