DIVISION OF ENVIRONMENTAL CHEMISTRY

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WEDNESDAY AFTERNOON

Emerging Environmental Technologies towards a Cleaner and Sustainable Society

P. Bishop, *Organizer*
V. Shah, *Organizer, Presiding*

1:30 — Introductory Remarks.

1:35 —84. Black carbon-catalyzed reductive degradation of energetic compounds. **S -Y. Oh**, P. C. Chiu

1:55 —85. Converting waste gases from pulp mills into value-added chemicals. **E. Sahle-Demessie**, C. B. Almquist

2:15 —86. Emission products of petroleum-based candles. R. Massoudi, **A. Hamidi**

2:35 — Intermission.

2:45 —87. Enhanced biodecolorization of reactive dyes by immobilized phanerochaete chrysosporium. **H. Liang**, D. Gao

3:05 —88. New method for recycling EDTA *via* formation of EDTA iron(III) sodium salt. **L. Wang**

3:25 —89. Photodegradation of methyl orange with the use of tantalum pentoxide under UV light. **E. Sosnov**, S. Prakash

3:45 —90. Sonochemical remediation of phthalates: A mechanistic analysis using LC-MS. **D. VandenBurg**, G. J. Price

ABSTRACTS

ENVR 84

Black carbon-catalyzed reductive degradation of energetic compounds

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Black carbons such as soot and graphite are often regarded as strong sorbents for organic compounds but are chemically inert themselves. However, our recent work strongly calls this assumption into question. Our results suggest that these black carbons are actually catalytically active and can play dual roles - as a sorbent and an electron shuttle - in the redox transformation of energetic compounds under reducing conditions. We will present data on the reduction of nitroaromatic and nitramine compounds mediated by black carbons. We will discuss the potential implications and applications of these findings with respect to contaminant fate and environmental remediation.

ENVR 85

Converting waste gases from pulp mills into value-added chemicals

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The pulp and paper industry generates large amounts of HAPs, VOCs and total reduced sulfur compounds (TRSs) of the various sources. As the industry is moving to a sustainable future, the U.S. EPA and Miami University have developed a catalytic technology that uses molybdenum modified copper catalyst that uses ozone as an oxidant, converted the methanol and TRS in the waste streams to methyl formate and SO_2 at mild temperatures of about 200°C. The catalyst was not poisoned by the sulfur compounds and remained active even at high concentrations of water (~50%). Catalytic oxidation occurs at lower temperatures with minimal formation of nitrogen oxides (NO_x) and lower energy requirements. Methanol was converted into methyl formate, and total removal of TRSs and 98% removal of HAPs was acheived. The new technology was tested using a pilot-scale unit at a commercial pulp and paper mill, Domtar Corporation pulp mill in Hawseville, Kentucky.

ENVR 86

Emission products of petroleum-based candles

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This brief reports the summary of our investigation of the emission products concerning paraffin wax compositions obtained from different candle manufacturers. The composition of emission products were identified by a Perkin-Elmer TurboMass GC/MS system equipped with a NIST Library of compounds. The experiment was carried out by burning the candles in a chamber (8" x 8" x 26") connected to a pump on the top, where the mixture of gases passed through an ampoule containing activated coconut charcoal at 0.20 L/min. Normal burning patterns were constantly monitored. After five to six hours of burning, the contents of the ampoule were transferred into spectroscopic grade of carbon disulfide to dissolve adsorbed materials then injected in the GC/MS to be analyzed. Paraffin-based candles produced clear sharp peaks for presence of many products such as toluene, alkanes, alkenes, as well as some ketones and aldeydes. Results proved largely reproducible.

ENVR 87

Enhanced biodecolorization of reactive dyes by immobilized phanerochaete chrysosporium

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The research and development of treatment technologies for textile wastewater containing reactive dyes is still a tremendous challenge in water pollution control. The white rot fungus *Phanerochaete chrysosporium* due to their nonspecific characteristics in degrading a wide spectrum of recalcitrant organopollutants such as synthetic dyes are becoming promising microorganisms in textile wastewater treatment. Biodecolorization of reactive dyes by the white rot fungus *Phanerochaete chrysosporium* immobilized polyurethane foam carriers was investigated in agitated Ehrlenmeyer flasks. Results showed that high and stable degrees of decolorization of 95% were achieved in the immobilized system only after incubating *Phanerochaete chrysosporium* for two days, and was high than 15% in the free suspended culture for five days. The maximum activity of MnP was 915.62 U/L in the immobilized culture, compared with 324.90 U/L in the suspended culture. Moreover, the consumption of carbon and nitrogen substrates in the immobilized culture was more rapid than that in the free suspended culture. So, we propose that the enhanced biodecolorization of reactive dyes in immobilized culture of *Phanerochaete chrysosporium* is due to

increased activity of MnP caused by carbon and nitrogen substrates in the culture consuming fast.

ENVR 88

New method for recycling EDTA *via* formation of EDTA iron(III) sodium salt

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$NO_x$and SO_2 emissions from combustion of fuels have given significant effects on environmental and human health. Current technique for controlling them by Fe(II) EDTA absorption is highly efficient. The final reaction products mainly include Fe(III) EDTA and $S_2O_6^{2-}$. In our experiment, the invalid absorption solution was oxidized and evaporated, and then the red brown crystal was precipitated and separated from the solution. FTIR revealed that this substance contained EDTA. XRD confirmed that its structure was $C_{10}H_{12}N_2FeNa•3H_2O$. All these showed that EDTA was converted into Ethylenediaminetetraacetic acid Fe(III) sodium salt. The product yield was greatly connected with pH value. In the pH range of 3 to 8, the precipitation yield increased firstly and then decreased subsequently due to the acid effect coefficient and the precipitation of $Fe(OH)_3$. The maximum yield reached 78.7% at pH 7.

ENVR 89

Photodegradation of methyl orange with the use of tantalum pentoxide under UV light

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The lack of clean water is a grave issue in today's world. The main focus of this study is towards organic contaminants. Titanium dioxide is the most common photocatalyst used for photodegradation of organic contaminants. Another emerging photocatalyst with a large band gap (4.0 eV) is tantalum pentoxide, which has been previously used in mixed-oxide photocatalysis. Ta_2O_5 particles, less than 5 microns in size, were dispersed in a methyl orange aqueous solution which was cast under UV light. Methyl orange dye was used to simulate organic contaminants. To determine the efficiency, UV-vis spectroscopy was implemented. A 30% reduction in the concentration of methyl orange is observed after 2 hours of exposure to UV light; however, compared results for TiO_2 show similar methyl orange degradation but often require light sources with more than 4 times the input power, suggesting that Ta_2O_5 can be a higher efficiency photocatalyst.

ENVR 90

Sonochemical remediation of phthalates: A mechanistic analysis using LC-MS

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Phthalates are widely used in plastic manufacturing and as such have become a worldwide contaminant of water sources. Ultrasound has been shown to be able to quickly reduce phthalate concentration in aqueous solutions. However the mechanism and products formed from this reaction are not known. This is potentially problematic if ultrasound is to be used in water treatment plants since the unknown by-products may be more toxic than the starting phthalates. Using high concentrations (10 mg/mL and 1 mg/mL) of dibutylphthalate we have analyzed the products formed using electrospray time of flight LC-MS and devised a mechanism for the sonochemical decomposition of dibutylphthalate. We have verified these products and mechanism in lower concentrations and have also compared the products formed from several phthalates. We have also studied the effects of power, dissolved gas and dual frequency ultrasound on the decomposition reaction.