Coal Combustion Products - Environmental Issues - Program 49

Program Overview

Program Description

Management options for coal combustion products (CCPs) are continuously evolving as tighter air emissions standards and new fuel blends change CCP characteristics and increase CCP volumes. New by-products are also being generated from advanced generation technologies such as integrated gasification combined cycle (IGCC) and increased co-burning of “green” fuels such as biomass. CCP management practices have captured the attention of the public as well as legislative and regulatory bodies at both the state and federal levels. Environmental standards and test methods for trace constituents such as mercury, arsenic, and selenium continue to trend downward. This changing landscape highlights the need for new and updated information on the composition and leaching characteristics of CCPs, environmentally protective management methods, groundwater protection and remediation requirements, and risk assessment data for CCP storage, disposal, and use.

The CCP Environmental Issues program provides scientific data, engineering knowledge, restoration methods, and other tools for cost-effective soil and groundwater protection associated with fossil fuel–fired power plants and CCP storage, disposal, and use. Research currently focuses on the effects on CCP management options of new control technologies for mercury and other hazardous air pollutants (HAPs), sulfur oxides, and nitrogen oxides; disposal regulations being developed by the U.S. Environmental Protection Agency (EPA); ash pond management and closure; groundwater remediation associated with legacy sites; large-volume land application uses; risk assessment; and by-products associated with the new generation of power plants, such as IGCC.

Research Value

Program research provides fundamental data on environmental management of CCPs. Collaborative efforts with other organizations, including EPA and the U.S. Department of Agriculture (USDA), specifically address pressing needs with respect to CCP disposal and new large-volume uses for increased quantities of flue gas desulfurization (FGD) gypsum. The program provides pivotal studies on leachability, groundwater transport, and mitigation of CCP constituent releases, as well as cost-effective and environmentally protective landfill/pond designs and closures. In addition, the program provides clear communications on the environmental risks associated with CCP management and a strong scientific voice on technical issues. Annual disposal costs for the industry are likely to increase significantly under the new EPA regulations; hazardous waste regulation would significantly increase management costs and potentially eliminate many current beneficial use alternatives. This research investigates ways to

- reduce costs associated with environmentally protective disposal,
- increase options for beneficial use, and
- adapt and improve technologies for treatment and remediation.

Approach

This program is a mature research area with extensive data and experience to draw from, enabling it to shape research to specific customer needs and to work on specific problems of interest. The program coordinates research activities with other industry groups and federal and state regulatory and research agencies. This program delivers

- a robust CCP characterization database,
- health and ecological risk assessments associated with CCP disposal and use,
- environmental geochemistry assessments,
- guidelines for the management and monitoring of disposal facilities,
Accomplishments

This program builds on years of Electric Power Research Institute (EPRI) research evaluating environmental issues associated with CCP use and management. EPRI collaborates with governmental and nongovernmental organizations to educate regulatory agencies, policymakers, engineers, and the public on the environmental and engineering benefits of using CCPs. EPRI also works closely with EPA on research questions to provide technical support on regulatory matters affecting disposal, groundwater remediation, and large-volume land application uses. Work in this program is very closely coordinated with the CCP Use program in EPRI’s Generation Sector, which focuses on beneficial use of CCPs. Program accomplishments include:

- analysis of the impact of potential alternative disposal regulations on power plant economics;
- life-cycle analysis of the environmental benefits of CCP use;
- compilation and analyses of twenty years of research, provided to and used by EPA and state regulatory agencies to inform the Bevill regulatory determinations and state disposal regulations;
- collection of a robust database that investigated leaching and volatilization of mercury from coal fly ash; analysis of this data later revealed that leaching and volatilization are not significant under typical disposal and land application conditions;
- coordination with EPA on development and appropriate use of a new leaching protocol for CCPs;
- laboratory and field data on geochemistry and speciation of arsenic, selenium, chromium, and mercury in leachate that can be used to more accurately evaluate ground water transport and health and ecologic risks;
- compilation and screening evaluation of groundwater remediation options that are most applicable for constituents found at CCP sites;
- preparation of comprehensive compilations of data on the occurrence, groundwater transport, treatment, and health effects of several key constituents (boron, arsenic, thallium, beryllium) at CCP and coal pile sites for use in permitting, groundwater evaluations, and risk assessments at CCP and coal pile management sites;
- organization of a consortium including utilities, EPA, USDA, the agricultural industry, and academia to advance understanding and further use of FGD gypsum and other FGD solids in agricultural applications; and
- assessment of risks associated with radionuclides in CCP solids and leachate.

Current Year Activities

Program research for 2011 will focus on compliance with new federal/state regulations, health and ecological risks associated with CCP management, CCP characterization, ash pond closure, groundwater remediation, and technology transfer. In particular, the program will respond to needs dictated by EPA’s new CCP rules, scheduled for release in 2010. Research on ash ponds will be coordinated with EPRI Environment Program 56, Effluent Guidelines and Water Quality Management, which is examining options for water treatment of ash pond discharges. Specific efforts will focus on:

- research to assist with assessing and complying with the new federal regulations governing CCP disposal and use;
- evaluation of health and ecological risks associated with mercury, arsenic, selenium, and other trace constituents in CCP disposal and use settings;
- methods for fixating metals in ash;
- ash pond management and closure;
- ensuring the appropriate use of the data from new leaching protocols being developed by EPA and others;
• completion of several demonstrations of FGD gypsum use as an amendment intended to improve crop growth in various soils;
• continued development of chemical profiles for key constituents associated with CCPs (selenium, molybdenum, antimony);
• development of data for assessing changes in CCP characteristics, focused on controls for $\text{SO}_3/\text{SO}_2$ (e.g., trona, sodium carbonate, lime), mercury controls, and resultant impacts on disposal and use;
• development and/or evaluation of effective groundwater treatment and remediation methods for key constituents at CCP disposal and use sites and at coal piles; and
• development of decision guidelines for determining the environmental acceptability of geotechnical uses of CCPs in structural fills, roadbase, and mine reclamation.

Estimated 2011 Program Funding
$1.5M

Program Manager
Kenneth Ladwig, 262-754-2744, keladwig@epri.com

Summary of Projects

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<tr>
<th>Project Number</th>
<th>Project Title</th>
<th>Description</th>
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<tbody>
<tr>
<td>P49.001</td>
<td>Communications and Outreach</td>
<td>A variety of outreach and communication vehicles, including short articles, technical briefs, oral presentations, workshops, and other methods will be used to convey research results from CCP research in a format that can be broadly disseminated to and understood by both technical practitioners and the general public.</td>
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<tr>
<td>P49.002</td>
<td>Groundwater and Environmental Risk Assessment</td>
<td>Research is focused on assessment and evaluation of groundwater effects and human health and ecological risks associated with the specific inorganic constituents that are commonly found at power plant facilities.</td>
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<tr>
<td>P49.003</td>
<td>Characterization of Coal Combustion Products</td>
<td>This research provides laboratory and field information on CCP characteristics and how they behave in environmental settings.</td>
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<tr>
<td>P49.004</td>
<td>Management of Coal Combustion Products</td>
<td>This project uses a mix of laboratory information, field studies, and engineering evaluations to assess and develop environmentally sound and cost-effective CCP management practices.</td>
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<tr>
<td>P49.005</td>
<td>Groundwater Remediation and Site Restoration</td>
<td>This project provides information and technologies for groundwater remediation at CCP and coal pile sites, and restoration of former power plant properties.</td>
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**P49.001 Communications and Outreach (069225)**

**Key Research Question**

Research results are only of value if utility technical staff, regulators, and the public have ready access to them in a convenient form. Outreach efforts—user-focused briefing papers, conference presentations, websites, and personal visits—can provide a means of communicating key research findings to CCP managers and their regulators to help support economically sound and environmentally safe management practices.

**Approach**

Effective communication of EPRI research on CCP issues is essential for the results to be considered and applied by the policymaking and regulatory communities. Communications activities under this program inform decision making and support the development of scientifically sound environmental policy through effective dissemination of significant research results to EPRI members, policymakers, regulators, scientists, and the public at large. These results are communicated via

- succinct descriptions of key EPRI research findings and their implications on a timely basis;
- presentations, briefings, and testimony to key stakeholders;
- detailed summary papers on EPRI research and analysis on major issues; and
- critical reviews of external studies published in technical reports or technical papers.

**Impact**

EPRI's outreach efforts enables users to

- better communicate with government entities and the public,
- coordinate use of research with evolving regulations, and
- stay abreast with state-of-the-science technologies for disposal, use, environmental assessment, and remediation.

**How to Apply Results**

Environmental compliance and CCP management staff can use the technical briefs and short communications in meetings with community members, potential CCP users, and local regulatory authorities.

**2011 Products**

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<td>CCP Research Summaries: A variety of outreach and communication vehicles, including short articles, technical briefs, oral presentations, workshops, and other methods will be used to convey research results from CCP research in a format that can be broadly disseminated to and understood by both technical practitioners and the general public, focused on issues of most interest during the year.</td>
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P49.002 Groundwater and Environmental Risk Assessment (058343)

Key Research Question

The need for environmental risk assessments at CCP disposal facilities and other power plant sites is expected to grow as monitoring requirements increase and EPA guidelines for new sites are enforced. Groundwater assessment costs alone can exceed $1 million per site, and potential health and ecologic effects from releases to surface water and air (dust) have not been fully characterized. Understanding potential risk is required to determine the need for further action and to select the optimum long-term plan for a site. Communication of the actual risk to the public and to regulators is critical to ensuring appropriate response actions.

In the past few years, releases of either ash or dissolved constituents from a handful of CCP management sites have significantly heightened public and regulatory interest in potential environmental risks associated with these facilities. The terms “toxic” or “hazardous” ash have recently become a standard part of the media and public lexicon. Scientific data, analysis tools, and objective evaluation are required to provide a fundamental basis for minimizing environmental impacts and for delineating real risk—as opposed to perceived risk—at these sites.

Approach

Research is focused on the specific inorganic constituents that are commonly found at power plant facilities and are most likely to drive human health and ecologic risk. Chemical profiles are developed for key inorganic constituents of interest, providing comprehensive information on occurrence, geochemistry, attenuation, potential health effects, and remediation and treatment. The chemical profiles are supplemented by laboratory and field studies on chemical transport and potential exposure. This research also provides tools, such as groundwater models, for assessing and managing long-term risks associated with environmental releases.

Impact

This project provides power companies and other stakeholders with the information and tools to assess and communicate the risks and impacts associated with CCP management sites and other power plant facilities. The research results provide

- tools and data developed specifically for addressing groundwater issues unique to power plant facilities,
- risk assessment methodologies to facilitate assessment of potential liabilities and selection of cost-effective management strategies,
cost savings realized with expedited groundwater investigations, and
wide-ranging information from EPRI and literature sources on key constituents at CCP and coal pile sites.

How to Apply Results
The information and tools developed under this project will assist power companies in evaluating and communicating risk and compliance at CCP management sites and other power plant facilities. Compliance managers can use assessment techniques to identify and define issues and to evaluate the significance and long-term ramifications of impacts. Health and ecological assessment data provides a basis for communicating with the public on complex environmental issues. Summary compilations for specific constituents will provide companies with concise compendiums of information that will allow remediation and waste specialists to perform site-specific risk assessments and groundwater modeling, and to select appropriate response actions. Groundwater data assessment tools can be used to establish efficient compliance programs for collecting, managing, and analyzing the large volumes of data that will accompany increased monitoring and compliance requirements at disposal sites.

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<tr>
<td><strong>Chemical Profile - Selenium:</strong> Information for evaluating the transport and fate of key constituents at power plant sites is assembled into individual reports, or chemical profiles. These data include power plant source concentrations, other potential sources, geochemistry, attenuation coefficients, treatment/remediation technologies, and health and ecological effects. The profile for selenium will be developed in 2011.</td>
<td>12/30/11</td>
<td>Technical Report</td>
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<td><strong>Groundwater Quality Signatures:</strong> Electric power companies are increasingly faced with monitoring multiple potential sources of groundwater contamination at power plant sites, including coal piles, ash ponds, ash landfills, and FGD management facilities. Distinguishing between on-site sources, as well as distinguishing on-site sources from potential off-site sources and background levels for compliance/remediation purposes, can be difficult. This research will develop methodologies for establishing unique signatures for groundwater quality monitoring programs, including use of stable isotopes.</td>
<td>12/30/11</td>
<td>Technical Update</td>
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<td><strong>Health &amp; Ecologic Effects:</strong> Issues related to potential health and ecological effects of both disposal and use of coal combustion products are increasingly of concern to the public, particularly in light of highly publicized releases such as the Kingston dike failure. This research will provide information on potential human health effects of key inorganic constituents in CCPs via ingestion, inhalation, and dermal contact, and potential ecological effects of inorganic constituents in CCPs.</td>
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<td>Chemical Profile - Molybdenum: Information for evaluating the transport and fate of key constituents at power plant sites is assembled into individual reports, or chemical profiles. These data include power plant source concentrations, other potential sources, geochemistry, attenuation coefficients, treatment/remediation technologies, and health and ecological effects. The profile for molybdenum will be developed in 2012.</td>
<td>12/30/12</td>
<td>Technical Report</td>
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<td>Risk Assessment: The need for remediation at CCP sites and power plant facilities is a function of human health and ecological risk posed by facility releases. This research will develop an overarching framework that participants can use to evaluate risks to groundwater, surface water, and air (inhalation) for their facilities under various management and release scenarios, including use in products. A key component of the research is development of communication pieces to convey risk information to the public. Focus topics include mercury, radionuclides, and trace metals.</td>
<td>12/30/12</td>
<td>Technical Report</td>
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<td>Chemical Profile - Chromium: This research will track innovative groundwater restoration technologies for inorganic chemicals, such as reactive walls and geochemical barriers. Treatability studies will be used to assess individual constituents and mixtures commonly encountered at power plant sites. Promising technologies will be further developed as appropriate for use at CCP management sites and coal piles. The profile for chromium will be initiated in 2013.</td>
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<tr>
<td>Health &amp; Ecologic Effects: Issues related to potential health and ecological effects of both disposal and use of coal combustion products are increasingly of concern to the public, particularly in light of highly publicized releases such as the Kingston dike failure. This research will provide information on potential human health effects of key inorganic constituents in CCPs via ingestion, inhalation, and dermal contact, and potential ecological effects of constituents such as selenium.</td>
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P49.003 Characterization of Coal Combustion Products (Q55327)

Key Research Question

Management options and environmental assessments for CCPs are driven largely by CCP physical and chemical characteristics. New and changing air emissions controls and advanced generation technologies substantively change the character of the by-products generated and their environmental behavior.

Air emissions controls that impact CCPs from conventional coal-fired plants include nitrogen oxide reduction, mercury (Hg) control, and sulfur trioxide (SO3) mitigation. Fuel blends include use of imported coals and increased use of biomass coburning. Integrated gasification combined cycle (IGCC) will generate a new class of by-products over the next decade. CCP radioactivity is under consideration again in light of technologically enhanced naturally occurring radioactive materials (TENORM) regulation.

CCP characteristics drive regulatory decisions as well as selection of appropriate management alternatives and long-term risk evaluations. In particular, several recent highly publicized events have reopened the question of the regulatory status of CCPs under the Resource Conservation and Recovery Act (RCRA), again raising the possibility of potential hazardous waste designation. In addition, EPA is introducing new leaching protocols for evaluating the environmental behavior of CCPs. Complete characterization data and critical evaluation of those data are an ongoing need to support development of environmentally sound and cost-effective management strategies.
Approach
This research provides laboratory and field information on CCP characteristics and how CCPs behave in environmental settings. The current focus is on changes to CCP characteristics due to mercury and SO$_3$ controls, co-burning of biofuels, radionuclides, and by-products derived from IGCC. EPRI is also working in parallel with EPA on development and interpretation of laboratory leaching methods and geochemical models for CCP leaching.

Impact
Research in this project provides core data touching all facets of CCP disposal and use. The information is used to provide technical underpinnings for regulation, management strategy, risk assessment, and remediation. The research results

- allow power companies to evaluate the impacts of plant modifications, such as fuel changes, air emissions controls, and flue gas additives;
- inform the regulatory deliberations on management of CCPs as nonhazardous under RCRA;
- support permitting, compliance, and groundwater assessment at CCP disposal sites;
- facilitate risk-based decision making considering the long-term behavior of CCPs in the environment; and
- support regulatory and public communications on environmental risks.

How to Apply Results
Engineers and scientists can use these data and tools to support a wide range of permitting and compliance activities at CCP management sites. A comprehensive database of CCP characteristics can be used as part of an overall risk-based management approach for CCPs. Reports on various air emissions control technologies and their impacts on CCPs can be used by CCP managers to make decisions on disposal and use alternatives. Summary brochures can be used to communicate those decisions to the public on sensitive issues.

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<td><strong>Radionuclides in CCPs:</strong> Research on the occurrence and form of radionuclides in CCPs will be updated. This work will include an evaluation of the risk presented by the occurrence of radionuclides under both disposal and use scenarios.</td>
<td>12/30/11</td>
<td>Technical Report</td>
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<tr>
<td><strong>CCP Composition and Leaching:</strong> Laboratory characterization studies will investigate and document the impact of evolving air emissions controls, such as enhanced Hg capture and SO$_3$ mitigation, on fly ash and FGD solids. The effect of coal blends, biofuels, and imported coal sources on ash quality also will be considered. Emphasis will be on development of a database and assessment of how changes in characteristics affect CCP disposal and use options.</td>
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<td><strong>Metals Leaching Geochemistry:</strong> Laboratory research on metals leaching geochemistry will focus on advanced leachate characterization protocols and on specialized testing to address specific release characteristics. Decision support tools are being developed for using the laboratory results to evaluate long-term leaching characteristics. Leachate modeling will be used as input to a framework for assessing disposal and use options. Parts of this work are being coordinated with development of new EPA leaching protocols and interpretation and use of that data.</td>
<td>12/30/12</td>
<td>Technical Update</td>
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<tr>
<td><strong>Environmental Testing of CCP Products:</strong> Life-cycle assessment of products made with CCPs (e.g., concrete, wallboard) requires knowledge of the product's environmental behavior when it is in use and when subsequently disposed. This project will develop characterization data for common uses that can be used to evaluate the potential risks associated with these products and to prepare communication pieces for intermediate processors, end users, and the public.</td>
<td>12/30/12</td>
<td>Technical Update</td>
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<tr>
<td><strong>CCP Composition and Leaching:</strong> Characterization studies will investigate and document the impact of evolving air emissions controls, such as enhanced Hg capture and SO3 mitigation, on total composition and general leaching characteristics of fly ash and FGD solids. The effect of coal blends, biofuels, and imported coal sources on ash quality also will be considered. Emphasis will be on development of a database and assessment of how changes in characteristics affect CCP disposal and use options.</td>
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<td><strong>IGCC By-Products:</strong> IGCC and other advanced coal-fired power plants are likely to become a growing part of the new electric generation fleet over the next several decades. This project will describe and characterize the residues produced from these advanced generation technologies and provide the basis for environmental management and use. Characterization work will initially rely on pilot facilities in advance of full-scale units.</td>
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**P49.004 Management of Coal Combustion Products (058342)**

**Key Research Question**

Disposal facilities are often subject to stringent design and management standards that do not recognize the unique characteristics and generally low toxicity of coal ash and flue gas desulfurization (FGD) products, along with the limited mobility of their chemical constituents in groundwater. Federal and state regulatory agencies are considering development of more-stringent requirements for all disposal facilities and large-volume land applications. These actions have the potential to significantly increase CCP disposal costs and decrease options for beneficial use, and they will certainly increase groundwater monitoring and compliance requirements at CCP management facilities.

Management of CCPs has become a focal issue of federal legislative and regulatory bodies as a result of a few high-profile environmental releases in recent years. EPA is currently evaluating federal regulation for CCP disposal, including the possibility of hazardous waste requirements. Ash ponds in particular have come under increased scrutiny; proposed options could range from liners and groundwater monitoring, to closure and complete phase-out of all ponds. At the same time, the Office of Surface Mining is developing regulations on placement of CCPs in mines. These actions will also put at immediate risk continued land-application beneficial uses, such as engineered fills and use of FGD gypsum in agriculture.
Approach

This project uses a mix of laboratory information, field studies, and engineering and economic evaluations to assess and develop environmentally sound and cost-effective CCP management practices. The objective is to predict and control environmental impacts at CCP disposal and beneficial use facilities. The research explores options for fixation of trace metals in CCPs to reduce the potential for leaching and release, evaluates improvements and innovation in liners and caps, conducts research on the use of FGD gypsum in agriculture, and develops assessment tools for structural fill and roadbed applications. The information will be used to update the EPRI CCP disposal manuals for coal ash and FGD solids. Ash pond closure, monitoring, remediation, and redevelopment are of particular interest due to current regulatory options under the Resource Conservation and Recovery Act and the steam electric effluent guidelines, which could significantly limit or eliminate the use of wet management practices.

Impact

Disposal requirements for CCPs will almost certainly change over the next few years in response to recent events. Research under this project will provide technical information to inform the regulatory process, as well as to provide power companies with options for disposal and beneficial use that reduce long-term environmental liability in a cost-effective manner. The research results help to

- inform EPA rulemakings on management standards for CCP sites and mine placement,
- reduce CCP management costs,
- improve risk-based decision making associated with environmentally sound management practices,
- develop cost-effective closure and remediation of ash ponds, and
- establish guidelines for environmentally acceptable use of CCPs in large-volume land applications

How to Apply Results

EPRI will use the broad information generated in this project to help inform rulemakings by the EPA and individual states on management of CCPs. Utility engineers and scientists can use the manuals and research results to ensure environmentally protective and cost-effective design and maintenance of disposal facilities using proven methods. Environmental data can be used by CCP managers to make risk-based decisions on the environmental suitability of land applications.

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<td>Use of FGD Gypsum in Agricultural Applications: FGD products will increase substantially in volume over the next ten years. Research will evaluate the environmental efficacy of using FGD gypsum and other FGD products for agricultural crops and related large-scale land applications, using a combination of laboratory tests and field plots in diverse geographic areas. Key environmental issues will be addressed, including the fate of mercury and other metals. This work is being closely coordinated with USDA and EPA. Deliverables will include site reports, risk assessments, and workshops.</td>
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<td>Ash Pond Closure: Regulatory actions by EPA related to CCP disposal and effluent guidelines may result in an accelerating rate of ash pond closure over the next five to ten years. Additional groundwater monitoring around these facilities will lead to the need for facility investigations, risk assessments, and possibly remedial activities. This project will investigate closure methods, pond stability, potential for long-term groundwater release, and final land use and will provide environmental and engineering information that can be used to develop effective closure plans</td>
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<td>Metal Fixation in Ash: Leaching of trace constituents from CCPs often leads to more-stringent disposal requirements, based either on a state hierarchal scheme or federal risk assessment modeling. Such leaching can also prevent the use of CCPs in some geotechnical applications. This project will explore additives and management approaches to chemically or physically fixate trace constituents in fly ash, thereby reducing leachability and expanding flexibility with respect to management options.</td>
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<td>Geotechnical Applications: Structural fills and roadbase applications provide high-volume use opportunities for CCPs that do not meet specifications for use in products such as concrete and wallboard. These applications offer important alternatives to virgin materials in sustainable construction practices. Placement of CCPs in surface or underground mines offers several potential benefits, including highwall stabilization, land reclamation, subsidence control, and acid mine drainage mitigation. This research will develop risk-based approaches to evaluating the long-term risks and benefits, including life-cycle societal benefits, associated with these geotechnical applications.</td>
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<td>Use of FGD Gypsum in Agriculture and Land Applications: FGD products will increase substantially in volume over the next ten years. Research will evaluate the environmental efficacy of using FGD gypsum and other FGD products for agricultural crops and related large-scale land applications, using a combination of laboratory tests and field plots in diverse geographic areas. Key environmental issues will be addressed, including the fate of mercury and other metals. This work is being closely coordinated with USDA and EPA. Deliverables will include site reports, risk assessments, and workshops.</td>
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P49.005 Groundwater Remediation and Site Restoration (069271)

Key Research Question

The need for soil and groundwater remediation at power company sites is expected to grow as new monitoring requirements are instituted at CCP management facilities, particularly ash ponds, and as older sites are closed. Legacy groundwater impacts will increase in importance over the next decade as a result of heightened awareness and changing water quality standards. Groundwater remediation costs can easily exceed $10 million for a single site. Much of the research on development of groundwater remediation technologies in the United States centers on organic chemicals, while the suite of chemicals unique to the CCP and coal storage piles consists largely of inorganic chemicals such as boron, sulfate, arsenic, selenium, chromium, thallium, antimony, molybdenum, and vanadium. Retired power plant properties also provide potential liabilities that require some level of site restoration to ensure environmental integrity prior to property transactions or development.
The universe of remediation options for inorganics is limited, and there has been little research on the specific mixtures of inorganic constituents commonly found at power plant CCP management facilities. The most commonly used methods are barriers (e.g., slurry walls) and pump and treat. Passive in situ methods are largely undeveloped for CCP sites. Research is needed to provide data on the effectiveness and cost for a range of options, to tailor existing treatment and remediation methods to power plant sites, and to develop new technologies.

This project is related to the “Site Closure, Redevelopment, and Green Remediation” project (P50.004) in program 50; research in the two projects will be coordinated for maximum effectiveness. P50.004 deals with remediation and redevelopment of legacy sites, such as former manufactured gas plant (MGP) sites and other decommissioned power plant sites. The focus of P50.004 is on remediation of organic contaminants (such as polycyclic aromatic hydrocarbons from coal tars) and implementation of environmentally friendly technologies that minimize adverse overall environmental impact.

Approach

This project provides bench-scale treatability data specifically to address difficult-to-treat constituents such as boron, molybdenum, and selenium. Field tests will be used in collaborative projects with power companies to refine the remediation technologies for chemical mixtures normally found at CCP and coal pile sites and to develop cost and engineering data. At retired power plant sites, a combination of soil and groundwater investigations, targeted remediation, and land use planning will be used to develop cost-effective site restoration strategies, in coordination with program 50.

Impact

Soil and groundwater remediation are generally high-cost endeavors, and often the long-term outcome is uncertain. The research results from this project are designed to lower the costs and increase the effectiveness of targeted remediation and restoration at power plant sites.

- Remediation methods are evaluated and developed specifically to address the mix of constituents commonly found in soil and groundwater at power plant sites.
- Significant cost savings can be realized with prescreening of available technologies and targeted remediation.
- Site restoration research provides a database for closure and revitalization of retired properties.

How to Apply Results

The information and tools developed under this project will assist power companies in effectively addressing groundwater remediation and site restoration projects. Bench-scale laboratory data can be used by remediation teams to screen groundwater remediation technologies and select those most appropriate. Field demonstrations will provide remediation engineers with implementation data that will allow selection and design of appropriate remediation methods.

2011 Products

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<tr>
<td><strong>Field Studies - Groundwater Remediation/Site Restoration:</strong></td>
<td>12/30/11</td>
<td>Technical Update</td>
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<td>This research includes field studies associated with the remediation, restoration, and development of former power plant properties. Projects are performed largely under collaborative agreements with utilities and include soil and groundwater assessment, excavation and capping, slurry walls, pump and treat, and evaluation of suitable development plans.</td>
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Future Year Products

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<td><strong>Groundwater Remediation Technologies</strong>: This research will track and evaluate innovative groundwater restoration technologies for inorganic chemicals, with emphasis on <em>in situ</em> methods such as reactive walls and geochemical barriers. Promising technologies will be further developed with field implementation under collaborative projects at CCP management sites and coal piles.</td>
<td>12/30/12</td>
<td>Technical Update</td>
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<td><strong>Groundwater Treatability</strong>: This project provides bench-scale treatability data for the inorganic constituents found at CCP facilities and other power plant sites. These data provide the basis for pilot-scale or field-scale tests of emerging treatment methods. Focus is on removal of boron and oxyanions (arsenic, selenium, molybdenum, vanadium), with applicability in both above-ground and <em>in situ</em> applications.</td>
<td>12/30/13</td>
<td>Technical Update</td>
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