

## DIVISION OF CHEMICAL EDUCATION

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### MONDAY AFTERNOON

#### Undergraduate Research Poster Session: Environmental Chemistry

N. Bakowski, *Organizer*

### ABSTRACTS

#### CHED 192

#### **Bacterial metabolism of ionic-liquid-pretreated lignocellulose: Production of biofuels**

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Several ionic liquids based on 1-methylimidazole, 4-dimethylaminopyridine and 1,4-diazabicyclo(2.2.2)octane cations bearing alkyl and hydroxyl functionalized substituents and phosphate anions have been synthesized. Their structures were confirmed using H-1, C-13 and P-31 NMR. These ionic liquids have been used to pretreat lignocellulosic materials such as wood flour to render the cellulose into a form that is readily accessible to enzymatic and bacterial degradation and fermentation. The pretreated material was then assessed for the bacterial production of the biofuels ethanol and butanol using *Clostridia*.

## CHED 193

### Biodegradation of ionic liquids

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Understanding the effect of the structure of ionic liquids (ILs) on their biodegradability is important for the success of their large scale application and gives insight into possible waste management procedures for spent ILs. Halide and phosphate salts based on the 1-methylimidazolium and N-methylpyrrolidinium cations bearing alkyl, hydroxyalkyl, and ethoxyethyl substituents have been prepared and studied. The biodegradation of the ILs has been assessed by incubating a fixed volume in a mineral salt medium with the soil microorganisms. After several dilutions at periodic intervals the fate of the IL was determined by comparing the NMR spectra of the ILs before and after contact with the microorganisms. Preliminary results for the hydroxyalkyl imidazolium bromide IL indicate that it was not degraded by the soil microorganisms.

## CHED 194

### Detection of prescription drugs in human hair

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Many of us ingest daily prescription drugs. Is it possible to detect the drug in the hair of the person consuming the drug? Which factors, if any, influence the detection of this drug, including drug structure, hair health, treatments, and sun exposure? Presented will be initial results of monitoring common prescription drugs in human hair in an attempt to shed light on the effects of hair health and hair treatment on drug detection in human hair.

## CHED 195

### Determination of mercury levels in seafood by atomic absorption

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Most fish caught from inland waters have high levels of mercury. There is not sufficient testing data on mercury concentrations in fresh water fish, imported and canned seafood. This poster will focus on the determination of mercury concentrations in various species of fish caught from Tioga County, Pennsylvania and store bought seafood by atomic absorption. The biological impact of high mercury levels in seafood and state health advisory levels will be discussed.

## CHED 196

### Exploring direct photolysis mechanisms of PAHs in non-polar solvents

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Polycyclic aromatic hydrocarbons (PAHs) are toxic components of oil spills whose fate is often controlled by photochemistry. However, photodegradation pathways of PAHs in hydrophobic media are not fully characterized, hampering efforts to predict PAH removal rates. Previous research suggests that direct photolysis cannot account for rates of PAH loss in oil. One hypothesis is that singlet oxygen ( $^1\text{O}_2$ ) is an important intermediate. To clarify this, we are studying the PAH direct photolysis mechanism in hydrophobic solvents. To determine whether self-sensitized reaction with  $^1\text{O}_2$  is important, we employ a  $^1\text{O}_2$  scavenger,  $\alpha$ -terpinene. Photolysis rates of benzo[a]pyrene (BAP) and benz[a]anthracene (BAA) at 365 nm were unaffected by 1 mM  $\alpha$ -terpinene, suggesting that PAH reaction with  $^1\text{O}_2$  is negligible. Furthermore,  $\alpha$ -terpinene degradation rates during BAP photolysis indicate a  $^1\text{O}_2$  quantum yield of at least 0.04 mol Es<sup>-1</sup>. Further experiments are aimed at more precise determination of PAH  $^1\text{O}_2$  quantum yields.

## CHED 197

### Fluorescence quenching of acridine orange by humic acid

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The acridine orange / humic acid system studied serves as a model for the binding of organic pollutants to humic acid. Fluorescence quenching was used to determine the equilibrium constant for the binding of acridine orange, a water soluble polycyclic aromatic hydrocarbon, to humic acid. The acridine orange fluorescence was monitored as aliquots of humic acid were added and a Stern-Volmer plot was produced whose slope is the equilibrium constant. The quenching experiments were performed at temperatures from 30°C to 45°C, and values of  $K_{eq}$  were found to be 0.467, 0.4168, 0.365, and 0.3345, respectively. A van't Hoff plot generated from the acridine orange and humic acid data above resulted in a linear plot with a slope of 2186.2 K. The thermodynamic values for the binding process were determined to be:  $\Delta H = -18.2$  kJ,  $\Delta G = 2.4$  kJ/mol, and  $\Delta S = -66.5$  J/K at 37.5°C.

## CHED 198

### Mapping mercury concentrations in soils near a coal burning power plant

**Mario Herrera** and **Charles A. Smith**, *smitc@lake.ollusa.edu*, Department of Chemistry, Our Lady of the Lake University, 411 S.W. 24th Street, San Antonio, TX 78207

San Antonio has several of the oldest coal burning power plants in the nation. These plants are “grandfathered” with respect to environmental laws because they were built before more stringent environmental laws that govern what these plants may emit into the air. Literature has suggested a link between rates of autism and the locality of these plants. It has been argued that the increased rate of autism in the San Antonio area is due to enhanced mercury levels in the local environment. Overall results along with digestion and analysis procedures of soil samples obtained in the vicinity surrounding a local San Antonio coal burning power plant will be presented.

## CHED 199

### Non mercury heavy metal analyses in vicinity of local coal and cement plants

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San Antonio has several of the oldest coal burning power plants in the nation. The city is also home to a cement plant that utilizes a kiln to produce cement. Both of these plants are known to emit heavy metals in addition to mercury including lead and chromium. Over time, the concentrations of these metals build up in the environment. Initial environmental analyses, technique, and results will be presented.

## **CHED 200**

### **Oxygen isotope analysis of diatom silica in sediment cores from Lake El'gygytgyn, Siberia**

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Lake El'gygytgyn (67°N, 172°E) is situated in a 3.6 million-year-old meteorite impact crater in northeastern Siberia. Samples are being analyzed from recovered lake sediment cores that extend to approximately 300 ka. Ongoing drilling at the lake should provide a unique record of Arctic climate extending to the time of the impact. The analysis of oxygen isotopes in diatom silica is being investigated for its potential as a paleoclimate indicator in the lake record. The preparation of the diatoms samples involves wet chemistry, sieving, heavy-liquid separation, melting of the silica to form a bead, laser vaporization, and analysis by mass spectrometry. The goal of this project is to test and develop these methods to contribute to the climate reconstructions from the lake record. The results of this work will be presented, including their implications for the development of the analytical method and interpretation of the climate archive.

## **CHED 201**

### **Reduction of cadmium and lead uptake of carrots with calcium, zinc, and manganese**

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According to a recent experiment in Romania, foliar application of  $MnCl_2$  to carrots significantly reduced Cd and Pb uptake of carrots. Inspired by this report, we examined if Ca and Zn exhibit the same effect because all these elements form divalent ions. Carrots were hydroponically grown in Hoagland nutrient solutions spiked with  $Cd^{2+}$ ,  $Pb^{2+}$ ,  $Ca^{2+}$ ,  $Zn^{2+}$ , and  $Mn^{2+}$ . Spectrophotometric analysis with an atomic absorption

spectrometer revealed that Ca lowered the uptake of Cd and Pb, and Zn increased the uptake of Cd. Interestingly, Mn increased the uptake of Cd, which may be due to the different application method (root application vs. foliar application).

## **CHED 202**

### **Searching for mercury in the soil surrounding a cement plant**

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Cement kilns evolve mercury during the cement production process when limestone is heated. It is difficult to ascertain the amount of pollutants coming from cement kilns. In 2006 EPA estimated that cement kilns emitted over 22,000 pounds of mercury per year. This estimate takes into account only non-hazardous waste burning kilns. Kilns require fuel and many use coal, while some also burn hazardous waste. One of the cement plants in San Antonio has a kiln that consumes hazardous waste as fuel. It is difficult to ascertain the degree, amount, or type of hazardous waste utilized at this or any cement plant for that matter. Overall results, including digestion and soil analysis procedures, will be presented.