Session II:

SITE CHARACTERIZATION

Session Chairs:

Shawn Glacken
Texas Utilities Services, Inc.
Dallas, Texas

Richard Shockley
Illinois Clean Coal Institute
Carterville, Illinois

COAL COMBUSTION BY-PRODUCTS
THE WESTERN U.S. PERSPECTIVE

J. Matthew Tanner
Texas Utilities Services, Inc.
Dallas, Texas

Abstract

Coal Combustion By-Products (CCBP) production and the subsequent use both on-site and off-site are currently environmental and economic concerns throughout the Western U.S. for electric utilities. Texas Utilities presents the Western U.S. perspective by providing local information on CCBP production and uses on-site at lignite mining operations and electric generation facilities.

Introduction to Texas Utilities

The Texas Utilities Company consists of six (6) principal subsidiary companies that include: TU Electric, TU Australia PTY. LTD., Southwestern Electric Service Company, TU Services, Texas Utilities Fuel Company and Texas Utilities Mining Company. The primary business of United States operations is to bring low cost and reliable electric service to approximately 2.4 million customers in 101 Texas counties with 89 billion kilowatt-hours of electricity. The customer base is composed of residential and large industrial facilities. Twenty-four generating facilities give the System 22 million kilowatts of power resources. Fuel sources range from fossil fuels such as natural gas, oil, lignite and western coal to nuclear fuels and renewable resources.

TU Electric provides, through various business units, generation, transmission, distribution, marketing and customer service to North Central, East and West Texas. Southwestern Electric Service Company, acquired in 1993, provides service to areas in North Central and East Texas.

Texas Utilities Fuel Company provides natural gas and fuel oil to TU Electric generating facilities through a 2,100-mile pipeline system and with 27 million cubic feet of underground storage. TU Electric, with this system and by direct connection to other suppliers, is the nation's largest consumer of natural gas, using about 15 percent of all natural gas consumed by electric utilities. Texas Utilities is also in the process of completing the acquisition of the ENSERCH Corporation which is the parent company to several natural gas related businesses including the Lone Star Gas Company, Texas' largest gas company.

Texas Utilities Mining Company (TUMCO) is the mining unit within the system and is the largest lignite producer in Texas. We are presently rated as the 5th largest mining company in the nation and the largest mining company in relation to overburden removed to obtain the mined product. Lignite is produced at mine-mouth operations for use in TU Electric generation facilities where 100% of the lignite produced is consumed.

TUMCO has three primary lignite mines with two of the mines containing satellite operations. Currently, more than 104,000 acres of land are regulated under permits issued by the Texas Railroad Commission. Mines range in size from 1,200 to more than 26,000 acres. Eleven mine permits are active plus other associated permits required for operation.

Mines operate as surface mines with a successive series of narrow, parallel pits. Equipment such as draglines, bucket wheel excavators and cross-pit spreaders provide overburden removal. Lignite transportation is accomplished by a combination of haul roads, service roads and rail transportation for movement of material from remote locations.

Other Electric Utilities in Texas

Other regions within Texas receive electric service from various public and private utilities. These utilities include small local cooperatives and large corporations with residential, rural and industrial customers. Major utility companies include Central & Southwest, Houston Lighting & Power and Entergy.

Regional Perspective & Characteristics

Texas Utilities Mining Company operates mines at locations within North Central and East Texas. The Big Brown Mine is in Freestone County approximately 90 miles south of Dallas. Directly east of Dallas in Titus County, is the Monticello Mine with a satellite operation in Hopkins County. Further to the southeast in Panola County, near the Louisiana border, are the Martin Lake Mine and the satellite Oak Hill Mine in Rusk County.

Terrestrial and aquatic wildlife, within the area surrounding these mines, is typical of species that inhabit the Texan and Austroriparian biotic provinces (Blair, 1950). The forested Austroriparian biotic province, as described by Blair (1950) is bordered on the west by the Texan province. It extends eastward from east Texas to the Atlantic coastal plain and as far north as the Dismal Swamp in southeast Virginia. Species range from forest dwellers to grassland inhabitants and transitional species between the two provinces. Many species are local inhabitants throughout much of East and North Central Texas.

Typical Wildlife Species in the Area

Mammals

white-tailed deer *(Odocoileus virginiana)*
Virginia opossum *(Didelphis virginiana)*
fox squirrel *(Sciurus niger)*
cotton mouse *(Peromyscus gossypinus)*
gray squirrel *(Sciurus carolinensis)*
common raccoon *(Procyon lotor)*
beaver *(Castor canadensis)*
coyote *(Canis latrans)*
fulvous harvest mouse *(Reithrodontomys fulvescens)*
nine-banded armadillo *(Dasypus novemcinctus)*

Birds

northern mockingbird *(Mimus polyglottos)*
mourning dove *(Zenaida macroura)*
red-winged blackbird *(Agelaius phoeniceus)*
great blue heron *(Ardea herodias)*
red-eyed vireo *(Vireo olivaceus)*
Carolina wren *(Thryothorus [udovicianus)*
northern cardinal *(Cardinalis cardinalis)*
blue jay *(Cyanocitta cristata)*

Reptiles

ornate box turtle *(Terrapene ornata ornata)*
western cottonmouth *(Agkistrodon piscivorus leucostoma)*
east Texas toad *(Bufo woodhousii)*
bullfrog *(Rana catesbeiana)*
common snapping turtle *(Chelydra serpentina serpentina)*
red-eared slider *(Trachemys scripta elegans)*

Texas Utilities Mining Company operations are found within three distinct vegetational regions in Texas including the Post Oak Savannah, Blackland Prairies and Pineywoods (Gould, 1975). Historically, between regions, vegetation is variable and ranges from: 1) open prairies with tall grass climax communities of little bluestem, 2) savannahs of oak, oak-hickory and tall grasses, and 3) extensive pine and pine-hardwood forests.

Land uses include the full spectrum of uses typical of East and North Central Texas. These include cropland, pastureland, grazingland, forestry, fish & wildlife habitat, developed water resources, undeveloped land, recreation areas, residential and industrial/commercial. Most of the area is rural in nature with scattered pockets of urbanization near major transportation routes. Rural areas are predominately agricultural in nature with primary land uses dictated by vegetational region. East Texas is dominated by land uses such as forestry and undeveloped areas intermixed with pastureland. Areas to the north and west are dominated by pastureland and grazingland areas intermixed with remnant bottomland forests that are vestiges of past forestland.

Generally, much of East and North Central Texas was affected by farming and forestry activities that occurred from the mid to late 1800's through the 1950's. Historic agricultural practice ranged from intensive cotton farming over large areas to truck farming of fruits and vegetables. The trend throughout the area has been from intensive land use for market crops to less intensive pastureland and grazingland for livestock production. Forestry activities, although controlled to some extent by regional vegetation, have ranged from intensive production of saw-logs to harvesting timber for pulpwood operations. Land uses associated with commercial/industrial activities include oil and gas operations and lignite mining.

The primary geologic features associated with Texas lignite include three geologic units - the Wilcox Group, Jackson Group, and YEGUA Formation (Kaiser, 1980). These tits are associated with three ancient depositional systems - fluvial, deltaic and strandplain/lagoonal. The Wilcox and Jackson Groups are the most important lignite bearing units with 90 percent of resources occurring north of the Colorado River. Texas Utilities Mining Company lignite mines are all in the Wilcox Group. Economically minable lignite seams range from 2 ft thick or thicker at depths ranging from 20 to 200 ft.

Soils associated with these mines are predominately of the soil orders Alfisols and Ultisols. Alfisols are characterized by gray to brown surface horizons with medium to high base supply, and with subsurface horizons of clay accumulation. They are usually moist but may be dry during the warm season and occur on gently or moderately sloping areas of rangeland, small grain and irrigated crops. Ultisols are characterized as usually moist soils on moderately sloping to steep areas in woodland and pasture with a horizon of clay accumulation and a low base supply. Soil and overburden material characteristics generally show pH and acid-base accounting values higher in the oxidized sediments than the reduced sediments.

Coal Combustion By-Products (CCBP)

The major fossil fuels used throughout Texas by electric utilities are natural gas, western coal from the Powder River Basin and Texas lignite. Texas Utilities uses a variety of fuel resources to diversify fuel use and to balance fuel cost. Fuel resources, in order of use, include lignite, natural gas and nuclear. Since the use of western coal is new at Texas Utilities, only CCBP from the combustion of lignite will be addressed in relation to Texas Utilities Mining Company and TU Electric operations.

On average. Texas Utilities produces 30,000,000 tons of lignite annually for use by generating facilities. From this production, approximately 5.7 million tons of CCBP are produced in the following categories.

Tons	Type of CCBP Produced
3,400,000 tons	fly ash
1,600,000 tons	bottom ash
726,000 tons	flue gas desulferization material

CCBP include fly ash, bottom ash and flue-gas desulfurization material. Each is defined as follows:

- Flv ash is the fine, light residue carried out of the boiler in the exhaust gases. It is removed from the air by an electrostatic precipitator or a baghouse.
- The larger, heavier material, bottom ash, falls to the bottom of the boiler/furnace system and is collected in a hopper.
- Flue-gas desulfurization material (FGD) results from exhaust gases passing through scrubbers, where pulverized limestone reacts with sulfur particulate and binds together forming these materials.

The volume of CCBP produced is related to the constituents within combusted material. Constituents within Texas lignite are variable between geologic groups and even within lignite seams at the same mine. Typically, lignite of the best quality occurs in the Wilcox Group north of the Colorado River and the poorest quality material is from the Jackson Group with YEGUA lignite intermediate between Wilcox and Jackson. Btu/lb values range from 7,500 to 4,500. Wilcox lignite on average has 33 percent moisture, 15 percent ash, 0.9 percent sulfur and a heat value of 6,000 Btu/lb.

Bottom Ash Use by Texas Utilities

Bottom ash is the primary CCBP used by Texas Utilities. Of the 1.6 million tons produced annually, approximately 230,000 tons of bottom ash are beneficially used each year at lignite mines and generating facilities.

Bottom ash is beneficially used by Texas Utilities Mining Company for various purposes related to transportation. These uses are beneficial due to economic benefits, material availability, product adaptability and Texas Utilities commitment to recycling and use of CCBP.

Bottom ash is used primarily as a cost-effective surfacing material for ramps and access roads in active mining and reclamation areas. All weather access is a critical component to the management of coal mining and reclamation activities. Lignite mining is a year round process that is done 24 hours a day. Access into mine pits is accomplished through the use of ramps. Ramps are constantly being moved or extended as the mine pits progress to keep up with the dynamics of the mining operation. Bottom ash is used to surface ramps to maintain suitable traction for 100 to 150 ton lignite haul trucks and service vehicles moving in and out of pits. As mine areas progress, reclamation activities immediately follow. A system of roadways is necessary to gain access for leveling and revegetation operations. Many of these roads are surfaced with bottom ash. Once reclamation is complete, the access road system may remain as a beneficial feature for future management of the land. The physical characteristics of bottom ash and its availability provide a durable and economical source of surfacing material for transportation uses at lignite mines.

Construction and maintenance of the transportation system for each mine operation are a major undertaking in relation to capital expense and size. Traction control is required on the curves of major haulage roads. for service roads and for infrequently used access roads, Use of bottom ash as construction material. primarily as road base and surfacing material, is a primary area of CCBP use. Approximately 110 miles of roads have been constructed using 100,000 tons of bottom ash since mine operations began in 1976.

At certain mine locations, railroad construction is a major area where bottom ash is used as a construction material. Rail lines are an integral part of some Texas Utilities Mining Company mines. They may be used to connect mine areas within a mine, mines to generating facilities or to connect generation facilities to CCBP disposal areas. It is estimated that a rail spur currently being constructed will use approximately 12,000 tons of bottom ash to set drainage culverts. The use of bottom ash instead of purchased material for this project alone will result in an estimated savings of $125,000. In another operation, temporary rail spurs at a CCBP disposal operation are constructed using bottom ash. To date, approximately five miles of rail spur using 9,000 tons of bottom ash have been constructed.

Lignite storage areas, parking lots and temporary 'lay down' yards are other examples of beneficial uses of bottom ash at mine facilities. In one application, 20,000 tons of bottom ash were used as base material for a lignite storage area.

TU Electric began using bottom ash at generating facilities as early as 1976 as light duty paving of temporary access roads, parking lots, drive ways and storage yards. Later, as generating facilities expanded, plant island piping and culverts are bedded with bottom ash due to its granular shape.

Other CCBP

Texas Utilities uses fly ash in other applications at lignite mines and generation facilities. Fly ash is used as an additive in concrete and as road base stabilization in conjunction with lime. These uses are infrequent and require only minimal amounts of fly ash compared to fly ash production.

No uses for FGD have been developed at lignite mines or generating facilities.

Environmental Issues and Milestones

Reclamation activities that prepare mine soils for planting are one area where Texas Utilities does not use CCBP. Stringent State regulations on postmine soil quality and the possibility of future liability are critical factors affecting the decision to use CCBP in reclaimed soils at Texas Utilities lignite mines. Fly ash and FGD, produced by Texas Utilities, contain trace elements (specifically heavy metals) which if added to reclaimed soils may elevate trace element concentrations above regulatory limits. Federal and State limits on trace elements in reclaimed minesoil make it difficult to justify the use of these by-products as amendments in reclaimed soils.

In 1993, after 20 years of study, the Environmental Protection Agency (EPA) affirmed that CCBP are nonhazardous solid waste and thus fall under the jurisdiction of the states. In Texas, the Texas Natural Resources Conservation Commission (TNRCC) regulates CCBP. The TNRCC, in a letter to the Texas Coal Ash Utilization Group, recognized that CCBP are not waste when used as road base, subbase and subgrade material when covered by a wear surface and used as road construction material. The Railroad Commission of Texas (RCT)
has followed the lead of the TNRCC in accepting the use of bottom ash as a useful and environmentally safe material. CCBP are not considered, by the TNRCC, industrial wastes until they are to be disposed.

CCBP are typically either a Class 2 or Class 3 waste material. The definitions of solid waste classes as adopted by the TNRCC are as follows:

- Class 3 Waste - any industrial solid waste which is inert and essentially insoluble. A material's waste classification, among other things, is based on its leachable metals. The leachate must meet drinking water standards set forth by the US EPA.

- Class 2 Waste - any industrial solid waste which cannot be classified as a Class III waste.

- Class 1 Waste - this includes materials which are toxic or carcinogenic or bioaccumulative. Hazardous wastes are determined by the US EPA and are listed in CFR Title 40.

CCBP that are not beneficially used are disposed of according to TNRCC requirements. There are no requirements for the disposal of Class 3 Waste bottom ash from TUMCO's Monticello or Big Brown mines. Bottom ash produced at the Martin Lake mine is a Class 2 waste since its selenium leachate exceeds drinking water limits. Fly ash and FGD material are Class 2 Waste. Class 2 Waste must be disposed in a registered landfill that is typically lined with 3 feet of impermeable clay or a double layered synthetic liner containing a leachate collection system. At the Monticello mine, TU Electric demonstrated to the TNRCC that the soil stratum within mine pits is suitable for containing Class II waste and as a result, a traditional constructed landfill is not necessary.

Texas Utilities Off-site Use of CCBP

All forms of CCBP are marketed by Texas Utilities for off-site use in asphalt roofing shingles, concrete, wallboard, commercial carpet backing, plastics, oil field drilling cement and for soil stabilization material. Approximately 330,000 tons are marketed annually for off-site use and recycling. Other uses are being researched to increase beneficial use of these materials and reduce expensive disposal options.

Summary

CCBP can be used in economical and environmentally sound ways. Texas Utilities has demonstrated that on-site use is practical; although the volume of materials used at mines and generating facilities cannot meet the volumes produced. Excluding elevated trace element levels, fly ash incorporation into reclaimed soils may have potential for positive benefits. Benefits include improved texture and neutralization of natural soil acidity. Further study on this issue is warranted.

Initial impediments to development of beneficial uses were regulatory in nature. Acceptance by regulatory agencies has renewed interest in CCBP recycling opportunities and increased interest in legitimate. beneficial and economical uses. The groundwork for future development of CCBP uses will be continued study and further documentation showing that CCBP have no negative environmental impact.

Acknowledgments

I am grateful to the following people who provided information and editorial comments for this paper: Shawn Glacken. Jacob Gonzales, Eddie Bearden, Joel Palin, Sid Stroud, Larry Williford, Brian Craig and Bruce Lousberg.

References

Blair. W.F. 1950). The biotic provinces of Texas. Tex. J. Sci. 2:93-l 17.

Gould. F. W. 1975. Texas plants - a checklist and ecological summary. MP-.585/Rev. Texas A & M University. Texas Agricultural Experiment Station. College Station. Tesas. 12 1 pp.

Kaiser. W. R.. Ayers. W. B.. LaBrie. L. W. 1980. Lignite resources in Texas. Report of Investigations No. 104. Bureau of Economic Geology. The University of Texas at Austin. 52 pp.