pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

COAL ASH MONITORING PARAMETERS AND CERTIFICATION STANDARDS

The regulations at 25 *Pa. Code* Chapter 290, §290.201 provide the methods for determining coal ash certification standards, but do not provide the actual leaching limits. This fact sheet provides the list of parameters that are to be measured when analyzing coal ash and the leaching limits used by the Department of Environmental Protection (DEP) in its decision making.

What is the basis for the certification limits?

The values given in Table 1 are derived from the Chapter 290 regulatory requirements as specified in §290.201. The certification leachate concentrations are derived using "fate and transport modeling." This method considers how various chemicals react with the materials through which they flow and the length of the flow path and is designed to be conservative. DEP has extensive monitoring data from sites utilizing coal ash that demonstrate how different chemicals behave in the coal mine environment. This knowledge has likewise been considered in determining the certification concentrations.

Table 1. Parameters required for leaching tests and the maximum acceptable leaching limits.

Parameter Symbol	Parameter Name	Leaching Limit mg/L		Parameter Symbol	Parameter Name	Leaching Limit mg/L
Ag	Silver	2.5		Hg	Mercury	0.05
Al	Aluminum	5.0		K	Potassium	*
As	Arsenic	0.25		Mg	Magnesium	*
B	Boron	15		Mn	Manganese	2.5
Ba	Barium	50		Mo	Molybdenum	4.375
Be	Beryllium	0.1		Na	Sodium	*
Ca	Calcium	*		NH_3	Ammonia	30
Cd	Cadmium	0.125		Ni	Nickel	2.5
Cl	Chloride	250		NO_2	Nitrite	1.0
Co	Cobalt	17.5		NO_3	Nitrate	10
Cr	Chromium	2.5		Pb	Lead	0.375
Cu	Copper	25		SO_4	Sulfate	2500
F	Fluoride	*		Sb	Antimony	0.15
Fe	Iron	7.5		Se	Selenium	0.5
				Tl	Thallium	0.05
Parameter		**Std Units**		V	Vanadium	6.125
pH**		7 or above		Zn	Zinc	50

* Limit not established.

** The pH measurement is done independent of the leaching test, refer to §290.201(b)(5)(iii).

The explicit values given in Table 1 were not placed in the regulations because the values may change if additional knowledge is gained about the pollution potential or health impacts of a particular parameter. Since it is difficult to revise the regulations for such a change, the regulation instead describes the calculation method. DEP forms and supporting documents, such as this one, can be referenced for the current values.

Why these particular chemical parameters?

The parameters that are required for leachate testing of ash at §290.201(b)(5) are based on DEP experience and parameters identified by the National Research Council (NRC) in their book "Managing Coal Combustion Residues in Mines." The NRC list was derived from a study of coal ashes across the United States. The list includes many parameters rarely observed in measurable quantities in Pennsylvania-derived coal ashes. DEP chose to use this inclusive list, including chemicals that are consistently below detection levels, in order to confirm that these rarely encountered chemicals are not a problem.

What leachate test method is used? Is it reliable?

Two leaching test methods are endorsed by the U.S. Environmental Protection Agency for testing of waste materials, the Synthetic Precipitation Leaching Procedure (SPLP) and the Toxicity Characteristics Leaching Procedure (TCLP). These leaching test methods allow for a solid material to interact with water and the resulting leachate is then analyzed for concentration of the chemicals of interest. Laboratory leaching procedures have limitations regarding simulating field conditions and should be used with these in mind. The TCLP method was developed to mimic conditions found in municipal waste landfills by subjecting the material to acetic acids common to landfills. The SPLP method simulates weathering of material with acidic rain by subjecting the material to nitric and sulfuric acids. The SPLP is the method

used by DEP for coal ash because it more closely replicates mine site conditions. DEP experience in monitoring sites utilizing coal ash has shown that the use of the SPLP method is protective of the environment.

If decisions are based on leachate results, why require total bulk chemistry analyses?

Total bulk chemical analysis provides actual concentrations of a chemical within the ash, whereas the leaching procedures provide information on chemicals that will leach out of a material. Table 2 lists the chemicals required for total bulk chemical analysis. Some elements such as silica make up a large percentage of coal ash, but silica is essentially inert in water. Therefore, even though it is a major component of coal ash it is not a required leaching parameter. Other chemicals, such as arsenic, mercury and cadmium, can be present in only parts per million but be of concern. The bulk chemical analysis can help explain why a particular chemical is or is not present in the ash leachate and is a good comparison against the leachate values. If a certain chemical has a higher concentration in a particular ash than is typical for most coal ashes, it alerts DEP to a potential question about the fuel source of the ash or combustion process. Bulk chemistry can help to eliminate coal ash as a suspected pollution source. For example, if an ash does not leach lead and the bulk lead concentrations in an ash are less than those in a typical backyard soil, it is unlikely that the ash is the cause of observed lead problems and the investigation should look for other sources of lead.

Values of the total bulk chemical analyses (for certain parameters) are used for determining loading rates when an ash is used as a soil substitute or additive. Table 2 provides a complete list of chemicals that must be analyzed for total bulk chemical analysis and provides the loading limits for ash used for soil substitute or additive. The loading rates are designed to prevent toxicity to plants and to protect surface water and groundwater.

Table 2. List of parameters required for bulk chemical analysis and loading limits. Not all parameters have loading limits. Loading limits from §290.103(e).

Parameter (and symbol)	Loading Rate (Lbs/Acre)	Parameter (and symbol)	Loading Rate (Lbs/Acre)	Parameter (and symbol)	Loading Rate (Lbs/Acre)
Aluminum (Al)	-	Cobalt (Co)	-	Potassium (K)	-
Antimony (Sb)	-	Copper (Cu)	1320	Selenium (Se)	88
Arsenic (As)	36	Iron (Fe)	-	Silver (Ag)	-
Barium (Ba)	-	Lead (Pb)	264	Sodium (Na)	-
Beryllium (Be)	-	Magnesium (Mg)	-	Sulfur (S)	-
Boron (B)	60	Manganese (Mn)	-	Thallium (Tl)	-
Cadmium (Cd)	34	Mercury (Hg)	15	Vanadium (V)	-
Calcium (Ca)	-	Molybdenum (Mo)	16	Zinc (Zn)	2464
Chromium (Cr)	2672	Nickel (Ni)	370		

Are there other properties of coal ash that are measured?

There are three other properties of coal ash that are required: (1) hydraulic conductivity, (2) degree of compaction (density), and (3) neutralization potential. Hydraulic conductivity measures the rate at which water can move through a material. Compaction is measured through field density testing and compared to laboratory compaction test (Proctor) results. Proctor tests allow for the development of a compaction curve that provides the optimum moisture content and maximum dry density for a material. Neutralization potential measures how alkaline a material may be. The applicant or DEP may also require strength testing to evaluate stability, if necessary.

Hydraulic conductivity can provide insights into how fast rainwater will infiltrate into ash and whether water will preferentially flow through the ash or through the surrounding materials, such as bedrock or mine spoil. Hydraulic conductivity is also used to determine whether an ash can qualify as a low permeability material. Low permeability ash is defined in Chapter 290 as an ash having a permeability of less than 1.0×10^{-6} cm/sec.

Adequate compaction is necessary to promote stability and to reduce potential for settling. §§290.104 (active mines) and 290.105 (abandoned mines) require that the placed ash achieve a minimum compaction of 90 percent of maximum dry density as determined by the Modified Proctor Test, or 95 percent of the maximum dry density as determined by the Standard Proctor Test.

Neutralization potential (NP) is a measure of the ability of the ash to neutralize an acidic solution by providing insight into the ability of the ash to generate alkalinity. If the ash is proposed for use for alkaline addition it must have a NP of at least 100 parts per thousand calcium carbonate equivalent (10 percent by weight) (§290.201). Refer to the technical guidance document, Alkaline Addition at Surface Coal Mines (563-2112-217) for more information on the use of coal ash for alkaline addition. A technical guidance document, Guidelines for Beneficial Use of Coal Ash at Coal Mines (563-2112-228) provides additional information on the coal ash beneficial use program.

For more information, visit www.dep.pa.gov.