New Legislation and Applied Research in Energy, Minerals and Restoration

Applied Research Conference 2007

December 5-6, 2007

OHIO UNIVERSITY

Presented by Ohio Department of Natural Resources, Division of Mineral Resources Management

Seventh Annual Ohio DMRM Applied Research Conference 2007

NEW LEGISLATION AND APPLIED RESEARCH IN ENERGY, MINERALS AND RESTORATION

December 5-6, 2007

Margaret M. Walter Hall, Ohio University, Athens

The Seventh Annual Ohio DMRM Applied Research Conference 2007 – to be held December 5-6, 2007 at Ohio University in Athens – provides mineral resources professionals with an opportunity to discuss current issues, new research, and technologies related to mineral resource extraction throughout the Ohio Valley. The focus of the conference will be on recent legislation and research related to energy sources, mineral extraction, and restoration techniques. The conference is viewed as a valuable resource for state and federal reclamation and environmental protection specialists; regulatory agency personnel, university researchers, mineral extraction and reclamation professionals; policy decision-makers; and local watershed restoration groups.

The Applied Research Conference is presented by the Ohio Department of Natural Resources, Division of Mineral Resources Management, in conjunction with the Ohio University Russ College of Engineering. Additional support for the conference is provided by the sponsors listed on the back cover of this booklet, as well as by the Institute for Local Government and Rural Development. Conference management is provided by the Ohio University Division of Lifelong and Distance Learning.

2007 DMRM Mineral Resources Awards

The Division of Mineral Resources Management (DMRM) recognizes outstanding accomplishments and exemplary performance by Ohio's mineral resource professionals in the area of mineral resource extraction and reclamation annually with its Mineral Resources Awards.

Recipients of the 2007 DMRM Mineral Resources Awards will be introduced at the Awards Luncheon during the Applied Research Conference. In addition to statewide honors, the winners become the Division's nominees for national award recognition, such as the awards programs sponsored by the Interstate Mining Compact Commission (IMCC) and Office of Surface Mining (OSM).

Past Award Recipients

❖ **OIL-FIELD OPERATIONS AWARD** recognizes outstanding commitment to the conservation and protection of soil, surface or ground water resources during oil and gas exploration, development and waste management operations.

2006 - Alliance Petroleum Corporation, Canton
Outstanding commitment to resolve a serious environmental problem under difficult circumstances

2005 - Artex Oil Company, Marietta
Exceptional commitment to quick response in the event of oil-field emergencies

2004 - North Coast Energy Inc, Cambridge
Outstanding reclamation of drilling sites and lease roads

2003 - Franklin Gas and Oil, Wooster
Outstanding protection of resources during exploration, site restoration and production operations, and exceptional response to oilfield emergencies

❖ **COAL MINING RECLAMATION AWARD** recognizes mining operators for their outstanding reclamation achievements through regulatory compliance, environmental protections and innovative reclamation techniques demonstrated during the course of coal mining activities.

2005 & 2006 - none

2004 - Cravat Coal Company, Poplar Ridge Mine (D-2131), Harrison County
Site reclamation and wetland construction for improved land use

2003 - Penn-Ohio Coal Company, Yorktown Pit (D-2079), Tuscarawas County
Versatile problem-solving field techniques that fit within established regulatory guidelines

2002 - Holmes Limestone Company, Thomas Operations (D-2011), Stark County
Mining of prime farmland soils that exceed restoration requirements

❖ **INDUSTRIAL MINERALS MINING RECLAMATION AWARD** recognizes mining operators for their outstanding reclamation achievements through regulatory compliance, environmental protections and innovative reclamation techniques demonstrated during the course of industrial minerals mining activities.

2006 - R. W. Sidley, Inc., Sidley-Painesville Plant (IM-162), Lake County
Accomplishing and maintaining high quality reclamation during significant climatic challenges

2005 - Kwest Group LLC, Gypsum Quarry (IM-344), Ottawa County
Enhanced post-mining land use through reclamation and restoration, and a renewed use of existing mineral resources

2004 - Watson Gravel, Inc., Harrison Kilby Road Plant (IM-761), Hamilton County
Site reclamation providing for improved, long-term land use by the Hamilton County Park District

2003 - Martin Marietta Materials Inc., Fairborn Sand and Gravel (IM-366), Clark County
Concurrent mining and reclamation activities that provide community consideration through a visually pleasing landscape.

❖ **ABANDONED MINE LAND RECLAMATION AWARD** recognizes outstanding abandoned mine land reclamation and exemplary reclamation techniques.

2006 - Huff Run Watershed Restoration Partnership, ATC Associates Inc. of Indianapolis, Crossroads RC&D, Red Malcuit, Inc. of Strasburg, National Fish and Wildlife Foundation
Reduction of acidity and toxic metals entering Huff Run through a combination of site reclamation and installation of passive treatment systems including open limestone channels and alkaline ponds using steel slag on the Lyons AMD Reclamation Project, Tuscarawas County

2005 - Raccoon Creek Partners (Vinton County SWCD, and ILGARD), Stockmeister Enterprises, Inc. of Jackson, and ATC Associates Inc. of Indianapolis
Using a combination of steel slag leach beds and wetland development to correct a basin-wide acid mine drainage problem effecting Raccoon Creek known as the Mulga Run Reclamation Project, Jackson County

2004 - Huff Run Watershed Restoration Partnership, Tucson Inc. of New Philadelphia, and OSM's Appalachian Regional Coordinating Center
Team contribution to the design and installation of Ohio's first Pyrolusite Process® treatment of acid mine drainage for the Linden AMD Bioremediation System in Carroll and Tuscarawas Counties

2003 - Triple A Construction of Barnesville and ODNR AML Project Team
Efforts to extinguish and cap burning coal refuse within the Brier Ridge Refuse Pile Emergency Project, Jefferson County

❖ **MINERALS AWARENESS/PUBLIC OUTREACH AWARD** recognizes efforts to raise awareness about the use of minerals and the issues associated with mining and the environment. The award may be given to a schoolteacher or school, and/or an individual or organization.

2006 - Huff Run Watershed Restoration Partnership – Public Outreach
Providing students with environmental awareness of the effects of mining and remediation on stream health in the Huff Run watershed

2005 - Dr. Mary Wilder Stoertz – Educator*
Implementing service learning classes that provide for environmental site characterizations of mine lands prior to restoration

2005 - Hanson Aggregates Midwest, Inc. (Wagner Quarry, Sandusky and Sandusky Crushed Limestone Facility, Castalia) – Public Outreach
Providing public awareness of mining operations through open houses, school tours, newsletters and community meetings

2004 - Monday Creek Restoration Project, New Straitsville – Public Outreach
Ten years of dedicated public outreach to residents of the Monday Creek Watershed

2004 - Dr. Lin Wu and Dr. Chuck McClaugherty, Mount Union College, Alliance – Educators
Providing education in the field of environmental impacts from mining while providing student assistance and research for watershed restoration efforts

2003 - Lafarge Inc. Great Lakes Division, Marblehead Quarry, Ottawa County – Public Outreach
Public outreach to foster cooperation, partnerships and environmental stewardship awareness within the surrounding community

* Additionally earned the National Mining Educators Award from the Interstate Mining Compact Commission.

Keynote Topic

The Strickland Energy Plan: Implications for Ohio's Natural Resources

Keynote Speaker

Mark R. Shanahan

Mark R. Shanahan is the executive director of the Ohio Air Quality Development Authority (OAQDA) and its Clean Air Resource Center. Appointed in 1989, he oversees the management of more than $1.6 billion in outstanding bond issues as well as the Authority's research and special project programs.

On January 17, 2007, Governor Ted Strickland created the position of Governor's Energy Advisor through Executive Order 2007-02 and appointed Dr. Shanahan to the position. In that role, he is responsible for coordinating state agencies' efforts to develop a comprehensive Ohio energy policy and to implement the Governor's order to significantly reduce state agency energy consumption.

Mr. Shanahan oversees the work of the Ohio Coal Development Office, one of the nation's leading clean coal technology research, development and deployment programs. Since 1994, he has served as Ohio's Clean Air Ombudsman for small business.

An active member of the Air & Waste Management Association, he is group coordinator for the Technical Council's Environmental Management Group. He is also the Governor's delegated representative on the Third Frontier Commission.

Shanahan earned his Ph.D. from Case Western Reserve University. He received his M.A. (with honors) from the University of Pennsylvania and graduated from Boston College (magna cum laude, Phi Beta Kappa).

ODNR-DMRM APPLIED RESEARCH CONFERENCE 2007: New Legislation and Applied Research in Energy, Minerals and Restoration

Conference Program

Conference proceedings will be provided on CD, and will be mailed to attendees after the conference closes.

Wednesday, December 5, 2007

9:00-12:00 **Registration – Walter Hall Lobby**

9:45-10:00 **Welcome and Opening Remarks - Walter Hall 135**
John Husted, Chief, Ohio Department of Natural Resources, Division of Mineral Resources Management

10:00-10:30 **Keynote Speaker - Walter Hall 135**
Mark Shanahan, Executive Director of the Ohio Air Quality Development Authority and Energy Adviser to Governor Ted Strickland

10:40-12:10 **Session 1A – Regulation Requirements and Recent Changes - Walter Hall 135 – Moderator: John Husted**

ACOE Regulations and Regulatory Changes that Affect Mineral Extraction Industries - Mark Taylor, Regulatory Branch, US Army Corp of Engineers, Huntington District Office

Federal Fish and Wildlife Regulation: Application to Ohio's Mineral Resources Industry - Jeromy Applegate, US Fish and Wildlife Service, Reynoldsburg Office

Recent Developments in Mining and Remining Permits in Ohio - Randy Bournique, 401 Section Manager and John Morrison, Stormwater Specialist, Ohio Environmental Protection Agency

10:40-12:10 **Session 1B – Watersheds I - Walter Hall 145 – Moderator: Jen Bowman**

Using Algae, Especially Diatoms, to Discern Chemical, Physical, and Landscape Impacts on Streams - N. J. Smucker and M. L. Vis, Department of Environmental and Plant Biology, Ohio University

Chemical, Biological and Habitat Changes in Hewett Fork after Acid Mine Drainage Treatment via Lime Dosing – Ben McCament, Voinovich School of Leadership and Public Affairs, Ohio University; Mike Greenlee, Division of Wildlife; Kelly Johnson, Biological Sciences, Ohio University; Sheila North, Research Associate, Ohio University; and Brett Laverty, Vinton Soil and Water Conservation District

A Sediment Study of Little Leading Creek – Guy Riefler, Jennifer Chapman-Kleski, Ben Stuart, Tiao Chang, Yanhui Fang, and Blake Arthur, Department of Civil Engineering, Ohio University

12:10-1:45 **6th Annual Awards Luncheon - Walter Hall Rotunda**

1:45-3:15 **Session 2A – HB 443 – Walter Hall 135 – Moderator: Tom Hines**

The session will cover an overview of the statutory provisions contained in HB 443 concerning the Coal, Industrial Minerals and Mine Safety Programs. There will be an emphasis on the coal provisions and DMRM's implementation.
John Husted, Deputy Chief and Lanny Erdos, Permitting Manager, Division of Mineral Resources Management

1:45-3:15 **Session 2B – Watersheds II – Walter Hall 145 – Moderator: Scott Miller**

Microbial Investigation of the Linden Bioremediation System Treating Acid Mine Drainage in the Huff Run Watershed – John Krinks, Guy Riefler, Ben Stuart, Department of Civil Engineering, Ohio University; Peter Coschigano, Department of Biomedical Sciences, Ohio University; Cheryl Socotch, Division of Mineral Resources Management

Development of an Innovative Treatment Technology for the Truetown Discharge – Guy Riefler, Department of Civil Engineering, Ohio University and Kaabe Shaw, Sunday Creek Watershed Coordinator

Operation and Maintenance of AMD Treatment Systems – Rebecca Black and Mike Steinmaus, Monday Creek Restoration Project

3:15-3:30 **Break**

3:30-5:00 Session 3A – Site Restoration – Walter Hall 135 – Moderator: Max Leuhrs

Development of Rapid Assessment Protocols for Beneficial Use of Post-2000 Coal Combustion Products in Virginia Coal Mine – W. Lee Daniels, Mike Beck and Matt Eick, Department of Crop and Soil Environmental Sciences, Virginia Polytechnic Institute

Spatial and Temporal Patterns of Aggregate Mines Along the Hocking River: Implications for Understanding Interactions with River Processes – Michael Hughes, Voinovich School of Leadership and Public Affairs, Ohio University

The Modern Landfill as a Site Restorative: A Case Study of the Potential Reclamation of an Abandoned Strip Mine – Gordon K. Parish and Wesley Rhiel, Malcolm Pirnie, Inc., Columbus, Ohio

3:30-5:00 Session 3B – Post Mining – Walter Hall 145 – Moderator: JT Kneen

Use of Remote Sensing in Determining Approximate Original Contour – David Lane, Office of Surface Mining, Knoxville, TN and Lukus Monette, Office of Surface Mining, Pittsburgh, PA

Monitoring and Exploration for Flooded Pools in the Pittsburgh Coal Basin of North West Virginia – Joseph J. Donovan, Department of Geology, West Virginia University

The Meigs Mine Pool - 2007 Update – Mary Ann Borch, Geologist, Division of Mineral Resources Management

5:00-7:00 Poster session – Walter Hall Rotunda

Thursday, December 6, 2007

7:30-8:30 Registration – Walter Hall Lobby

8:30-9:30 Session 4A – AML Reauthorization – Walter Hall 135 – Moderator: Max Leuhrs

Reauthorization of the Ohio Abandoned Mined Lands Program – Terry VanOfferen, AML Program Manager, Division of Mineral Resources Management

Reauthorized AML: West Virginia's Strategy for Using Set Aside Funds for Maximizing Stream Recovery – Paul Ziemkiewicz, West Virginia Water Research Institute

8:30-9:30 Session 4B – Reforestation – Walter Hall 145 – Moderator: Mitch Farley

Preliminary Results of American Chestnut Restoration and Mineland Reclamation: Bringing Technologies Together – Brian C. McCarthy and Corie L. McCament, Department of Environmental And Plant Biology, Ohio University

Jockey Hollow Reforestation and Mineland Reclamation Project Permit D-2235 – Jeff Emmons and Mike Hiscar, Environmental Specialist, Division of Mineral Resources Management

9:30-9:45 Break

9:45-12:00 Session 5A – Energy – Walter Hall 135 – Moderator: Scott Miller

A Novel Gasifier for Carbon Recycling - Dave Bayless, Director of the Ohio Coal Research Center, Ohio University

Energy Production from Sulfur-Containing Coal Syngas via Solid Oxide Fuel Cells – Matt Cooper, Department of Chemical and Biomolecular Engineering, and Dave Bayless, Director of the Ohio Coal Research Center, Ohio University

An Overview of Geologic Sequestration Research in Ohio – Larry Wickstrom, Division of Geological Survey Chief and State Geologist

Ohio's Deep CO_2 Sequestration Test Well – Doug Mullett, Division of Geological Survey

9:45-12:30 Session 5B – Water Monitoring Workshop (Voinovich Center) – Walter Hall 145 – Moderator: Ben McCament

This two hour and 45 minute interactive workshop will focus on field methods of water quality monitoring in acid mine drainage impaired streams. The workshop will be led by a panel of experienced water quality monitoring professionals and will cover such topics as:

- developing a sampling plan for watershed characterization
- pre- and post-AMD treatment monitoring
- monitoring equipment
- quality assurance and quality control

The workshop will allow for a question and answer session on AMD monitoring techniques and issues.

Workshop will be led by Jen Bowman - Environmental Project Manager; and Ben McCament - Raccoon Creek Watershed Coordinator at Ohio University's Voinovich School of Leadership and Public Affairs.

Conference proceedings will be provided on CD, and will be mailed to attendees after the conference closes.

Field Trip Agenda

12:45 PM	Collect box lunch from Walter Hall (Rotunda) food serving area
1:00 PM	Depart Walter Hall
2:00 PM	Arrive at Pine Run Stream Capture, Perry County
2:45 PM	Depart Pine Run Stream Capture
3:00 PM	Arrive Lost Run Phase 2, Hocking County
3:45 PM	Depart Lost Run Phase 2
4:30 PM	Return to Walter Hall

If necessary, the time spent at the projects can be adjusted for a 4:00 PM return. See following page for site descriptions

PINE RUN STREAM CAPTURE

A 319-Implementation grant was awarded to the Sunday Creek Watershed Group in 2004 to help address various issues throughout the watershed. The Pine Run Stream Capture was funded through a cooperative agreement between ODNR and Ohio EPA to eliminate fresh water from entering an abandoned underground mine complex through a stream capture and two subsidence features. The intent of the project is to decrease the quantity of acid mine drainage entering Pine Run, a tributary to Sunday Creek. A reconnaissance study performed by an Ohio University Hydrogeology class in 2000 estimated that 50 million gallons of water is being capture annually.

Construction was completed in 2007 at a cost of $71,981.00. Project work included filling and sealing both the subsidence features and the stream capture hole and constructing over 1000 linear feet of stream channel to create positive drainage from the stream capture to Pine Run. Those who attended the 2006 ARC Tour may remember visiting this site prior to construction.

LOST RUN PHASE 2

The Lost Run Phase 2 Reclamation Project is the second of potentially three or more phases of projects that consist of the construction of alkaline-producing surface drainage systems. The intent of these projects is to decrease acid mine drainage that currently discharges into Lost Run, a tributary of Monday Creek. It is estimated that Lost Run contributes 9% (average 346 lbs/day) of the acid loading to Monday Creek at base flow (Source: - *Acid Mine Drainage Abatement and Treatment Plan for the Monday Creek Watershed – Monday Creek Restoration Project or AMDAT*).

Lost Run Phase 2 was recently completed at an estimated cost of $491,387. The project consists of two sites and involves the installation of passive AMD treatment alternatives including 2 limestone berms, 3 steel slag berms, a limestone leach bed, open limestone channels, a steel slag leach bed and water containment structures.

The tour will visit Site 1E, which is located in the downstream portion of Lost Run and receives flow from approximately ten intermittent streams. The drainage has been affected by surface mining and contains highwalls, pit impoundments, spoil piles, and seepage. In spite of the mining, the discharge at the mouth is net alkaline at low to moderate flows. Due to the tributaries substantial flow contribution (measured as high as 610 gpm) to the mainstem of Lost Run and its net alkaline status, 1E provides an excellent opportunity for increased alkalinity production through the installation of a steel slag bed and open limestone channels.

Program Abstracts

Session 1A – Regulation Requirements and Recent Changes

ACOE Regulations and Regulatory Changes that affect Mineral Extraction Industries

Mark A. Taylor, Chief of South Regulatory Section, Regulatory Branch, Operations and Readiness Division,
U.S. Army Corp of Engineers, Huntington District Office

Presentation will focus on new ACOE Nationwide Permit Requirements and their impact to the mineral extraction industries. The talk will also address the impact of and resulting changes to the regulatory implementation as a result of the "Rapanos" litigation decision.

Federal Fish and Wildlife Regulation: Application to Ohio's Mineral Resources Industry

Jeromy Applegate
Fish and Wildlife Biologist, U S Fish and Wildlife Service, Reynoldsburg, OH

The U.S. Fish and Wildlife Service (Service) is the principal Federal agency responsible for conserving, protecting and enhancing fish, wildlife and plants and their habitats for the continuing benefit of the American people. The Service administers such Federal wildlife laws as the Endangered Species Act and Fish and Wildlife Coordination Act. Both laws have application to mineral resources industry projects, primarily those that require a Surface Coal Mining and Reclamation Act (SMCRA) permit or Clean Water Act (CWA) section 404 permit.

The Fish and Wildlife Coordination Act requires the Corps of Engineers (Corps) coordinate with the Fish and Wildlife Service and state wildlife agencies regarding impacts of water development projects to fish and wildlife resources. The Act requires that the Corps give fish and wildlife resources equal consideration when evaluating all the merits of a project proposal. The Service frequently provides input to the Corps during the CWA section 404 application process regarding minimization and avoidance of impacts to fish and wildlife and mitigation of streams and wetlands.

The Federal Endangered Species Act prohibits the unauthorized take of federally listed species. Section 7 (a)(2) of the Act requires that Federal agencies consult with the Service to ensure that their actions do not jeopardize the continued existence of listed species. Federal Actions related to the mineral resources industry include Office of Surface Mining oversight and approval of state coal mine permitting programs under SMCRA, and Corps issuance of CWA section 404 permits for placement of fill material into waters of the U.S. As a result of this consultation requirement, any applicant for a state coal mining permit or Federal CWA section 404 permit must evaluate the potential impacts to federally listed species resulting from their project proposal.

Recent developments in Federal fish and wildlife regulation include removal of bald eagle from the Federal list of threatened and endangered species, development of an internet-based system for Section 7 consultation, and close of the public comment period for a revised Indiana Bat Recovery Plan.

Recent Developments in Mining and Re-mining Permits in Ohio

Randy Bournique, 401 Section Manager
John Morrison, Stormwater Specialist, Ohio Environmental Protection Agency

Mr. Bournique will provide an update on recent revisions to the Nationwide Coal Mining and Remining permits as well as a brief overview on Ohio's experience thus far with the innovative Integrated Permitting Process that was developed between Ohio's coal industry, the Corps of Engineers, Ohio EPA and ODNR-DMRM.

Mr. Morrison will provide an update on the status of the draft Coal Surface Mining NPDES General Permit renewal highlighting its differences with the current permit. Also Mr. Morrison will discuss how Ohio EPA's 401/404/Isolated Wetlands Program and NPDES coal general permitting program coordinate with one another.

Session 1B – Watersheds I

Using Algae, Especially Diatoms, To Discern Chemical, Physical, and Landscape Impacts On Streams

Smucker, N.J. and Vis, M.L.
Department of Environmental and Plant Biology, Ohio University, Athens, OH 45701, USA
George V. Voinovich Center for Leadership and Public Affairs, Athens, OH 45701, USA

Algae, especially diatoms, are crucial components of stream ecosystems, yet they are often neglected in biological assessments of stream impairment. They provide many important functional services and respond to a variety of chemical and physical variables. For the purpose of investigating natural and anthropogenic influences on stream algal communities, 44 streams throughout the Western Allegheny Plateau (WAP) of southeastern Ohio were sampled during the summer of 2005 for algae, chemistry, hydrogeology, and landscape variables. Ten reference sites representing least impaired conditions throughout the region were selected, and an index based on a diatom community model using genus level taxonomy was created. Scores were derived from percent similarity to the reference model ranging from 0 - 100 with higher percent similarity indicating less impaired conditions. Index scores were strongly correlated with many chemical variables, especially components of conductivity such as Na, Cl, Ca, and Mg. Scores were also correlated with certain physical and landscape variables. Partial multiple regression revealed a high proportion of variation in index scores represented by chemistry, landscape, and an interaction between the two sets of variables. Site scores were classified as unimpaired (> 66th percentile), moderately impaired (>33rd percentile), and severely impaired (< 33rd percentile). Discriminant analysis separated the groups with low misclassification rates primarily along the first axis based on chemical and physical variables. During the summer of 2006, 19 sites throughout the WAP, 24 sites within one watershed and 18 sites within a neighboring acid mine drainage impacted watershed were sampled for testing the index and further investigation of species-environment relationships at multiple spatial scales. Future research includes investigating the influence of spatial and temporal variability on stream assessments using algae and measuring functional components, e.g. succession, metabolism, and enzyme activity, of AMD impaired and remediated streams.

Chemical, Biological, and Habitat Changes in Hewett Fork after Acid Mine Drainage Treatment via Lime Dosing

Ben McCament[1], Mike Greenlee[2], Kelly Johnson[3], Sheila North[4], and Brett Laverty[5]
1 - Voinovich School for Leadership and Public Affairs, Ohio University, Athens, Ohio
2 - ODNR-Division of Wildlife, Athens, Ohio
3 –Biological Sciences and Faculty Fellow in Voinovich School of Leadership and Public Affairs, Athens, Ohio
4 – Research Associate, Ohio University, Athens, Ohio
5 –Vinton Soil and Water Conservation District, McArthur, Ohio

The Carbondale underground mine discharge is the largest source of acid and metal contamination in Hewett Fork, a tributary to Raccoon Creek which drains 40.5 square miles. In the spring of 2004 an Aqua-Fix® lime doser treatment was installed to neutralize acid loads from the site that had detrimental effects on eleven miles of Hewett Fork. Due to space limitations at the project site, sludge generated by metal oxides and unreacted calcium oxide could not be stored on site and is thus discharged into Hewett Fork as suspended load.

Chemical, physical, and habitat data was collected at up to ten sites in Hewett Fork to document and analyze effects from treatment. Post-treatment chemical data shows effective acid neutralization by the doser with a consistent net-alkaline discharge. On average an alkaline load of 683 lbs/day discharges into Hewett Fork compared with 786 lbs/day of acidity pre-treatment. Fish and macroinvertebrate data show increases in diversity and abundance in Hewett Fork in general but overall biological health is enhanced furthest downstream of the doser. Full recovery of aquatic life has occurred in Hewett Fork in the lower four miles of stream, which now attain Ohio EPA biological criteria for Warm Water Habitat. Although the seven miles of stream closest to the doser has shown improvements in biological communities post-treatment, sites remain in poor condition in relation to biological criteria. Habitat impairments from metal flocculents and untreated acid mine drainage appear to be limiting factors for full recovery of the entire reach of Hewett Fork downstream of the doser.

A Sediment Study of Little Leading Creek

Guy Riefler, Jennifer Chapman-Kleski, Ben Stuart, Tiao Chang, Yanhui Fang, and
Blake Arthur, Department of Civil Engineering, Ohio University

Erosion rates on abandoned strip mine lands represent by far the highest soil losses on any land within the state of Ohio (USDA 1985). The highly erosive character of spoil from within these mined areas coupled with the high transport capacity provided by the hill slope processes and steep gradient stream channels result in accelerated sedimentation of the drainage system down gradient of the unreclaimed areas. As stream channel gradients transition from steep uplands to a lower sloped valley floors the competency to transport the sediment load is reduced. The eroded materials fall out of transport and accumulate as stored alluvium on floodplains and in the lower sloped stream channels. These accelerated sedimentation rates generally produce channel bed aggradation and increase flood plain elevation.

The traditional response to these types of AML impacts is to reduce erosion by eliminating the primary sources of sediment through reclamation. With a decrease in sediment delivery, the drainage system responds by the initiation of rejuvenation. As the aggraded streams approach base level and the stream profile approaches grade sediment transport competency decreases. For streams having an excess of transportable materials the result is attenuated sediment storage and an increase in transfer time of sediments through the drainage basin. Large volumes of sediment become stored as sand slugs; sandbars; and lateral bank deposits in low gradient reaches that act as sediment traps or sinks. The trapped sediments remain locked within these segments at discharges ranging below mean daily flow thresholds only being flushed through the segments during less frequent high flow events. Little Leading Creek is an example of one such stream. The trapped sediments in Little Leading Creek appear to have had a significant impact on aquatic life. Excess sediment in the water column and substrate composed almost entirely of sand provide poor habitat for macroinvertebrates and fish. A study has been conducted of this stream in order to understand the dynamics of transport through this drainage system. Through an understanding of these dynamics solutions have been proposed.

Session 2A – HB 443

The session will cover an overview of the statutory provisions contained in HB 443 concerning the Coal, Industrial Minerals and Mine Safety Programs. There will be an emphasis on the coal provisions and DMRM's implementation.

John Husted, Deputy Chief; Dave Clark, Regulatory Manager; Jerry Stewart, Mine Safety Manager; and Lanny Erdos, Permitting Manager, Division of Mineral Resources Management

Session 2B – Watersheds II

Microbial Investigation of the Linden Bioremediation System Treating Acid Mine Drainage in the Huff Run Watershed

John Krinks, Guy Riefler, Ben Stuart, Department of Civil Engineering, Ohio University; Peter Coschigano, Department of Biomedical Sciences, Ohio University; Cheryl Socotch, Division of Mineral Resources Management

The objective of this study was to investigate the microbial community present in the Linden Bioremediation acid mine drainage treatment system. This system consisted of a wetland and a large limestone treatment bed utilizing the Pyrolusite Process®, which involved inoculating the treatment bed with lab cultured, manganese-oxidizing bacteria for the purpose of oxidizing and removing manganese.

Microbial communities were investigated at inoculated and non-inoculated locations in the bioremediation system. If the initial inoculation was successful, microbial communities in the inoculated locations should differ significantly from the non-inoculated locations. Furthermore, bacteria from the inoculated locations should have manganese-oxidizing capacity. To perform the microbial study, DNA was directly extracted from the locations, amplified by polymerase chain reaction, and analyzed by terminal restriction fragment length polymorphism (TRFLP), clone libraries, and sequencing. TRFLP was used to determine the number and abundance of different species. Clone libraries separated each DNA fragment from the community so it could be sequenced and compared with available databases linking genetic sequences to species.

Sequencing of bacteria indicated a greater likelihood for manganese oxidation in the inoculation location than in the non-inoculated location. It was concluded that the inoculation of the limestone bed was likely successful at introducing a manganese-oxidizing population of bacteria, and that they were still active after three years. However, the certainty of this conclusion was limited based on two restrictions to this study, namely, the unavailability of the original inoculum and the lack of a truly identical non-inoculated control location.

Development of an Innovative Treatment Technology for the Truetown Discharge

R. Guy Riefler, Department of Civil Engineering, Ohio University
Kaabe Shaw, Sunday Creek Watershed Coordinator

An abandoned deep mine in Truetown, Ohio has been releasing high levels of acidity and iron into Sunday Creek for the past 25 years. Concentrations from the mine average 380 mg/L iron and 730 mg $CaCO_3$/L acidity at a steady flow rate of 1.2 million gallons per day. This severe loading eliminates the possibility of passive treatment, and though a doser could correct for the high acidity, the continued load of iron to the creek would prevent recovery. Because of the unique problems with the site, a fresh approach was taken to identify new treatment alternatives by evaluating the wide range of technologies available for drinking water production. This effort was conducted by civil engineering students at Ohio University as part of service learning projects of two classes: an undergraduate senior design class and a graduate advanced water treatment class.

The students' work indicated that the Truetown discharge could be treated to produce drinking water, and the sale of drinking water and iron sludge for pigment could pay for all maintenance costs. The first challenge for the treatment plant was the removal of iron. At low pH ferrous iron is stable and slow to oxidize by mixing with air. The conventional AMD treatment approach is to raise the pH to increases ferrous iron oxidation rates and allow for air oxidation. However, the addition of alkali results in

iron sludge with numerous impurities unsuitable for pigment production. Instead the students tested several strong oxidants to precipitate iron at the low initial pH. Hydrogen peroxide, potassium permanganate, and sodium hypochlorite (bleach), all resulted in rapid iron precipitation, however bleach proved to be the cheapest and also resulted in sludge that settled rapidly. To treat 3% of the Truetown flow for pigment recovery would require one tanker truck per week of concentrated bleach at a cost of $92,000 per year, however pigment sales would generate $132,000 per year.

The primary limitations to producing potable water are the high levels of sulfate at 2,040 mg/L and hardness at 890 mg $CaCO_3$/L, which greatly exceed drinking water standards of 250 mg/L and 150 mg $CaCO_3$/L, respectively. After evaluating a variety of technologies, the students determined that reverse osmosis was the most cost efficient. An innovative treatment plant was designed incorporating pigment production, sequencing batch reactors, and a reverse osmosis system for a total cost of $5.4 million. This includes $1.9 million for deep well injection of the reverse osmosis brine, however, which could be eliminated if disposal to the creek is allowed. Operation and maintenance costs total $0.90 million per year, however pigment sales reduce that cost to $0.77 million per year. This would produce 0.4 million gallons per day of drinking water and translates to a water cost of 0.527 per gallon, below most utility bills. This analysis demonstrates that acid mine drainage treatment can be profitable, although a significant initial investment is required. On the other hand, this treatment plant is extremely complex and may have unforeseen technical difficulties.

Operation and Maintenance of AMD Treatment Systems

Rebecca Black and Mike Steinmaus
Monday Creek Restoration Project

A variety of treatment measures have been implemented to neutralize acid water in streams throughout the coal mining areas of southeast Ohio. Some treatment systems require little maintenance, whereas other systems are dependent upon regular operation and maintenance practices. Treatment systems examined will include Successive Alkaline Producing Systems (SAPS), leach beds and dosers.

This session will explore the operation and maintenance requirements of several commonly used treatment systems. The basic design and operational characteristics of each system will be described. This will be followed by a description of maintenance programs established for efficient, long-term treatment of AMD. Physical and environmental conditions affecting operation and maintenance will be presented.

Session 3A – Site Restoration

Development of Rapid Assessment Protocols for Beneficial Use of Post-2000 Coal Combustion Products in Virginia Coal Mines

W. Lee Daniels, Mike Beck and Matt Eick
Dept. of Crop and Soil Environmental Sciences
Virginia Tech, Blacksburg, VA

We studied the relative leachability/bioavailability of As, Cr, Mo, Se, B and certain metals from coal combustion products (CCPs) in coal mine site applications via a combination of chemical extraction and column leaching techniques. We also refined a pre-existing bioassay method for screening CCPs as potential mine soil amendments. Our combined results indicate that net calcium carbonate equivalence (CCE) is the most important characteristic of CCPs that affects bioavailability or leachability for most elements of concern, and that bulk CCE also had the predominant impact on plant growth. At the higher CCP loading rates necessary for long term neutralization of strongly acid-forming (1% pyritic S) coal refuse, our results indicate that significant B and Mo could potentially be available for leaching. That being said, it is important to re-emphasize the fact that by adding appropriate levels of alkaline CCPs, the tendency of the refuse itself to generate soluble As, Se, Cu, and other metals is drastically curtailed. The critical issue is whether or not sufficient total alkalinity is loaded into the system for long-term (multi-year) and permanent acid control. Relative leachability of most elements of concern was readily predicted by the modified sequential extraction procedure employed. Our combined results indicate that a few relatively simple lab measurements (pH, EC, CCE) coupled with a simple soybean bioassay can readily predict both the relative effectiveness and potential toxicity of a given CCP when used as either a bulk mine soil amendment or an alkaline additive for acid control.

Spatial and Temporal Patterns of Aggregate Mines along the Hocking River: Implications for Understanding Interactions with River Processes

Michael L. Hughes
Voinovich School of Leadership and Public Affairs, Ohio University

The Hocking River valley of southeastern Ohio has been a reliable source of construction aggregate since before the turn of the 20th century. Production of commercial aggregate greatly increased in Ohio, and likely also in the Hocking valley, following World War II when industrial excavation equipment became widely available. Examination of satellite imagery from 2007 showed at least 35 aggregate pits of various conditions at 11 operational sites along the Hocking River between Lancaster and Athens. This portion of the valley coincides with at least four Pleistocene terraces that provide coarse aggregate at depth, in addition to the finer aggregate mined from shallow alluvium on the modern floodplain. Downstream of Athens, the Hocking River valley is generally broader, the valley-floor alluvium is finer, the terraces are thinner (or nonexistent), and land-use is more agricultural, resulting in fewer aggregate mines. Mines occur in various geomorphic settings, which have different implications for hydrogeomorphic interactions with the river channel. Using a time series of historical aerial photos coupled with field reconnaissance of pit sites, I will map the distribution of aggregate mines along the Hocking River and develop a classification of the mines according to their positions on the valley floor relative to the river channel. This information will provide the initial basis for conceptualizing differences among mines with respect to interactions with channel processes such as lateral migration, pit capture of floodwaters, and hyporheic exchange of water between the river and open pits. The implications for balancing sustained aggregate production and environmental functionality of the river-floodplain system will be discussed in light of these results.

The Modern Landfill as a Site Restorative: A Case Study of the Potential Reclamation of an Abandoned Strip Mine

Gordon K. Parish, P.E., C.P.G. and Wesley Rhiel, P.E.
Malcolm Pirnie, Inc.
Columbus, Ohio

In the mid-1990s, a private company became interested in a remote property in southeastern Ohio: 650 acres of rough terrain, pockmarked with coal mine spoil piles, exposed bedrock cliffs, and numerous ponds containing an estimated ten million gallons of acidic water seeping into the headwaters of a stream flowing off site. The company envisioned the potential for developing the former strip mine as a landfill – one that ultimately could contain 65 million cubic yards of airspace, enough to provide for regional waste disposal for approximately 50 years.

The objective of siting and operating a landfill is seemingly incongruous with the idea of improving the environmental condition of a property. But in this case, the installation of a modern landfill would initiate several long-term benefits for the property:

- The acidic ponds would be drained and the water treated on site before discharge into the stream.
- The construction of the landfill liner system would reduce the amount of infiltration and recharge through the former strip mine.
- Mine spoils would be re-used in landfill components: as a clay liner when mixed with bentonite, as daily cover within the landfill, or as engineered subgrade for ancillary landfill structures.
- Long-term potential to introduce the pond water into the landfill in a bioreactor project – thereby treating both the acidic water and the municipal solid waste.
- Long-term potential to capture and utilize the methane gas being generated by the decomposing waste to generate electricity for local consumers.

Although the development of the landfill would provide long-term environmental benefits for the property, it was crucial to demonstrate that the unique geology associated with the abandoned strip mine was suitable to safely support the facility – a slope failure at a landfill can be a catastrophic event. Malcolm Pirnie implemented a geotechnical investigation and conducted parametric slope stability analyses to develop a design that incorporated appropriate factors of safety against slope failure in order to protect human health and the environment.

Session 3B – Post Mining

Using Remote Sensing to Evaluate Approximate Original Contour Reclamation

Lukus Monette
Remote Sensing Specialist, Office of Surface Mining, Pittsburgh, PA

This presentation will provide an overview of remote sensing techniques used to evaluate post mining configuration and spoil handling for a selected number of surface mine sites in Kentucky as part of OSM oversight. Of interest are mining operations involving the mining of entire coal seam running through the upper fraction of a mountain, ridge or hill and returning the mine sites to approximate original contour.

Monitoring and Exploration for Flooded Pools in the Pittsburgh Coal Basin of North West Virginia

Joseph J. Donovan
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Numerous underground coal mines in the Pittsburgh coal basin of West Virginia and Pennsylvania have closed in the period 1980-2003. Of an estimated 1000+ once-active mines, only 11 are currently active, most relatively deep in the basin. These closures have caused flooding of mines and caused new discharges of mine water, of which all are either currently flooding or pumped and treated by mine operators or state agencies.

This newly-created aquifer is a series of semi-interconnected compartments formed by mines separated by barrier pillars of 25-400 feet thickness. The leakage rate through barrier pillars is quite variable spatially and may be either very high (with hydrologically open conditions between adjacent mines) or very low (creating relatively isolated "pools" of one or more mines). Due to this fact and to the various closure dates of mines, the flooding history is complex with mines at a wide variety of water levels and flooding extents. However, experience shows that most mines near the Monongahela River flood within 10 years or less, and thus a new "equilibrium state" is expected to be attained by about 2015. At this time, flooding of most mines will be complete and an estimated 53,000 gpm (85,479 acre ft/yr) of mine discharge – both treated and untreated – will flow into the Monongahela watershed from below-drainage mines. This is in addition to an additional 8,000 gpm estimated from above-drainage free-draining mines. At this time, the flooded Pittsburgh coal will become the largest spatially-continuous high-yield aquifer exclusive of Cambro-Ordovician karst aquifers in the Northern Appalachian region.

The locations of discharge from mines are known for 2003, subject to limitations of data availability, and may be speculatively projected for year 2015, subject to numerous assumptions and future circumstances. It is expected that all of the new discharges will required active treatments for metals removal to prevent discharge to the Monongahela and Ohio River watersheds. This resource of treated water may be utilized for other purposes such as commercial development and aquaculture.

The Meigs Mine Pool - An Update, 2007

Mary Ann Borch
ODNR Division of Mineral Resources Management

Mine pools are developing throughout the Appalachians subsequent to the removal of deep underground coal. States are learning how to treat perpetually discharging mine water and are creating the technology and the legal and financial framework to address this issue.

The Meigs Mine in southeastern Ohio was the first in Ohio to use the longwall method in the 1970s. Since mining ceased in 2002, a mine pool has been filling the void space left by coal removal. Pumping and treatment of mine water will commence in 2008 – 2009.

The mine complex is almost entirely below drainage. The Clarion coal dips to the southeast at a rate of 30 ft/mi beneath an overburden that ranges from 200 to 600 feet. A coal barrier 1,350 feet thick separates Meigs No. 2 from the Meigs No. 31 and Raccoon mine complex.

The mines are recharged by vertical infiltration, lateral inflow from adjacent flooded mines and from ground water in the coal itself. Variations in mine pool recharge occur spatially and seasonally. Incremental differences in the fill rates from specific monitoring points are apparent. In general, the pool rises and falls in concert over the complex. Recharge rates were volumetrically determined as follows: 0.266 gpm/acre for Meigs No. 2, and 0.284 gpm/acre for Meigs No. 31 (Siplivy, consultant for CONSOL).

Near surface aquifers and streams are impacted by mining induced fractures. In areas of low cover, the inflow of groundwater to the mine may be direct. In most cases, the aquifer systems and streams flow downward facilitated by fracture dilation. These fractures may heal themselves with time given sufficient amount of clay and shale material in the strata. On the other hand, if the strata are friable sandstone units, the ability of the fractures to heal is diminished as is the case with stream loss in tributaries of Sisson Run, Zinns Run, and Bucks Run.

To prevent mine pool from discharging to low-lying stream valleys, pumping will be required. Water will have to be treated prior to discharging. The first pumped water is the worst quality because of the flush of concentrated soluble pyrite oxidation

products (iron sulfate salts). Based on experience with other below-drainage Appalachian mines; that water quality will improve dramatically with time. Due to the partially unflooded mine pool, the mine pool water quality will likely never fully meet effluent limits, and thus may require perpetual treatment.

New legislation promulgated in HB443 (Dec. 2006) will enable a long-term security bond provide by the coal company to pay for treatment.

Session 4A – AML Reauthorization

Reauthorization of the Ohio Abandoned Mined Land Program

Terry Van Offeren
Senior Manager for Ohio's Abandoned Mine Land Program, Division of Mineral Resources Management,
Ohio Department of Natural Resources

On December 20, 2006, Public Law 109-432 was signed into law, reauthorizing the reclamation fee on coal. This important legislation will allow Ohio to continue to abate the hazards and environmental pollution associated with abandoned coal mines.

Some key features of the new law include:

- Extension of the reclamation fee through 2021;
- Grants to Ohio will be distributed outside the congressional appropriations process;
- 25.7 million dollars in the AML Trust Fund arrears will be paid back to Ohio over the next seven annual grant cycles;
- The set-aside for acid mine drainage treatment and abatement will be increased from 10% to 30% of state share and historical coal production grant funds;
- Revises the grant distribution formula to increase funding to states, like Ohio, that have had significant historical coal production;

The existing 2007 grant for non-emergency AML work in Ohio is 4.9 million dollars. It has been projected by the Office of Surface Mining that the distribution will increase to 8.1 million dollars in 2008. This distribution will steadily increase until it peaks at 21.3 million dollars in 2013. After that date, funds will begin to decline. A total of 139.5 million dollars will be received by Ohio between 2007 and 2016. Additional funds will be received through 2024 with the amount dependent on the existence of any remaining public health and safety hazards.

Ohio's AML Program intends to concentrate over the next two years on updating the AML Inventory and preparing engineering designs in preparation of the larger grants that will be coming in 2010 and beyond. A reorganization of staffing and program areas will enable Ohio and its partners to hit the ground running with this fortunate increase in AML funding.

Reauthorized AML: West Virginia's Strategy for Using Set Aside Funds for Maximizing Stream Recovery

Paul Ziemkiewicz, PhD
National Mine Land Reclamation Center
West Virginia University

Congress reauthorized the Abandoned Mine Land (AML) Program in December 2006 amending and extending the Surface Mining Control and Reclamation Act Amendments for fifteen years. The AML program substantially increases not only the total allocation to West Virginia but increases the set aside program to 30% of the annual grant. The West Virginia program will grow from roughly $23 M/year to a range of $60 to $90 M/year. While the bulk of the AML fund would be targeted toward reclamation of surface hazards, set aside moneys can be used for both capital and operating/maintenance costs for treatment of mine drainage. These changes carry important implications for watershed restoration. Most significantly, increases in the set aside program allow the State to develop and implement a comprehensive plan to restore a large portion of stream miles that have been impaired by pre-law coal mining.

The magnitude of water quality impairment from pre-law mining is too widespread to address in the traditional source by source treatment approach. Consequently, restoration actions will need to be prioritized based on which actions will provide the greatest ecological benefits per unit cost. Furthermore, justification of restoration expenses will require demonstration of measurable aquatic benefits and associated economic benefits.

This presentation outlines the State's strategy, focusing on the goal of maximizing recovery of cold and warm-water fisheries in watersheds impaired by historic, pre-law coal mining. The National Mine Land Reclamation Center at West Virginia University is providing technical assistance to the WVDEP by developing strategic approaches and cost/benefit metrics for watershed restoration projects.

Session 4B – Reforestation

Preliminary Results of American Chestnut Restoration and Mineland Reclamation: Bringing Technologies Together.

Brian C. McCarthy and Corie L. McCament
Department of Environmental and Plant Biology, Ohio University

Reclaimed mine lands are often characterized by highly compacted soil and re-vegetated with grasses. While these methods help to control erosion, it often mis-directs natural succession and results in lowered species diversity. American chestnut provides ample opportunity for successful reforestation of these landscapes due to their rapid growth in areas of high light, poor soil quality, and low pH. American chestnut has been largely ignored in mine land reforestation efforts because of its demise caused by chestnut blight (Cryphonectria parasitica). However, a blight resistant variety is scheduled to be commercially available within the next decade. The objective of this study is to evaluate different soil preparation technologies to assist in reclaiming mine land and restoring American chestnut. We utilized a randomized complete block crossed effects statistical design. Three experimental blocks (73 × 37 m; 240 × 120 ft) were established at the site. Each block contains four soil prep treatment plots (each 18 × 36 m; 60 × 120 ft). The treatments include an untreated control, ripped (to 0.9 m; 3 ft) plot, a plowed and disked plot, and a plot that is ripped then plowed and disked. Each plot received 100 American chestnut hybrids (April 2007), totaling 1200 chestnut seedlings on the site. An ANOVA detected a significant difference in survival and growth among treatments ($P < 0.01$) in June. At this early stage of the experiment, only the control was significantly different than the treated plots. These preliminary results suggest that soil prep plays a critical role in chestnut viability on mine land soils.

Jockey Hollow Reforestation Mine Land Reclamation Project Permit D-2235

Jeff Emmons, Environmental Specialist, ODNR Division of Mineral Resources Management
Michael Hiscar, Reclamation Specialist, Department of Interior, OSMRE

This presentation will provide an update on the status of the reclamation and reforestation efforts on this mine site. Permit D-2235 is the first permit in Ohio to implement all five points of the Forestry Reclamation Approach (FRA) and is located on State of Ohio property that is managed by ODNR, Division of Wildlife. The presentation will discuss the paradigms of ODNR staff and mine company personnel and how they were dealt with throughout the permitting, mining, and reclamation processes. We will show the different ways that the mine operator implemented the five steps of the FRA and the adjustments that were made to make the FRA successful on this mine site. The current status of the survival of the tree and shrub seedlings will be shown and the planting of ground cover will be discussed. Although this region of Ohio experienced severe drought conditions for most of the growing season following planting, seedling survival is estimated to be over 70% while plantings on non-FRA sites are experiencing less than 30% survival. The reclamation on this site is an example of the success of multiple partnerships and was the site of the 2007 Arbor Day event held in May and is a winner of the Ohio's Appalachian Regional Reforestation Initiative and is being nominated for a regional award.

Session 5A – Energy

A Novel Gasifier for Carbon Recycling

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Imagine a world where we could grow all our feedstock (called biomass) for fuel without sacrificing food crops to do it. The Ohio Coal Research Center is working towards making that vision a reality. Ohio University is developing gasification technology that can convert biomass into a synthesis gas (syngas) which is comprised of hydrogen (H_2) and carbon monoxide (CO).

This syngas can subsequently be converted to natural gas or even liquid transportation fuels via a process known as Fischer-Tropsch synthesis (FTS). Current FTS produces high quantities of CO_2. Because of the reaction chemistry, increased H_2 in the final product requires the production of more CO_2. For example, if you want to produce methane (CH_4, the primary constituent in natural gas) from coal, you will produce more CO_2 than if you want to produce diesel fuel (which has an empirical formula closer to CH_2). In order to produce the additional hydrogen necessary, engineers take advantage of the Water-Gas-Shift (WGS) reaction which reacts CO and steam (H_2O) over a catalyst to produce H_2 and CO_2. Because of the stoichiometry of this reaction, the more hydrogen (H_2) needed, the more CO_2 produced.

Integrating this process with biological carbon capture can recycle all of the carbon from gasification, FTS, and the "upgrading" of current processes (like a petroleum refinery) and use it to produce fuel. This is significantly different than existing FTS technology which converts only about 50% of the carbon in the gasification feedstock (usually coal) to fuels, while the rest is rejected (wasted) as CO_2. The release of substantial quantities of CO_2 is the major stumbling block to financing such units (which cost billions of dollars). Without technology to mitigate CO_2 emissions in some fashion, capital markets fear the environmental

pushback and financial risk associated with FTS. The use of a biomass feedstock is environmentally preferred over coal because the feedstock carbon is derived from current atmospheric CO_2, not carbon that is newly released to the atmosphere after being sequestered underground for long periods of time.

Energy Production from Sulfur-Containing Coal Syngas via Solid Oxide Fuel Cells

Matthew Cooper, Graduate Student, Ohio University Dept. of Chemical Engineering
David J. Bayless, Director- Ohio Coal Research Center, Ohio University Dept. of Mechanical Engineering

Growing concerns over the environment as well as political instability in oil-producing regions of the world have ignited a large degree of interest in converting the electrochemical energy from coal-derived fuel streams using fuel cells. One specific type of fuel cell, known as the solid oxide fuel cell (SOFC), has the ability to produce energy from hydrocarbon fuels at efficiencies far greater than traditional combustion engines. However, hydrogen sulfide (H_2S), a common component of hydrocarbon fuels, poisons conventional SOFCs and necessitates costly fuel treatment, preventing the utilization of SOFCs for distributed power from being financially feasible.

The aim of this research is to develop a SOFC reaction process which will allow the use of a H_2S-containing fuel derived from coal reserves known as "coal syngas." In the proposed process, a two-stage SOFC reaction system will be used. In the first stage, SOFCs will utilize an electrode material known as lanthanum strontium vanadate (LSV), which has shown high activity toward consuming H_2S; it is hypothesized that these LSV SOFCs will "scrub" any H_2S present in the syngas stream via electrochemical oxidation while leaving behind non-H_2S species such as hydrogen (H_2) and carbon monoxide (CO). The outlet gases from this LSV SOFC will then be fed to another SOFC utilizing conventional Ni anodes; these conventional anodes have been shown to readily oxidize H_2 and CO, leading to the hypothesis that the combined process will efficiently produce electricity even when using a H_2S-contaminated fuel stream.

An Overview of Geologic CO_2 Sequestration Research in Ohio

Larry Wickstrom, ODNR, Division of Geological Survey, Columbus, Ohio

Ohio ranks third in the nation for the amount of coal it consumes. If Ohio's future energy production is to include clean coal technologies, ethanol, and synthetic fuels, and limit the amount of greenhouse gases emitted into the atmosphere, geologic CO_2 sequestration must play a large role in the mix. Developing Ohio's potential for sequestration with these new energy sources and production methods will be a challenge involving proper planning and sitting of facilities and the implementation of new regulations.

Geological sequestration involves the capture of CO_2 from power plants and other facilities and its storage in geologic reservoirs. Potential reservoirs include depleted and producing oil and gas fields, unmineable coal seams, and deep saline formations. Such reservoirs have naturally stored crude oil, natural gas, brine and CO_2 for millions of years. In partnership with surrounding state geological surveys and other state agencies, the U.S. Department of Energy, Battelle Memorial Institute, and academic institutions, the Ohio Department of Natural Resources, Division of Geological Survey has been researching Ohio's potential for geologic sequestration since 2000.

Early analyses of potential reservoirs included gathering and analyzing geological and geophysical data (mainly from the state's oil and gas records), which were then integrated through mapping and geostatistical techniques to provide three-dimensional models of subsurface units. These models form a base from which CO_2 sequestration capacities are calculated. Follow-up investigations and pilot projects continue to provide more detailed information via drilling and analyses of deep wells, injection testing, and modeling.

Ohio's Deep CO_2 Sequestration Test Well

Douglas J. Mullett
Ohio Department of Natural Resources, Division of Geological Survey

The State of Ohio budgeted approximately $2.3 million from the general revenue and clean coal research funds to evaluate CO_2 injectivity and storage potential of deep saline reservoirs and the effectiveness of confining units in a test well. The location for this sequestration test well was selected based on scarcity of deep geological information and the occurrence of a complete stratigraphic interval at a cost-effective drilling depth. A site in Tuscarawas County was chosen and the Ohio Geological Survey CO_2 #1 carbon sequestration research well was drilled to a total depth of 8,695 feet on June 9, 2007, into Precambrian rock.

After drilling was completed, geophysical well logging and sidewall coring operations were conducted. A total of 84 sidewall cores were collected from potential sequestration reservoir and confining zones. Coring depths were selected based on geophysical well log responses. In August 2007, slug and constant-pressure injectivity testing was performed from the Rose Run and basal sandstone intervals by injecting treated brine into discrete intervals. Following formation testing, the lower portion of the well was plugged with cement. The well was transferred to the operators who own the oil and gas rights to the site.

An enormous amount of information has already been collected from the well and its core. Core analysis and detailed evaluation of sidewall cores is currently under way. As information continues to be gathered, assimilated and interpreted, our understanding of subsurface conditions improves, allowing us to better assess sequestration potential of target reservoir zones. Information collected will be used to generate detailed models for CO_2 sequestration simulations.

Poster Session

A Predictive Model for Bio-monitoring of Wadeable Streams in Ohio's Western Allegheny Plateau Eco-region

Sheila H. North, Aquatic Ecologist, Ohio University
Dr. Kelly Johnson, Biological Sciences, Ohio University

While the U.S. has focused almost exclusively on the sole use of multi-metric techniques in stream and river bio-assessments to-date, Europeans have concurrently developed alternative programs which rely on predictive (probability-based) bio-assessment models such as the River Invertebrate Prediction and Classification System (RIVPACS) and key U.S. scientists (Hawkins et al 2000, Parsons et al 2000) now strongly recommend testing a RIVPACS-type model for U.S. application in stream restoration techniques. Predictive model values provide a way to describe resource status and trends on a regional basis and can be a potentially powerful means of describing how conditions vary among basins and entire regions.

For this study, macro-invertebrate data (200 sampling sets) from approximately 86 minimally impacted reference sites were collected throughout wadeable streams of the Western Allegheny Plateau (WAP) Level III Eco-region. A RIVPACS-style predictive model of macro-invertebrate community composition under least impacted conditions was developed based on observed versus expected (O/E) frequencies of occurrence and available environmental/geomorphic/habitat data. I will report on the performance of the model for assessing the biological condition of WAP streams using O:E ratio and Discriminant Analysis models which link biological community structure to a stream's physical habitat.

Cooperation & Innovative Techniques Accommodate Both Bats and Watershed Restoration Goals

Katrina Schultes, Wildlife Biologist, USDA Forest Service,
Wayne National Forest, Nelsonville, Ohio

Abstract
Watershed restoration activities on the Wayne National Forest (NF) in southeast Ohio are aimed at improving water quality while also addressing safety issues and wildlife habitat potential. Acid Mine Drainage source-control projects sometimes conflict with the maintenance of underground habitat for bats. Closing holes can eliminate suitable bat habitat or even entomb animals, if work proceeds during critical periods. However, cooperation and innovative ideas can lead to projects that meet multiple resource goals. Several projects were initiated on the Wayne NF that incorporated watershed restoration or safety measures, and that accommodated bat-use of the sites, including use of stream diversions, bat-friendly gates, vent pipes for air flow maintenance, and simple habitat enhancements. Pre- and post-project fall swarming surveys for bats help track the success of these measures to conserve bat habitat. Preliminary data suggest that bats continue to use the modified openings after projects are complete, and, in some cases, bat use has increased. Goals for watershed restoration, safety, and wildlife conservation are not mutually exclusive. Case studies from the Wayne NF suggest innovative, and sometimes low-cost, techniques can be used to protect bat habitat while still meeting restoration and safety goals. Collaboration and cooperation at all levels are required to be successful. Pre- and post-project monitoring is essential to determine effects of designs, if any, on bats. Successes and failures must be documented and shared among resource professionals.

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