Session III:

REGULATORY REQUIREMENTS

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REGULATION OF COAL ASH PLACEMENT ON SURFACE COAL MINES IN INDIANA

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Abstract

In 1988 the Indiana General Assembly enacted legislation which placed the regulatory jurisdiction for placement of coal combustion by-products on coal mines within the authority of the Indiana Surface Mining Control and Reclamation Act (I-SMCRA) and its regulations. As a result, in 1992 the Indiana Department of Natural Resources, Division of Reclamation DOR) began to implement a program for regulation of placement of ash materials on permitted coal mines using the I-SMCRA regulations. This paper describes some of the literature, research data and rationale for the I-SMCRA regulatory approach adopted in Indiana. It was concluded, based upon all available information, that like most coal ash, Indiana ash is environmentally benign and could be properly regulated using the environmental conservation and public protection and public participation regulations of the Indiana surface mining act. A copy of the Indiana program for addressing coal ash on surface mining sites is included with this paper.

Introduction

Like the purpose set forth in the federal Surface Mining Control and Reclamation Act (SMCRA) of 1977 (P.L. 95-87) at Section 102(f), responsible management of natural resources must "strike a balance" between enviromnental protection and economic impacts upon society. The framers of SMCRA were visionary in recognizing that environmental programs come with a monetary price to society through taxes and cost of goods and services. This important concept of balance is just now being recognized by many other non-SMCRA environmental regulatory agencies and opinion leaders in the country – some 20 years after the passage of SMCRA Indeed, cost-benefit considerations were an important component of the United States Environmental Protection Agency (USEPA) 1993 Final Regulatory Determination on coal combustion by-products (hereafter referred to as "coal ash") regulation discussed below.

Literature Review

Suloway (1983) showed alkaline coal ash leachate tests met primary drinking water standards (PDWS) 76% of the time. Envirosphere (1982) made over 4,000 observations of ground water near 25 coal ash disposal sites in the U.S. and found PDWS to be exceeded only 3% of the time. Franklin and Associates (1984) made 15,000 observations of ground water from wells near coal ash disposal sites nationwide; primary drinking water standards were exceeded only 7.4% of the time. Jackson and Moore (1984) through a U.S. Department of Energy study, compiled the results of 2,492 separate extraction tests for eight PDWS constituent metals and found that most leached at concentrations less than l/10 the hazardous limit; none exceeded PDWS by 50 times. Arthur D. Little (1985) conducted a study sponsored by USEPA, which revealed no EP toxicity level in the extracted leachates of any samples. In field studies by Little (1985) only 5% of the down gradient observations exceeded the PDWS. Natural soils apparently attenuated RCRA elements at some of the power plants studied. Mason and Carlisle (1985), who conducted a study sponsored by the Electrical Power Research Institute (EPRI). found leaching samples averaged l/4 the RCRA metals limit using acidic leachate methods. Radian (1985) conducted an EPRl study which showed the only coal ashes to exhibit EP toxicity were those containing untreated boiler cleaning acid chemical wastes. Beaver et al. (1987) found in a comprehensive long term study of ground water associated with ash burial on a North Dakota surface mine that ash disposal did not make any significant incremental difference in groundwater minemlization levels. It was also determined in many settings, liners were not considered appropriate, because liners can cause concentmtion of elements. When

disposal sites are unlined, elements can be released slowly to allow natural attenuation.

USEPA Findings

The USEPA's 1988 Report to Congress, Wastes from the Combustion of Coal by Electric Utility Power Plants analyzed most of the above literature and concluded in part:

1. Coal combustion wastes generally are not EP toxic, although there are some exceptions. The exceptions were determined to be "quite rare", as "average levels are substantially below 100 times PDWS."

2. Each ash source should be tested on a site specific basis to verify that it falls within the expected benign norm.

3. While there is some rare evidence that hazardous constituents have occurred from coal ash disposal sites, "ground water contamination does not appear to be widespread. Only a few percent of all ground-water quality observations indicate that a PDWS exceedance has occurred,..."

4. When ground-water contamination does occur, the magnitude of the exceedance is generally not large.

5. There are few cases considered to be documented evidence of groundwater contamination or any other damage from coal combustion waste disposal.

6. Additional regulation under RCRA standards was estimated to cost about $5 billion if all existing facilities were capped and closed and new facilities were constructed with liners, leachate collection systems, flood protection and ground water monitoring. The cost of generating electricity with coal could increase by several percent.

7. Preliminary finding "EPA does not intend to regulate under Subtitle C fly ash, bottom ash, boiler slag and flue gas desulferization wastes. EPA's tentative conclusion is that current waste management practices appear to be adequate for protecting human health and the environment."

On August 9, 1993, following up on the 1988 report, USEPA issued its Final Regulatory Determination, wherein the original preliminary findings were largely affirmed. USEPA found that "regulation of the four large-volume fossil-fuel combustion [FFC] wastes as hazardous waste under RCRA subtitle C is unwarranted" (emphasis added). Human health impacts were found to be negligible. Overall it was found that "the extent of actual damage/environmental harm cases associated with large volume FFC waste management appears limited." Only 6 sites out of an estimated 500 sites which exist in the nation were found to have caused damage and "only one case can clearly be attributed to fly ash management alone." However even this single damage case was not due to ground water leachate contamination, but rather was due to failure of a levee which released a large volume of ash directly into a river. The remaining 5 cases involved co-disposal of coal ash with other wastes, such as petroleum by-products. It was concluded that regulation of coal ash as hazardous material would be "inappropriate for these wastes...It is more appropriate for individual states to have the flexibility necessary to tailor specific controls to the site or region specific risks posed by these wastes."

Discussion

It would seem that policy makers around the country are coming to a consensus that surface coal mines. as regulated under SMCRA, are proper coal ash sites, which is not surprising for several reasons. State programs share the common under-pinning of the comprehensive environmental conservation and citizen protection principles of federal SMCRA, which effectively addresses potential impacts from coal ash. In addition, coal ash is accepted by most in the scientific community to be of an environmentally benign nature (see the Literature Review); thus, it would not be effective to install expensive control systems such as liners and leachate control systems for materials which are not hazardous. Back haulage of coal ash to its place of origin holds promise for reducing stomge and disposal cost for electric utilities, therein providing a potential

reduction of utility costs for consumers. Finaly, it is good public policy to save our valuable and limited landfill space for substances which are truly a threat.

Indiana public policy determinations have been similar and have followed the lead of several other states who have surface coal mine ash programs. However, while the enabling legislation was passed in Indiana in 1988, the I-SMCRA regulatory approach was not approved by the Indiana NaturaI Resources Commission, the policy-making board for the Department of Natural Resources, until 1992. Now in 1996, the Indiana coal mining industry has only within the last year begun to implement approved coal ash plans under the I-SMCRA program. As of April 1996 Indiana had received 17 coal ash applications but only 4 permitted mine sites were placing ash in surface mined pits. Nearly all permit decisions have been challenged by an environmental group; one permit issuance has been affirmed by an administrative law judge and another has been pending an administrative decision for over a year. A total of 116,000 tons of ash have been placed in active surface mines in Indiana, but only 116,000 tons of material at sites operating entirely under the 1992 regulatory approach.

Much information was taken into account by the Division of Reclamation DOR) prior to the 1992 adoption of the I-SMCRA regulatory approach. Specifically, a study of Indiana coal ash conducted by the University of North Dakota Energy and Mineral Research Center, Mining and Mineral Resource Research Institute (discussed below), data in the literature, site specific information from an Indiana wet disposal site in an unlined coal mine impoundment, data submitted for permit applications, the determination of the USEPA and consultation with the scientific community. It is clear from the body of coal ash knowledge known at this time, that it is generally considered an environmentally benign substance in the vast majority of circumstances.

Indiana Ash Study

In order to verify whether Indiana coal ash was similar to ashes described in the literature, the DOR facilitated a study of Indiana coal ash by the University of North Dakota Energy and Mineral Research Center (UND), in cooperation with environmental and citizen groups, the power industry and the coal industry. Extensive short-term (18 hour) and long-term (30 day) leachate tests were run on Indiana coal ashes representing about 33% of all ash produced at Indiana utility plants. UND concluded none of the Indiana coal ashes tested were hazardous using any testing method. Moreover, the study concluded the use of liners may not be necessary to provide adequate environmental safe guards. The results showed only 4 of the 8 RCRA elements leached in sufficient quantities to generate meaningful data, arsenic, barium, chromium, and selenium leachate results showed that all four elements were only sparingly leachable.

UND's calculation of the maximum possible concentration (MCP) of these four elements also revealed the low risk of the Indiana coal ash. The MCP represents the maximum leachate which could occur, in a hypothetical situation, where every atom of the element leached all at one time. The MCP's showed only chromium could theoretically reach RCRA limits, but leachate tests showed that chromium exhibited extremely limited leaching as chromium was well within PDWS in all tests (PDWS = 0.05, Average leachate = ,002).

It is important to note that these leachate results represent raw laboratory results which did not take into account field conditions such as dilution, dispersion and attenuation. For example, the highest leachate for arsenic was found at 7% of the Resource Conservation and Recovery Act (RCRA) limit (or 7 times drinking water standards). However, actual field data from ground water monitoring wells at the unlined final cut impoundment wet disposal site, where this material had been placed for 3 years, showed achievement of PDWS for arsenic in wells only 50 feet down gradient from the edge of the disposal site. Consistent with UND's findings, the DOR concluded: The testing procedure is probably conservative and tends to exaggerate leachate concentrations upward. And. physical, chemical and hydrological factors present in a surface mine setting can be effective in naturally remediating the small amount of leachate generated in unlined coal ash disposal sites.

DOR Application File Data

Finally. the DOR reviewed its own permit files which contained over 700 hundred elemental sample results from EP toxicity tests and ground water monitoring results from a surface mine coal ash disposal site.

The test results in the DOR files were consistent with trends identified in the literature, by the UND study and by USEPA.

Indiana Regulatory Approach and Rationale

With this background, the following represents a summary of the approach and the rationale behind Indiana's coal ash program regulated under I-SMCRA

1. Wise natural resource management suggests a safe approach to disposal of coal ash is to return it to its original location, i.e. where the coal seam was removed. In this way, no new elemental species wilI be introduced into the hydrogeologic system associated with the disposal site if that site is the same geologic and hydrogeologic setting from which the feed coal was obtained (Beaver et al. 1987).

2. Wise natural resource management would suggest minimizing disturbed areas, when possible. Why disturb 2 areas when you need disturb only one to accomplish both recovery of coal resources and disposal/use/recycling of coal ash?

3. Once the decision has been made to allow surface mining, placement of coal ash, even in a saturated disposal setting apparently will not make any incremental difference in ground water mineralization levels (Beaver et al. 1987). In other words if surface mining is to be allowed, some mineralization of water is to be expected and accepted. Based upon over 6 years of ground water monitoring data from a wet disposal site in a surface mining impoundment in west-central Indiana, coal ash has not caused mineralization to significantly increase, if at all (Division of Reclamation permit records).

4. The existing surface mining regulations provide the necessary environmental safeguards and opportunities for public participation to safely and responsibly reclaim coal ash placed on mine sites.

5. Coal ash is a benign material in the vast majority of circumstances. Tests reveal it has chemical characteristics in common with many coals, topsoils and mined overburdens, which are all resources addressed in the SMCRA program. The literature previously reviewed overwhelmingly shows coal ash poses little threat to the environment, drinking water or public health. Currently, in Indiana most disposal of coal ash is not subject to the extent of scrutiny practiced by the DOR under the surface mining program as only 8 of the 25 major coal ash producers in lndiana are subject to the Indiana Department of Environmental Management's site hydrogeologic characterization according to a report composed by the Hoosier Environmental Council (1991). Moveover. no ground water demonstrations or monitoring are required on these 17 coal ashes that produce about 4 million tons of ash annually. This represents 83% of the total ash produced in Indiana. Therefore, the I-SMCRA approach can be more effective regulation of 83% of Indiana's coal ash, because the DOR addresses quality of ground water, surface water, soil cover, revegetation and bonding requirements.

6. Calcareous spoil in the majority of Indiana mines will place coal ash in a neutral to above neutral pH environment which will serve to limit leaching of metals.

7. When placed in an ongoing surface mine operation, the ash will be distributed in smaller quantities relative to the amount of overburden, thereby matimizing the effectiveness of attenuation. The fragmented nature of mine spoil provides greater surface area for chemical reactions to occur, which can bind up leachate through natural processes.

8. Disposal without liners will allow a gradual release of elements which may be leached, therein allowing the environment to naturally assimilate them (Beaver et al. 1987); however, liners can be required by the DOR if site specific circumstances warrant.

9. The approach is modeled after other state programs which have effectively dealt with coal ash placement on surface coal mines.

10. Flexibility, as provided under I-SMCRA will allow appropriate reaction to a wide variety of scenarios to better manage enviromnental and citizen protection

11. The approach follows many of the recommendations received from interested parties. For example, many of the items recommended by the Hoosier Enviromuental Council in a preliminary report titled, Disposal of Coal Combustion Wastes in Indiana: An Analysis of Technical and Regulatory Issues (Boulding 1991) were adopted including suggestions as follows:

a. An initial screening of elements
b. Leach tests which assess long term leaching and approximate disposal site conditions.
c. Dust control plans.
d. Ground water monitoring.

12. Most of the recommendations of the UND researchers, who have perhaps the most research experience in the nation on placement of ash on coal mines, were adopted.

13. Site specific hydro-geological assessments including background data as required by Indiana SMCRA regulations address hydrologic balance protection. Ground water monitoring is required until release of the bonded acreage.

14. Coal ash is not considered for mine placement if the leachate is greater that one-fourth the RCRA level. DOR believes leaching characteristics are best "modeled" by a neutral leachate test, because a neutral solution more closely approximates field conditions. Testing with acidic solutions is not considered appropriate, in most circumstances, as it is not representative of most Indiana ground water. Quarterly monitoring of the ash is required to assure the source characterizations remain consistent.

15. Liners, in most circumstances, are not required so that elements will release gradually naturally remediate the minimal levels of leachate through attenuation and dilution.

16. Burial of the waste on the pit floor or a minimum 5 foot soil cover will prevent plant uptake of elements.

17. The RCRA-based approach incorporates the safety factors built into drinking water standards, which should minimize risk and ensure environmental conservation and citizen protection.

18. Landowner concurrence assures protection of landowner rights.

19. Requirements that ash proposals be done through the SMCRA permit or significant revision process assures opportunities for complete public participation.

Summary

The DOR found the state of knowledge regarding coal ash to reveal a safe and largely environmentally benign substance, which could be addressed under the environmental and public protection provisions of I-SMCRA. When one considers the acceptance of coal ash as a raw material in drywall for our homes, road fills, concrete, grout, ceramics as well as its usage for land application on agricultural lands as fertilizer and use as a road application material to alleviate winter driving conditions, it is indeed enigmatic that this same material could be viewed as problematic by some when returned to and backfilled on surface mines. Essentially, use of this material as part of the backfill at a surface mine represents just another recycling usage of a product which otherwise would become waste. Combined with the body of scientific data and the SMCRA-required environmental regulatory controls which already exist, placement of coal ash on surface mines appears to be good public policy.

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INDIANA DEPARIMENT OF NATURAL RESOURCES PATRICK R. RALSTON. DIRECTOR

MEMORANDUM 92-1

TO: ALL OPERATORS AND INTERESTED PARTIES

FROM: MICHAEL SPONSLER, DIRECTOR
DIVISION OF RECLAMATION

DATE: JUNE 8, 1992

SUBJECT: DISPOSAL OP COAL CONBUSTION WASTE ON SURFACE COAL MINES

As a result of approval by the Natural Resources Commission, the disposal of coal combustion waste (CCW) on lands permitted for surface coal mining will be regulated by the Division of Reclamation through existing authority of IC 13-4.1 and 310 IAC 12.

Applications seeking initial approval to dispose CCW on surface coal mines shall be submitted as a new permit or a significant revision to an existing permit.

In order to assist applicants and to facilitate permit application preparation of required waste characterization, site specific hydrogeologic monitoring and design requirements, a pre-submittal meeting with Division staff is highly recommended.

The following emphasizes certain required information necessary for the permit application:

A. Site Specific Characterization

Both geology and hydrology information shall be presented as a detailed, integrated evaluation of the hydrogeologic conditions beneath and adjacent to the proposed disposal site that adequately describes the production and migration of any coal combustion waste derived leachate. Information on the capability of in situ materials to contain and or attenuate any leachate levels before off-site migration will be useful.

A qualitative and quantitative analysis of the effects of the emplacement of CCW in the existing hydrologic regime must be addressed. Hydrogaologic data must be based on a systematic investigation utilizing data from borings, piezometers, water wells and other nearby water sources, the chemical characteristics of subsurface waters, and other available information. Baseline data will be a critical feature of applications for CCW disposal. As always a minimum of 6 months of data will be necessary. Landowner concurrence for the disposal of CCW is required. Appropriate existing data, information and plans may be referenced.

B. Waste Characterization

Initial screening of the coal combustion waste shall be done to determine the leachability of trace elements from coal combustion waste. The screening procedure must fully satisfy the following objectives:

1. Identify trace elements of environmental significance, including those of primary drinking water standards and others present at significant total concentration levels, and include them in the leachate testing.
2. Determine the total amounts of all identified trace elements in each sample submitted for evaluation.
3. Measure and compare the leachability (mobility in water) of the identified trace elements using short term (18 hours) and long term (30 days) leaching tests that meet ASTW standards.

Table I summarizes the required testing parameters for waste quantity (concentration present) and quality (total amount leachable).

Table II summarizes the required groundwater monitoring parameters.

Testing and monitoring requirements will be based upon baseline data and may be revised as data and testing methods are refined and appropriate parameters are identified.

MS:pep

Attachments

"EOUAL OPPORTUNITY EMPLOYER"

REGULATORY APPROACH TO

DISPOSAL OF COAL COMBUSTION WASTE

I. Coal combustion waste (CCW) may be disposed in the permit area, only if approved by the Director pursuant to 310 IAC 12-3-105 thru 12-3-119. Landovnars shall be notified and consent granted to the applicant for proposed CCW disposal operations. Approval shall be based on a demonstration by the person vho conducts surface mining activities in the permit area, using hydrologic, geologic, geotechnical, physical, and chemical analyses, that disposal of such materials does not:

(1) Adversely affect the quality of surface and groundwater;

(2) Create public health hazards; or

(3) Affect the establishment of vegetation which supports the approved postmining land use of the permit area.

coal combustion vaste, vhich exceeds one-fourth (291) of the RCRA limit for any one RCRA element shall not be considered for disposal on land under permit for coal mining operations.

II. APPLICATION REQUIREMENTS

A. Site Characterization

Each application for a permit to dispose of coal combustion waste shall comply with the requirement of 310 IAC 12-3-28 through 12-3-54 and contain a thorough evaluation of the area hydrology and geology, including the presence of aquifers, permeability of natural materials and whether natural buffers or liners exist. Previous information may be referenced. Also include, maps, plans and cross sections vhich show the extent of the disposal area, including the expected rate and direction of groundwater movement in the vicinity of the disposal area.

Each application proposing to dispose of coal combustion waste shall contain a description of how minimization of adverse impacts upon the prevailing hydrologic balance wi11 be accomplished. This description shall include, but is not limited to:

(1) The anticipated interaction betveen the mine spoil, liners, or buffer materials, and the coal combustion waste.

The effects the coal combustion waste will have on the hydroloqic balance, including a discussion of the risk potential of contaminating any water bearing strata,

(3) A minimum of six months of baseline monitoring for surface and ground water in and within 1000 feet of the permit area in accordance vith 310 IAC 12-3-32 and 12-3-33.

For the purpose of baseline monitoring of both surface and ground vater the parameters in Table II shall be monitored. Parameters other than those specified above may be required by the Director in order to ensure the protection of public health and safety and the environment.

B. Waste Characterization

Each application proposing to dispose of coal combustion waste shall contain a thorough characterization of the vaste material including:

(1) The generating facility. Consideration for disposal wi11 be limited to CCW generated in Indiana or CCW generated from burning Indiana coal.

(2) The types of coal combustion waste to be disposed. (Fly ash, bottom ash, etc.)

(3) Total volume of coal combustion waste to be disposed over the life of the operation and ratio of waste to spoil. Disposal shall not exceed ten feet in thickness unless approved as a monofill.

(4) Initial waste characterization testing as approved by the Director shall be conducted as follows:

(a) Screening for chemical constituents using bulk analysis.

(b) Short term, 18 hour leaching test meeting ASTM standards for the chemicals in Table I.

(c) Long term leaching test meeting ASTM standards for 30 days for the elements in Table I.

Data from the initial screening shall be used to calculate maximum possible concentrations of the elements identified in the screening test.

Periodic coal combustion vaste sampling and analyses for each active vaste stream shall be conducted at least quarterly according to a schedule approved by the Director. Sampling frequency may later be reduced based upon the consistency of the analyses.

TABLE I

INDIANA COAL COMBUSTION WASTE TESTING AND MONITORING PARAMETERS

.Arsenic	.Boron
.Barium	.Chloride
.Cadmium	.Copper
.Chromium	.Fluoride
.Lead	.Iron
.Mercury	.Manganese
.Selenium	.Molybdenum
.Silver	.Sodium
.Sulfate	.Total Organic Carbon
.Total Dissolved Solids	.Zinc
.Nickel	.Sulfide

Acid/Bass Accounting

The following shall be measured:

Potential acidity
Neutralization potential
Net neutralization potential
pH

Parameters other than those specified may be required by the Director in order to ensure the protection of public health and safety and the environment.

Any new source of CCW, must be identified and approved prior to disposal, and is subject to the requirements as stated herein.

Evaluation of a proposal to dispose CCW on surface coal mines will consider, at a minimum, the risk assessment factors described as follows:

(a) Proximity of public and private water supplies or other critical off-site features.

(b) CCW characteristics including MPC (maximum possible concentration) calculated from solids concentration and appropriate leachate tests.

(c) Geologic and hydrologic site characteristics, such as type and extent of aquifers, overburden characteristics, expected spoil characteristics.

(d) Expected attenuation, dispersion and dilution.

(e) Direction of ground water flow.

(f) Baseline water quality and quantity.

(g) Volume of waste proposed for disposal.

(h) Impact of natural liners, artificial liners, compaction, capping or other operational features.

(i) Type of proposed disposal operation, i.e. backfill, monofill.

III. **SITE SPECIFIC DISPOSAL PLANS**

A. Operations Plans. Disposal methods shall be described in detail by providing the information required by 310 IAC 12-3-41 through 12-3-45 and demonstrating compliance with 310 IAC 12-5. The application shall describe any proposed compaction, methods to reduce infiltration or contact with water, liners, caps, co-disposal with coal processing waste, etc. Detailed maps, plans, and cross-sections shall be provided.

B. Reclamation Plans. A detailed reclamation plan shall be submitted pursuant to 310 IAC 12-3-46 through 12-3-55 demonstrating compliance with 310 IAC 12-5. Restoration of approximate original contour, post-mining land Use and revegetation shall be described. The plan shall provide for a minimum soil cover of five (5) feet Of non-toxic earthen material.

C. Dust control. A plan to control dust in a manner which prevents damage to public or private property pursuant to 310 IAC 12-5-69 through 12-5-71 shall be provided. Specifically plans shall discuss techniques to show how wind erosion and dust will be prevented during transport, placement, and disposal of CCW.

D. Water Monitoring. Water monitoring programs will be dependent on site specific conditions. Ground water shall be monitored at both upgradient and downgradient locations with at least one monitoring well in the expected path of leachate migration.

A plan for monitoring surface and ground water during the disposal of coal combustion waste and through final bond release of the permit area shall be provided as approved by the Director. This plan must specify the frequency of monitoring both surface and ground water, locations of monitoring *points*, parameters to be monitored and the location and availability for inspection by the Director of all monitoring records. The results of this monitoring plan shall be submitted to *the* Director in accordance with a schedule approved by the Director.

TABLE II

INDIANA COAL COMBUSTION WASTE WATER TESTING AND MONITORING PARAMETERS

The operator must determine the concentration or value of the following parameters for assessing groundwatar quality. Metal parameters should be reported as total.

Field measurements:

Arsenic	Boron
Barium	Chloride
Cadmium	copper
Chromium	Fluoride
Lead	Iron
Mercury	Manganese
Molybdenum	Nickel
pH	Selenium
Silver	Sodium
Specific Conductance	Sulfate
Sulfide	Temperature
Total Organic Carbon	Total Dissolved Solids
Zinc	

Acid/Base Accounting

The following shall be measured:

Cation/Anion balance
Neutralization potential
Net neutralization potential
pH (lab)
Potential acidity
Specific conductance
Temperature

Parameters other than those specified may be required by the Director in order to ensure the protection of public health and safety and the environment.

STATE OF KENTUCKY REQUIREMENTS FOR DISPOSAL OF COAL COMBUSTION BY-PRODUCTS IN SURFACE MINED AREAS

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Abstract

The Department for Surface Mining has received the authority to set requirements for the disposal of coal combustion by-products in the Commonwealth of Kentucky. Senate Bill #266, became law in April 1994, and will allow the mining industry to dispose of coal combustion by-products while maintaining environmental integrity. The Senate Bill was passed with the intention of encouraging the production of coal and allowing flexibility in the placement of the coal combustion by-products. The requirements that must be met in coal combustion by-product disposal emphasizes protection of the Commonwealth.

Introduction

The Department for Surface Mining Reclamation and Enforcement (DSMRE) regulates mining and reclamation operations under KRS Chapter 350.DSMRE may issue a permit to dispose of CCBP at coal mine sites under KRS 350.270. However, if the applicant chooses to propose disposal of CCBP on mine sites in a method other than addressed in KRS 350.270, the applicant must apply for a duel permit from DSMRE and her sister agency, Division Of Waste Management, which is regulated through KRS Chapter 224.

Materials Eligible for Disposal

Senate Bill #266, defined "coal combustion by-products" in the Kentucky statute KRS 350.010 to mean fly ash, bottom ash, scrubber sludge, and waste from fluidized bed combustion, produced by the combustion of coal. The definition excludes boiler slag and residues of refuse derived fuels, such as municipal solid waste, tires, and solvents.

The remainder of the provisions contained in the bill were codified in the statute KRS 350.270. "Applicability" provisions authorize disposal of certain materials and exclude others. Disposal of waste from burning clean oil or gas with coal is allowed only if the oil or gas is used for startup or flame stabilization.

The Bill excludes disposal of any CCBP for which a special waste formal permit or a special waste registered permit-by-rule is required by administrative regulations.

Also excluded is disposal of any CCBP that exhibit hazardous waste characteristics, or that have been mixed or otherwise co-managed with low volume waste or with materials that exhibit hazardous waste characteristics. The exclusion of any CCBP generated prior to July 15, 1994, is also included unless the applicant can demonstrate that these by-products have not been mixed or otherwise co-managed with materials that exhibit hazardous waste characteristics.

Finally. the Bill excludes underground injection of CCBP

Permitting Procedures for Disposal of Coal Combustion By-Products

General Procedures

An applicant may propose disposal of CCBP when a surface mining application is originally submitted, or may propose to add such disposal to a permit that has already been issued.

An application to modify an existing permit to include disposal must be an amendment or a major revision application. All of these applications require publication of public notice.

If an existing permit includes disposal of CCBP, and the applicant wishes to modify the permit to increase the amount or mixture of by-products, or to change the facility from which the by-products are received, the application may be submitted as a minor revision. However, if the department determines that the change will result in a potential increase of heavy metal concentrations or that public notice is necessary, the change must be made through submission of a major revision or an amendment application.

Maior Items in Application

The application must include the following information:

a. The legal right to dispose of coal combustion by-products must be demonstrated by a conveyance that grants or reserves the right to dispose of waste materials such as CCBP. If the mineral and surface property estates have been severed, the applicant must submit written consent from the surface owner to dispose of CCBP on his property.
b. The location, business name, mailing address, and telephone number of the facility that will generate the CCBP, and the name and title of a contact person at the generating facility.
c. Identification of each component of the CCBP that will be disposed of, and the approximate amount that will be received from the generating facility annually, and for the term of the permit.
d. Results of representative sampling and laboratory analysis of each component of the CCBP for contaminants shall be submitted. Any contaminant must not exceed levels pursuant to KRS Chapter 224 and Resources Conservation Recovery Act (RCRA). The analysis must also i include neutralization potential and potential Acidity.
e. A description of the proposed handling and disposal methods, and record keeping method.
F A determination of the probable hydrologic consequences (PHC) of the disposal to the permit area and adjacent areas.
g. Six (6) months of baseline information on surface water and ground water including the standard parameters required for any permit application, and including four (4) months of information on the additional parameters of arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver, or different parameters determined by DSMRE based upon the demonstrated characteristics of the CCBP.
h. Maps and drawings of all areas and facilities to be used in the permit area for disposal of CCBP.
i. A description of the measures to be used to prevent the CCBP from becoming airborne.

Operating Requirements and Environmental Protection Performance Standards

a. The performance bond must cover the disposal of CCBP.
b. Disposal areas designated in the permit application must be designed, located, maintained, and operated in a manner not to pose a threat to human health, and to minimize disturbance to the hydrologic balance in and adjacent to the permit area.
c. The permittee must keep records of the source and amount of each shipment of CCBP received and make this information available to DSMRE.

d. The permittee must prepare and maintain accurate maps showing each location where CCBP have been disposed of, and the volume disposed of at each location.
e. The permittee must provide representative samples of the CCBP to DSMRE if requested, or if required by the issued permit.
f. The permittee must annually submit a laboratory analysis for the CCBP.
g. Placement of the CCBP must be four (4) feet above the seasonal water table that is projected after mining.
h. CCBP must not be placed within four (4) feet horizontally of a fmal highwall, exposed coal seam, or coal outcrop.
i. Areas selected for disposal must minimize water contact with the CCBP.
j. The volume of CCBP disposal must not exceed the in-place volume of the marketable coal seams to be removed, and DSMRE may decrease the disposal volume if necessary.
k. The disposal must not cause the amount of excess spoil to be greater than would exist without the disposal of CCBP.
l. The thickness of the CCBP must not exceed forty (40) feet at any point, and DSMRE may decrease this thickness if necessary.
m. The CCBP must be covered as contemporaneously as practicable with at least four (4) feet of nonacid-forming spoil material.
n. The permittee must monitor and report the quality of surface water and ground water until final bond release on the permit area. The monitoring must be conducted quarterly, except monitoring for the extra parameters due to disposal of CCBP must be conducted semi-annally. Monitoring for the extra parameters may be reduced if those parameters show no increaces of regulatory levels after four (4) monitoring events.

As of July 1996, DSMRE has issued one permit and received one additional application to dispose of CCBP at surface mines under KRS 350.270. However, we expect application to increase significantly in the next several years as the availability of this method of disposal becomes more widely recognized.

PENNSYLVANIA'S REGULATORY REQUIREMENTS FOR USE OF COAL COMBUSTION ASH AT COAL MINING OPERATIONS

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Background

Coal combustion ash is regulated in Pennsylvania under the state's Solid Waste Management Act (PA SWMA). In 1986, the PA SWMA was amended to exclude coal ash from the definition of solid waste and to establish provisions for the beneficial use of coal ash. The provisions for beneficial use of coal ash apply to fly ash, bottom ash or boiler slag resulting from the combustion of coal. Wet scrubber sludge and ash generated from combustible waste fuels (e.g. petroleum coke) co-fired with the coal are not considered coal ash. Regulations relating to the beneficial use of coal ash were adopted as part of Pennsylvania's Residual Waste Management Regulations (25 PA Code Chapter 287) in 1992. The coal ash beneficial use regulations allow for coal ash to be used as a soil substitute or soil additive and as placement for fill material at surface coal mines, coal refuse reprocessing operations and coal refuse disposal sites.

The Pennsylvania Department of Environmental Protection (PA DEP) administers the program for the beneficial use of coal ash at coal mining operations. The Bureaus of Mining and Reclamation and District Mining Operations have'program responsibilities for use of coal ash on active coal mining operations and the Bureau of Abandoned Mine Reclamation has program responsibilities for use on abandoned mine lands. The Bureau of Land Recycling and Waste Management within PA DEP has program responsibility for the beneficial use of coal ash at sites other than coal mining operations.

Permitting Procedures and Requirements

The beneficial use of coal ash at active coal mine operations is accomplished through the coal mine permitting process. Two additional permit application modules were developed for use with the coal mine permit application for evaluating proposals for beneficial use of coal ash. Module 25 was developed for placement of coal ash as fill material and Module 27 for use of coal ash as a soil substitute or additive.

Proposals for the beneficial use of coal ash at coal mining operations must include an identification of the sources(s) of the coal ash, the quality and quantity of the coal ash to be utilized, an operation and reclamation plan, a locational map, and a signed statement by the landowner acknowledging and consenting to placement of coal ash on their property. A chemical analysis of the coal ash and coal ash leachate is required using applicable procedures in EPA's Test Method for Evaluating Solid Waste (SW-846) and SW-846 Method 13 12, Synthetic Precipitation Leaching Procedure (SPLP). The chemical analysis of the ash leachate is compared with "groundwater parameters" for each constituent analyzed. The "groundwater parameters" are based upon human health and environmental protection standards. For a coal ash to be approved for beneficial use, metals and other cations in the leachate may not exceed 25 times the "groundwater parameter". Anions may not exceed the "groundwater parameter" except that up to 10 times the "groundwater parameter" for anions may be approved if the applicant can demonstrate that use of the coal ash will result in an improvement in pre-existing groundwater degradation.

Generally the quantity of coal ash for placement as fill material may not exceed the amount of coal. coal refuse, culm or coal silt removed from the mine site. It may be exceeded, however, if the coal

ash is generated by a fluidized bed combustion facility and is needed for contouring abandoned unreclaimed mine land as part of a coal remining operation or the coal ash is part of an approved pollution abatement plan of a coal remining operation. The quantity of coal ash placed at mining operations involving reprocessing coal refuse banks or piles may not result in rebuilding the bank or pile. In addition, the quantity of coal ash used a soil substitute or additive may be limited based upon metal analyses of the ash to avoid plant toxicity and to comply with established maximum lifetime metal loadings in conjunction with land reclamation.

The operation and reclamation plan in the permit application must address handling and on-site storage of the coal ash, method(s) and equipment for coal ash compaction/incorporation, dust control measures, monitoring coal ash quality and quantity, monitoring water quality, and final grading and reclamation of the site. Plans for ash placement as fill material must include groundwater monitoring. At least one monitoring well must be placed at a point. hydraulically up gradient of the proposed ash placement area and be representative of groundwater quality unaffected by the mining and ash placement. At least three monitoring wells must be located down gradient of the ash placement area. Six months of background groundwater data is required for placement of coal ash as fill material. Trigger levels for groundwater constituents are established which require groundwater assessment and abatement if the levels are exceeded during the operation. The trigger level for each constituent is established as the higher value of either, the "groundwater parameter" or the background level for the constituent.

In addition to the above, public notice of the proposed coal ash placement as fill material is made by the Department and the coal mine operator. The Department publishes notice of the proposal in the Pennsylvania Bulletin. The mine operator publishes notice of the proposal in a newspaper of general circulation in the locality of the proposed coal ash placement activity.

Operational Reauirements And Performance Standards

The following requirements and standards apply to the beneficial use of coal ash for placement as fill material at coal mining operations:

- Ash may not be placed in surface water drainage areas for streams designated as High Quality or Exceptional Value Waters, unless the Department approves ash placement for the purpose of improving degraded surface or groundwater quality.

- Final site grading must minimize percolation of precipitation and surface runoff into the coal ash placement area. The surface grade may not be less than 3%.

- The operator must isolate the coal ash deposits from coal seams, coal outcrops, and the pit floor using barriers of natural, compacted soil or backfill material at least 8 feet (2.43 meters) thick.

- Underground mine openings within the site must be sealed in a manner approved by the Department.

- Ash placement must be at least 4 feet (1.21 meters) above the premining seasonal high groundwater table or perched water table, and at least 8 feet (2.43 meters) above the regional groundwater table. The regional groundwater table may not be artificially manipulated to achieve the above.

- Coal ash must be spread and compacted in horizontal layers which are no more than 2 feet (.60 meters) thick. Each layer must be compacted to attain at least 90% of the maximum dry density as determined by the Modified Proctor Test or 9.5% of the maximum dry density as determined by the Standard Proctor Test.

- A final cover of at least 4 feet (1.2 1 meters) of non-acid forming materials must be placed over the ash placement area and must not include any rock over 6 inches (15.24 centimeters) in diameter. The top 1 foot (.30 meter) layer must not have a coarse fragment content exceeding 60% by weight of particles that do not pass the number 10 mesh sieve (2 millimeter opening).

- The pH of the coal ash delivered to the mine site must be in the range of 7.0 to 12.5. The pH of the ash may be adjusted at the site where it is generated. The ash and leachate analyses must be reported after pH adjustment.

- Each coal ash source must have a chemical analysis and a leachate analysis at least once every six months. The Department may require more frequent analyses depending on the variability of the coal ash.

- Each coal ash source must have a laboratory analysis for optimum moisture content and maximum dry density(Standard Proctor or Modified Proctor Test) at least once every six months. The Department may require more frequent analyses depending on the variability of the coal ash.

- Upgradient and downgradient monitoring wells must be sampled and analyzed annually for total and dissolved metals and quarterly for all other constituents.

The following requirements and standards apply to the beneficial use of coal ash as a soil substitute or soil additive for reclamation of coal mine operations:

- The pH of the coal ash and the pH of the soil must be in the range of 6.5 to 8.0 when mixed together. Lime may be used to adjust pH.

- Coal ash must be incorporated into the soil within 48 hours of application, unless otherwise approved by the Department.

- Coal ash must be applied at a rate per acre that will protect public health, public safety and the environment.

- Coal ash may not be applied to soil being used for agriculture where the soil pH is less than 5.5.

- Coal ash may not be applied if the resultant chemical or physical soil conditions would be detrimental to biota.

- Coal ash, soil, vegetation and surface and groundwater quality must be monitored in accordance with the approved plan.

Distance Limitations **For Coal Ash Utilization**

Distance limitations have been established for utilization of coal ash. Coal ash may not be applied:

- Within 100 feet (30.48 meters) of an intermittent or perennial stream or a wetland other than an exceptional value wetland.

- Within 300 feet (91.44 meters) of an exceptional value wetland.

- Within 500 feet (152.40 meters) upgradient of a surface drinking water source or within 300 feet (9 1 .44 meter) of a groundwater source.

- Within 100 feet (30.48 meters) of a sinkhole or drainage area to a sinkhole.

- Within 300 feet (91.44 meters) of an occupied dwelling unless the owner provides a written waiver.

Extent of Beneficial Use of Coal Ash At Active Coal Mines

Pennsylvania has over 70 coal mining operations (includes coal refuse reprocessing operations) where coal ash is being used under the beneficial use provisions of PA SWMA. In 1995, over 6,700,000 tons (6,082,260 metric tons) of coal ash had been used as fill material at coal mining operations within the state. An additional 6,500 tons (5,900 metric tons) of coal ash had been used as a soil substitute or soil additive.

Future Direction of Program

Pennsylvania's regulations on the beneficial use of coal ash are currently in the process of being revised. Several of the present operational requirements and performance standards are viewed as being too prescriptive and would be deleted from the regulations. For example, the requirement for a surface grade of not less than 3% (for operations involving coal ash placement as fill material) would be deleted under the revisions currently in process. The revised regulations include provisions for the certification of coal ash sources for specific beneficial uses. Certification guidelines would be developed which identify the acceptable physical and chemical characteristics of coal ash for various beneficial uses. A coal ash generator may request to have their ash certified for specific beneficial uses by demonstrating that the ash quality meets the acceptable physical and chemical characteristics. Once the coal ash has been certified, use of the ash at coal mining operations may be authorized without providing additional data on the quality of the ash. In addition, technical guidance would be developed to facilitate review of beneficial uses of coal ash at coal mining operations. The guidance would identify operational requirements and performance standards for the specific beneficial use.

NEW MEXICO'S REGULATORY REQUIREMENTS FOR THE USE OF COAL COMBUSTION BY-PRODUCTS

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The Mining and Minerals Division (MMD) of the Energy, Minerals and Natural Resources Department of the State of New Mexico currently regulates two mines where disposal of coal combustion materials has been approved, Aside from regulation by the Mining and Minerals Division, coal combustion by-products are specifically exempted from regulation under the State of New Mexico's solid waste regulations by definition of a "solid waste".

In 1982 the MMD received an application from the San Juan Mine to dispose of approximately 1.5 million cubic yards of coal combustion by-products per year as part of its backfill and regrade operation. Several factors favored this scenario, not the least of which was the mines' location in an arid environment, receipt of annual rainfall amounts between four and six inches per year and this usually occurring in the form of short, intense, summer, thunderstorms. The area also has a pan evaporation rate of 67 inches per year. The potential for direct infiltration of rainfall as recharge appeared to be very low, except in areas of concentrated runoff.

Geological conditions also appeared to be favorable for disposal of coal combustion by-products. The only horizon that could be considered as an aquifer was the lowermost coal seam that was scheduled to be mined. This seam is separated from a lower sandstone horizon by a shale interval that should restrict flow between the two horizons.

To demonstrate the favorable nature of the site for long-term disposal of coal combustion wastes the mine also was required by MMD to conduct several other investigations. These included sampling the water qualities of the coal seam aquifer, conducting leachate studies of the spoil/combustion waste and determining the impact on the quality of the waters of the coal seam. In addition, compaction and permeability tests were performed on composited spoil/combustion waste materials as a means to assess the post-mining hydraulic properties of the reclaimed mine area. Leachate transport studies were conducted and once significant pathways were identified, an analysis of projected travel times and flow volumes was performed.

Upon approval of the coal combustion disposal plan additional requirements were placed in the permit as part of the disposal plan. Specifically, all disposal areas are to be covered by a minimum of ten feet of spoil material in addition to topsoil material. Drainages that run above disposal areas should have low drainage gradients to reduce the possibility of down cutting. Disposal areas are mapped to determine the location of the material as far as depth of disposal and thickness of the material. These maps are submitted to the MMD in the annual report.

Recently, a permit requirement was added and two porous cup lysimeters were installed to determine whether irrigation waters were infiltrating the topsoil and spoil material. One lysimeter was installed to the top of the waste material and the other through the waste material to the bottom of the combustion waste. To date, all indications are that the combustion material is remaining dry and not producing leachate.

The second application for disposal of coal combustion waste was received in September of 1993 from the Pittsburg & Midway Coal Mining Company, York Canyon Mine Complex, in northeastern New Mexico. The application was for the disposal of a pelletized fly ash from Wisconsin Electric Power Company from coal that was mined at the York Canyon mine complex. The pelletized fly ash is comprised of spherical cement nodules, approximately 3/8 inches in diameter and would be placed in the mined out pit floors as part of the backfilling and grading process.

The climate of the area is arid to semi-arid, with annual rainfall at the site of about 15 inches. Local relief in the area varies from 500 to 2000 feet and is dominated by incised canyons and arroyos. Drainage is by intermittent or ephemeral streams which are tributary to a perennial, high quality, trout stream. Regional ground water is below the deepest proposed mining level. Mining is essentially a mountain-top removal operation.

As part of the application, the HELP, version 2.05, program was used to quantify surface infiltration and potential leachate generation rates. Input from the HELP model was used to estimate a steady-state infiltration rate through the spoils and ash system and into the natural ground water flow system. The HELP model results were integrated with geologic data and materials properties to develop input for a MODFLOW evaluation. The MODFLOW program, version 3.0, was used to evaluate the potential for vertical and horizontal ground water flow patterns beneath the site. Finally, a program called Geochemist's Workbench™ was used to estimate the potential chemical concentrations of fluids produced by flow through the various spoils and ash systems.

In addition to the above tests, ASTM leaching procedure D-3987-85 was performed on samples of pelletized fly ash using locally obtained groundwater samples as the leaching medium. This test was repeated on samples of overburden using deionized water as the leaching medium. A TCLP analysis was required on the pelletized ash and was compared to a TCLP analysis of the leachate obtained from the overburden.

It was determined that the disposal of combustion waste in the form proposed as part of the mining operation carried little measurable risk to the surface or ground water environment and the proposal was approved. The MMD added the requirements that the waste be end-dumped only in the pit bottom and not between spoil ridges as originally proposed, to assure that high material wasn't inadvertently placed in the root zone. The Approximate Original Contour(AOC) was also designed to remove water as quickly as possible without resulting in erosive velocities and to avoid infiltration. A barrier of oxidized coal was also to be left around the outcrop and all ash was to be covered by a minimum of two meters of spoil material in addition to the topsoil. Following reclamation, a system of lysimeters were to be installed to monitor any resaturation that may have occurred.

Although the permit was issued in a timely manner, contract problems between the mine and Wisconsin Electric Power Company resulted in the project not being carried through. Any future application for coal combustion waste disposal would carry similar requirements prior to approval.