

**DIVISION OF ENVIRONMENTAL CHEMISTRY**  
**238th ACS National Meeting**  
**Washington, D.C.**  
**August 16-20, 2009**

**WEDNESDAY EVENING**

**Advances in Analytical Chemistry for Environmental Applications -- Posters**

T. Jones-Lepp, *Organizer*

D. D. Dionysiou, *Presiding*

**6:00 - 8:00**

**181.** *In situ* groundwater arsenic removal using iron-oxide coated sand. **H. Yu**, Y. H. Huang

**182.** Inexpensive detection method for petrodiesel levels in contaminated soil. **B. B. Kreutzer**, W. S. Teel, J. P. Cabaniss, J. A. Edwards, S. L. Evans, M. O. Portegies-Zwart

**183.** Assessment of seasonal variations in surface water quality of Chitral River, Pakistan. **J. Khan**, S. A. Baig, A. Hussain, Q. Mahmood, M. Nafees, A. R. Khan, R. Farooq

**184.** Chemically enhanced treatment of carwash industry wastewater. Z. A. Bhatti, **Q. Mahmood**, I. A. Raja

**185.** Developing the system of ferrous cement paste and slag as viable media of PRB for the removal of TCE. **J. Im**, W -H. Choi, J -Y. Park

**186.** Enhanced fenton reaction by ferrous ion chelated with cross-linked chitosan. **Y. Lee**, W. Lee

**187.** Geochemical conditions affecting electrode-based removal of uranium. **J. Peng**, K. B. Gregory

**188.** New flow injection chemiluminescence system for the determination of 2,4-dichlorophenol. **Q. Wang**, H. Zhuang

**189.** Novel arsenic filters based on composite iron matrix: Fundamental studies, production and large scale deployment. **S. Ahamed**, A. K. M. Munir, A. Hussam

**190.** Novel method to improve the mercury adsorption capacity of carbonaceous materials. **J. Luo**, J. Luo

**191.** Study on the determination of polybrominated biphenyls by ELISA. **Q. Wang**, L. Yang, H. Zhuang, H. Chen

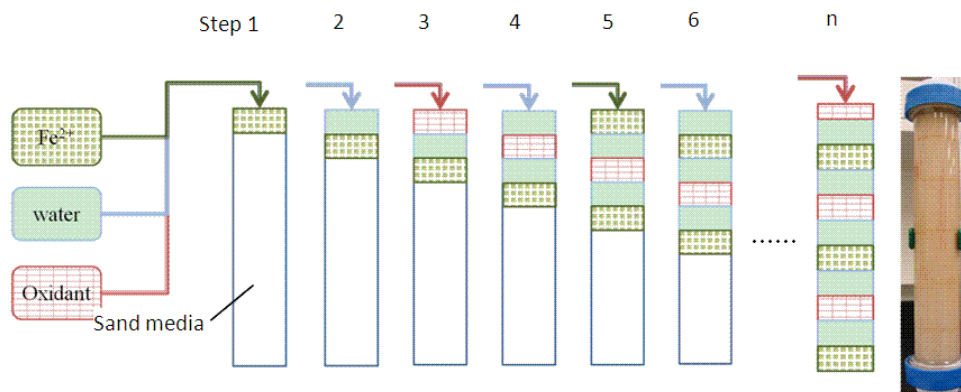
## ABSTRACTS

### ENVR 181

#### *In situ* groundwater arsenic removal using iron-oxide coated sand

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Iron oxide-bearing minerals have long been recognized as an effective reactive media for arsenic remediation. A unique iron oxide coating technique is invented to develop a cost-effective *in situ* treatment technique for removing arsenic from contaminated groundwater. To *in situ* emplace iron oxide coatings on soil particles, ferrous salt and sodium hypochlorite solutions are periodically injected into soil matrix following a specially designed injection scheme. The resulting adsorption, diffusion, and redox reaction could continuously deposit large quantities of ferric oxide onto the surface of soil particles, thus creating a constantly-refreshed reactive surface for continuous adsorption and co-precipitation of arsenic and other heavy metals. The bench-scale column tests have shown that the technique could rapidly and sustainably remove arsenic from synthetic water spiked with arsenic. More than 99% of 10 mg/L As(III) and As(V) could be removed even with a hydraulic retention time as short as 20 minutes.



### ENVR 182

#### Inexpensive detection method for petrodiesel levels in contaminated soil

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Petroleum hydrocarbon levels in multiple contaminated soil samples are expensive to determine for institutions which lack the necessary analytical equipment and must outsource their testing. We have tested an inexpensive volatilization method easily performed by students with minimal technical training. Diesel fuel is a common petroleum hydrocarbon soil pollutant. Minute changes in soil diesel component levels were observed upon weighing petrodiesel contaminated soil which had been remediated by mycorrhizal onions or oyster mushrooms and heated to different temperatures. This volatilization method has strong potential for institutions with limited funding in these tight financial times.

### **ENVR 183**

#### **Assessment of seasonal variations in surface water quality of Chitral River, Pakistan**

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An attempt has been made to study different aspects of Chitral River, Pakistan. Both open- and close-ended questionnaires were designed for the targeted people and the primary data were collected. Different monitoring sites were selected to collect three times water samples during the year from 2003 to 2004. Laboratory work was carried out to analyze the various chemical water quality parameters (total suspended solid (TSS), dissolved solid (DS), alkalinity, hardness, chloride, sulfate and nitrate; total suspended and dissolved solid, alkalinity, hardness and chloride, sulfate and nitrate) [Table 1]. All the physical and chemical parameters are within the WHO permissible limits except the suspended solids (700 mg/L) and sulfate concentration (12.79 mg/L). This is due to high land degradation and steepness of topographic features. The results provided evidence that the importance of cultivable soil and the line agencies should focus for the conservation of soil in the developmental processes.

**Figure 1 A** Results of Physical Parameters **B** Results of Chemical Parameters

Parameters	Month of Sampling	Alkalinity (mg/l)	Hardness (mg/l)	Chloride (mg/l)	Sulphate (mg/l)	Nitrate (mg/l)
S. Locations Mastuj Station (S#1)	Nov, 03	92	112	9.94	4.56	Nil
	April, 04	101	126	10.93	3.14	Nil
	Aug, 04	108	100	4.97	1.18	Nil
	Mean	101	113	8.61	2.96	Nil
Kuragh Station (S#2)	Nov, 03	98	125	17.39	7.88	Nil
	April, 04	111	140	7.95	5.79	Nil
	Aug, 04	87	104	5.96	1.89	Nil
	Mean	99	123	10.43	5.19	Nil
Khughuzi Station (S#3)	Nov, 03	111	127	14.08	4.23	Nil
	April, 04	116	140	12.42	2.85	Nil
	Aug, 04	76	98	4.47	1.20	Nil
	Mean	101	122	10.32	2.76	Nil
Shoghor Station (S#4)	Nov, 03	61	100	15.73	12.44	Nil
	April, 04	83	104	9.94	12.79	0.86
	Aug, 04	81	102	5.96	2.95	0.66
	Mean	75	102	10.54	9.40	0.50
Chitral Station (S#5)	Nov, 03	99	100	13.25	9.45	Nil
	April, 04	83	136	12.42	10.0	0.23
	Aug, 04	81	90	5.46	1.26	1.60
	Mean	88	109	10.37	6.90	0.61
Drosh Station (S#6)	Nov, 03	104	120	16.56	8.67	Nil
	April, 04	92	136	10.43	7.43	0.22
	Aug, 04	84	109	4.97	1.29	1.00
	Mean	94	121	10.65	5.80	0.40

**A**

Parameters	Month of Sampling	Temp (C°)	pH	DO (mg/l)	Turb (NTU)	Cond (us/cm)	TS (mg/l)	SS (mg/l)	TDS (mg/l)
S. Locations Mastuj Station (S#1)	Nov, 03	2	7.8	13.00	47	310	200	45	155
	April, 04	7	7.8	12.13	51	312	200	44	156
	Aug, 04	10	7.6	11.28	58	294	180	34	146
	Mean	6	7.7	12.44	49	305	193	41	152
Kuragh Station (S#2)	Nov, 03	4	7.4	13.14	104	320	400	240	160
	April, 04	11	7.6	11.02	100	330	400	241	159
	Aug, 04	10	7.2	11.28	239	310	700	545	155
	Mean	8	7.4	11.84	147	320	500	342	158
Khughuzi Station (S#3)	Nov, 03	6	7.4	12.44	36	340	200	30	170
	April, 04	11	7.5	11.02	38	317	162	22	140
	Aug, 04	12	7.4	10.77	31	309	400	46	154
	Mean	10	7.4	11.28	34	322	254	33	155
Shoghor Station (S#4)	Nov, 03	3	7.3	13.46	78	230	200	85	115
	April, 04	12	7.7	10.77	22	273	137	17	120
	Aug, 04	13	7.8	10.53	116	193	280	189	91
	Mean	9	7.6	11.53	72	232	206	97	109
Chitral Station (S#5)	Nov, 03	6	7.2	12.44	47	330	200	35	165
	April, 04	11	7.3	11.02	50	320	200	37	163
	Aug, 04	14	7.4	10.30	125	290	560	315	145
	Mean	10	7.3	11.28	74	313	320	129	158
Drosh Station (S#6)	Nov, 03	6	7.4	12.44	108	320	400	245	155
	April, 04	16	7.5	9.87	50	313	200	44	156
	Aug, 04	16	7.4	9.87	125	290	580	430	150
	Mean	13	7.4	10.53	94	308	393	240	154

**B**

## **ENVR 184**

### **Chemically enhanced treatment of carwash industry wastewater**

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Car wash wastewater (CWW) contains petroleum, hydrofluoric acid, ammonium bifluoride products, paint residues, rubber, phosphates, oil, grease and volatile organic compounds (VOCs). The CWW samples were collected from various carwash stations in Abbottabad, Pakistan and treated in a treatment system of five liters capacity. Due to high load of oil and grease, CWW was aerated and scum was removed to decrease chemical oxygen demand (COD) load. Alum was used as coagulant in primary treatment which resulted 93% and 97% reduction in COD and turbidity. CWW was further treated with waste hydrogen peroxide causing further 71% and 83% reduction in COD and turbidity, respectively. Other desirable changes were also observed in pH, total dissolved solids (TDS), conductivity and dissolved oxygen contents. The designed system consisting of aeration, alum coagulation and waste hydrogen peroxide (40%) could be effectively used to treat CWW.

## **ENVR 185**

### **Developing the system of ferrous cement paste and slag as viable media of PRB for the removal of TCE**

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The combined system of ferrous cement paste and steel converter slag was studied to develop viable media of permeable reactive barrier (PRB) for the removal of TCE. For Fe(II) of 100 mM, the system of 70% slag and 30% cement paste demonstrated the best performance. That is, the half life of 6.1 hr was observed for TCE of 0.25 mM with the solid to liquid ratio of 0.1. With the selected combination, column studies were performed using contrasting modes for the addition of Fe(II): initial pulse input and continuous step input. The combined system employing the continuous step input of Fe(II) demonstrated more effective removal of TCE than the system of initial pulse input. The results of the combined system imply that it is competitive media of PRB for the removal of TCE.

## **ENVR 186**

### **Enhanced fenton reaction by ferrous ion chelated with cross-linked chitosan**

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Because of low pH requirement and rapid hydrogen peroxide consumption, the application of Fenton process to the *in situ* remediation of contaminated soil and groundwater seems to be ineffective. We have investigated that degradation of trichloroethylene (TCE) by the Fenton reaction could be significantly enhanced in the presence of cross-linked chitosan by glutaraldehyde (Fe(II)-GLA/chitosan) at neutral pH. No significant research has been conducted to characterize the enhanced Fenton reaction with Fe(II)-GLA/chitosan. The effect of initial suspension pH (pH 5-7), Fe(II) content (0.5-1 mM), H<sub>2</sub>O<sub>2</sub> (50-300 mM) and cross-linked chitosan concentration (1-2 g/L) on the reaction kinetics for the TCE degradation has been identified. The enhanced Fenton system with Fe(II)-GLA/chitosan showed significant degradation of TCE at pH 5, while classical Fenton system did not show any degradation. The enhanced reactivity may be due to dissolved Fe(II) chelated by cross-linked chitosan. The fastest reaction kinetics has been able to be observed at pH 5.4, 1.08 mM Fe(II), 50 mM H<sub>2</sub>O<sub>2</sub> and 2 g/L cross-linked chitosan.

## **ENVR 187**

### **Geochemical conditions affecting electrode-based removal of uranium**

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Cathodically-poised electrodes emplaced in the subsurface have emerged as a strategy for *in situ* bioremediation, removal and recovery of contaminants from groundwater. Little is known, however, about the biological or geochemical conditions which may affect the removal and/or recovery processes. We report on the impact of pH and cations on the removal of U(VI) from aqueous solutions. Initial removal rates of U(VI) were approximately first order and increased from 0.01 hr<sup>-1</sup> at pH 2.0 to 0.06 hr<sup>-1</sup> at pH 6.0. The slower removal rates exhibited at lower pH were overcome by increasing the applied potential. With low electrode potentials (2.5 V), U(VI) removal rates were unaffected over a range of concentrations of Al(III). However, at 5 V, removal rates decreased with increasing Al(III). Results demonstrate that electrodes may be employed for rapid removal and recovery of U(VI) from acidic groundwater with high concentrations of aqueous metals.

## ENVR 188

### **New flow injection chemiluminescence system for the determination of 2,4-dichlorophenol**

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The effect of 2,4-dichlorophenol (2,4-DCP) on the new chemiluminescence (CL) system of N-( $\beta$ -carboxylpropionyl) luminol-KMnO<sub>4</sub> has been studied in alkaline medium. 2,4-DCP was found to enhance obviously the CL intensity from above the new CL system, effect of pH, KMnO<sub>4</sub>, N-( $\beta$ -carboxylpropionyl) luminol concentration on the CL intensity of system were investigated. Therefore a rapid and sensitive flow injection CL method was developed for the determination of 2,4-DCP. The linear range was  $1.5 \times 10^{-9}$ - $3.0 \times 10^{-7}$  g/mL. The detection limit obtained was  $5.6 \times 10^{-10}$  g/mL. The relative standard deviation is 4.5% (n=10). This method was successfully applied to the determination of 2,4-DCP in water. Keywords: 2,4-Dichlorophenol, N-( $\beta$ -carboxylpropionyl) luminol, KMnO<sub>4</sub>, flow injection, chemiluminescence. We acknowledge the financial support by the National Natural Science Foundation of China (project no. 20 677 008), the Research Fund for the Doctoral Program of Higher Education (project no. 20 060 255 004) and Shanghai Leading Academic Discipline Project (project no. B604).

## ENVR 189

### **Novel arsenic filters based on composite iron matrix: Fundamental studies, production and large scale deployment**

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The presence of toxic levels of arsenic in the groundwater of Bangladesh and in many parts of the world is now known to cause serious health problems, including cancer. Arsenic is primarily present as inorganic species: H<sub>2</sub>AsO<sub>4</sub><sup>-</sup>, HAsO<sub>4</sub><sup>2-</sup>, and H<sub>3</sub>AsO<sub>3</sub>, where arsenite (H<sub>3</sub>AsO<sub>3</sub>) is the most toxic, the most mobile, and the most difficult to remove species. This presentation will cover the development of an arsenic filter based on a composite iron matrix (CIM). Some basic properties such as removal capacity based on adsorption isotherm, adsorption kinetics, and some mass transfer characteristics of composite iron granules (CIG) - the precursor of CIM - will be discussed. The filter passed through several environmental technologies verification programs for arsenic mitigation (ETVAM) projects and approved by the Government of

Bangladesh for household use. It also received the 2007 Grainger Challenge Prize for Sustainability from the National Academy of Engineering. The development of the SONO filter based on CIM and the distribution of more than 100,000 SONO filters in remote arsenic-affected areas in Bangladesh and Nepal will be presented along with problems and future prospects.

## ENVR 190

### Novel method to improve the mercury adsorption capacity of carbonaceous materials

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Three typical types of surface oxygen complexes were selected for surface modification of a coal-based activated carbon and an as-received fly ash. Thermal and chemical methods were used in this study. The carboxyl group significantly enhanced the mercury capture ability of the carbon samples. While the phenolic hydroxyl group showed strong inhibition effect on the adsorption of mercury vapor. And the carbonyl group did not increase carbons' mercury adsorption capacity in this investigation.

## ENVR 191

### Study on the determination of polybrominated biphenyls by ELISA

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An indirect competitive enzyme-linked immunosorbent assay (ELISA) was developed for the determination of polybrominated biphenyls (PBBs), in which a polyclonal antibody produced against a hapten±protein (albumin) conjugate was used with indirect competitive ELISA. After a series of optimization, the indirect competitive ELISA of PBBs showed that the value of IC<sub>50</sub> (PBB concentration when the inhibition reaches 50%) was 11.58 µg/L for coating antigen concentration of 2.5 µg/L, and detection limit (LOD) IC<sub>20</sub> (the PBB concentration when the inhibition reaches 20%) fell into 0.196 µg/L, the recovery of the water samples were between 97%-147%, the PBB antibody showed low cross-reactivity with PCB77. The indirect competitive ELISA of PBBs is a

good alternative tool for detection of PBB in environmental samples. Keywords: polybrominated biphenyls, ELISA, determination. We acknowledge the financial support of the National Natural Science Foundation of China (project no. 20 677 008), the Research Fund for the Doctoral Program of Higher Education (project no. 20 060 255 004) and Shanghai Leading Academic Discipline Project (project no. B604).