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| United States Nuclear Regulatory Commission Official Hearing Exhibit | |
| In the Matter of: CROW BUTTE RESOURCES, INC. (License Renewal for the In Situ Leach Facility, Crawford, Nebraska) | |
|  | ASLBP #: 08-867-02-OLA-BD01 |
| | Docket #: 04008943 |
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NRC-077
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Mark Fuhrmann, Ph. D.

Office of Nuclear Regulatory Research
U. S. Nuclear Regulatory Commission
Phone: (301) 251-7472, **e-mail:** mark.fuhrmann@nrc.gov

EXPERTISE:

Geochemistry of Contaminants, Leaching of Contaminants

EXPERIENCE:

2007-present U.S. Nuclear Regulatory Commission, Office of Research, Geochemist

Responsible for managing research projects on Uranium bioremediation and sorption of contaminants. Member of teams reviewing remediation plans at the Cimarron and Shieldalloy sites.

**1980-2007 Brookhaven National Laboratory. Geochemist (Continuing Appointment)
Manager of Beamline X-11 at National Synchrotron Light Source**

Experience includes: Chemistry of tank back-fill grouts; Phytoremediation of radionuclide contaminated soils; Sorption and desorption of radionuclides and RCRA elements as contaminants on soils; Leaching processes and alteration of solid phase of waste forms; Synchrotron based techniques applied to contaminant geochemistry; Geochemistry of radioactive waste disposal; Ocean disposal of low-level radioactive waste.

Patents and Standards

- ! Co-inventor of sulfur polymer treatment of Hg waste, patent # 6,399,849
- ! Inventor of in-situ methods for removal and treatment of Hg from soils, patents 7,692,058 and 7,589,248
- ! Developed the Accelerated Leach Test (ASTM C-1308) and ASTM Method for K_d Determinations

Principal Investigator:

- ! Sorption Isotherms for radionuclides and RCRA elements on grout for high-level waste tanks at West Valley Demonstration Project, including molecular characterization of Cr on the grout.
- ! Lab Directed Research Grant A Chemistry of the Rhizosphere@.
- ! Phytoremediation of radionuclide contaminated soil at BNL, multi-year grant completed 2002.
 - Plant uptake of ¹³⁷Cs from BNL soils, including large-scale field studies.
 - Plant uptake of ²⁴¹Am and metals from BNL filter beds, greenhouse and field studies.
- ! Sorption/desorption of radionuclides on concrete at the Maine Yankee Nuclear Power Station
- ! Developed inexpensive method to remove ⁹⁰Sr from BNL waste water.
- ! Studied sorption of iodine on minerals by XANES at the National Synchrotron Light Source.
- ! Characterized and selected materials to sorb ⁹⁰Sr on the permeable sorbant barrier planned for the West Valley Demonstration Project.
- ! Conducted a geochemical study of contaminant transport and interactions with soils at West Valley that included: measurement of diffusion coefficients in glacial tills, sorption kinetics and K_d values for U, Sr, Cs, Co, I, Pu, Np, Am, and Tc, and interactions of TBP with soil and its effect on uranium partitioning in groundwater.
- ! Developed waste form performance criteria for DOE mixed wastes.
- ! Developed for EPA, waste form performance criteria for ocean disposal of radioactive waste.
- ! Led a laboratory and economic analysis of methods that may be used for Asoil washing@ of ¹³⁷Cs and ⁹⁰Sr from contaminated soil at BNL.
- ! Quantified sorption (K_d) and desorption of radioactive contaminants that were dumped into the Kara Sea by the Former Soviet Union and calculated mass balances of these contaminants showing that contaminants appear to stay localized.
- ! Experimental studies to determine K_d values for U, Mo and V at the Fernald site, under conditions that simulated the effect of leaching from cement based waste forms.
- ! K_d values determined for radionuclides for soils from Brookhaven National Laboratory.

EDUCATION:

State University of New York, Stony Brook
Adelphi University, Garden City, NY
State University of New York, Empire College

Ph.D. 1997 Geochemistry
M.S. 1980 Geology
B.S. 1978 Marine Sciences

Selected Publications

Fuhrmann, M. and C. Barr, Fundamentals of Adsorption of Contaminants, Short Course Published as NRC web video Course ID 145145, 2015.

Fuhrmann, M. and J. Kanney, Early Leak Detection External to Structures at Nuclear Power Plants, NUREG-2151, 2013.

Co-author of invited talk at the Goldschmidt 2014 Conference: Oxidative remobilization of uranium following biostimulated reduction

S. B. Yabusaki, Y. Fang, S.R. Waichler, C. C. Fuller K. Akstin, P.E. Long, and M. Fuhrmann, Assessing the Potential for Bioremediation of Uranium In Situ Recovery Sites, NUREG/CR-7167, 2013

Ftenakis, V., M. Fuhrmann, J. Heiser, A. Lanzirrotti, J. Fitts, and W. Wang, Emissions and Encapsulation of Cadmium in CdTe PV Modules During Fires, In Press, *Progress in Photovoltaics*, 2004.

Fuhrmann, M. and J. Fitts, Adsorption of Trace Metals on Glass Fiber Filters, *Journal of Environmental Quality*, 33:1943-1944, 2004.

Fuhrmann, M. and A. Lanzirrotti, ^{241}Am , ^{137}Cs , Sr and Pb Uptake by Tobacco as Influenced by Application of Fe Chelators to Soil, *Journal of Environmental Radioactivity*, vol. 82:33-50. 2004.

Lombi, E., F-J Zhao, M. Fuhrmann, L. Ma, and S. McGrath, Arsenic Distribution and Speciation in the Fronds of the Hyperaccumulator *Pteris vittata*, *New Phytologist*, 156:195-203, 2002.

Fuhrmann, M., M. Lasat, S. Ebbs, J. Cornish, and L. Kochian, Uptake and Release of ^{137}Cs by Five Plant Species as Influenced by Soil Amendments in Field Experiments, *Journal of Environmental Quality*, 32:2272-2279, 2003.

Fuhrmann, M., Lasat, M., Schwartz, M., Ebbs, S., Kochian, L. and Cornish, J., Uptake of ^{137}Cs and ^{90}Sr from Contaminated Soil by Three Plant Species: Application to Phytoremediation, Vol. 31, no. 3, pp. 904-909, *Journal of Environmental Quality*, 2002.

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Fuhrmann, M. H. Zhou, J. Neiheisel, and R. Dyer, Sorption of Radioactive Contaminants by Sediment from the Kara Sea, *Marine Pollution Bulletin*, Vol. 43, pp.102-110, 2001.

Fuhrmann, M., Melamed, D., Kalb, P., Adams, J. and L. Milian, Sulfur Polymer Stabilization/Solidification of Elemental Mercury Waste, Vol. 22, pp. 327-333, *Waste Management*, 2002

Fuhrmann, M., S. Bajt, and M.A.A. Schoonen, Sorption of Iodine on Minerals Investigated by X-ray Absorption Near Edge Structure and ^{125}I Tracer Sorption Experiments, Applied Geochemistry, Vol. 13, No.2, pp.127-141, 1998.

Dushenkov, S. and M. Fuhrmann, Evaluation of Crop Plants Potential for Phytoextraction of ^{137}Cs , In: Proceedings of the Fourth International Symposium and Exhibition on Environmental Contamination in Central and Eastern Europe, 1998.

Lasat, M., M. Fuhrmann, S. Ebbs, J. Cornish, and L. Kochian, APhytoremediation of a Radiocesium-Contaminated Soil: Evaluation of Cesium-137 Bioaccumulation in the Shoots of Three Plant Species@, Journal of Environmental Quality , Vol. 27, pp. 165-169, 1998.

Bebie, J., M.A.A. Schoonen, M. Fuhrmann, and D.R. Strongen, Surface Charge Development on Transition Metal Sulfides: An Electrokinetic Study, Geochimica et Cosmochimica Acta, Vol. 62, pp.633-642, 1998.

Fuhrmann, M., and M. A. A. Schoonen, Mass Balances and Sorption / Desorption of Radionuclides in the Kara Sea, Radioprotection-Colloques, Vol. 32, pp. C2-189-196, 1997.

Fuhrmann, M. H. Zhou, J. Neiheisel, R. Dyer and M.A.A. Schoonen, Sorption/Desorption of Radioactive Contaminants by Sediment from the Kara Sea, Invited Paper, Science of the Total Environment, Vol. 202, pp. 5-24, 1997.

Cornish, J., M. Fuhrmann, L. Kochian, and D. Page, Phytoextraction Treatability Study: Removal of ^{137}Cs from Soils at Brookhaven National Laboratory's Hazardous Waste Management Facility Site, Report BRS-3, MSE Technology Applications, Butte, Montana, 1997.

Fuhrmann, M., Aloysius, D., and Zhou, H., A Permeable, Subsurface, Sorbent Barrier for ^{90}Sr : Laboratory Studies of Natural and Synthetic Materials. Waste Management, Vol. 15, pp. 485-493, 1995.

Fuhrmann, M., H. Zhou, B. Patel, B. Bowerman, and J. Brower, Cs-137 Contaminated soil: Laboratory Study and Economic Analysis of Soil Washing, BNL-63679, Brookhaven National Laboratory, 1996.

Mc Connell, J., Rogers, R.D., Jastrow, J., Sanford W., Cline, S., Sullivan, T., Fuhrmann, M., Reed, P., Results After Ten Years of Field Testing Low-Level Radioactive Waste Forms Using Lysimeters, In Proceedings of the Waste Management '97 Symposium, paper 13-26, 16 pages, 1997.

Fuhrmann, M., H. Zhou, B. Patel and J. Brower, Remediation of Soil Contaminated with Cs-137, Presented at The Eighth National Technology Information Exchange Workshop, April 16-18, 1996. Sante Fe, NM.

Fuhrmann, M. and S. Bajt, Iodine Oxidation States in Contact with Minerals, In: Rothman, E.(Ed.) National Synchrotron Light Source Activity Report, Brookhaven National Laboratory, pp. B-182, abstract only, 1994.

Fuhrmann, M., H. Zhou, J. Neiheisel and R. Dyer, Sorption of Radioactive Contaminants on Sediment from Three Stations in the Kara Sea, In: P. Strand and A. Cooke (Ed.) Environmental Radioactivity in the Arctic , Norwegian Radiation Protection Board, Osteras, Norway. Proceedings of the Second International Conference on Environmental Radioactivity in the Arctic, Oslo Norway, 1995, pp.173-178.

Fuhrmann, M., D. Aloysius and H. Zhou, Permeable, Subsurface Sorbent Barrier for Sr-90: Laboratory Studies of Natural and Synthetic Materials, Waste Management '95, Proceedings of a conference, Tucson AZ, 1995.

Fuhrmann, M. and H. Zhou, Applicability of an Accelerated Leach Test to Different Waste Form Materials,, pages 156-161 In; Spectrum '94, Vol. 1, Proceeding of the Nuclear and Hazardous Waste Management International Topical Meeting, August, 1994.

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Fuhrmann, M., R. Pietrzak, J. Nieheisel and R. Dyer, Partitioning of Cs-137 Between Sediment and Water from the Black Sea, Chemistry and Ecology, Vol. 7, pages 3-17, 1992.

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Fuhrmann, M., R.F. Pietrzak, J. Heiser, E.M. Franz and P. Colombo, Development of an Accelerated Leach Test, Waste Management '89, Vol. II, Post and Wacks (editors), University of Arizona, Pages 305-309, 1989.

Fuhrmann, M. and P. Colombo, An Evaluation of Techniques of Ocean Disposal of Soils Containing Naturally Occurring Radionuclides (FUSRAP Wastes),, Report #EPA/520/1-89-025, U.S. Environmental Protection Agency, September 1989.

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