

**American Coal Ash Association, Inc.**

**GLOSSARY OF TERMS  
CONCERNING THE MANAGEMENT AND USE OF  
COAL COMBUSTION PRODUCTS (CCPs)**

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**Introduction**

This document contains terms and phrases that are commonly used by those who are involved with the management and use of coal ash and combustion products (CCPs). While stakeholders in the “CCPs industry” have used many of these terms for many years, other terms have evolved over the years, and still other terms are relatively new. Even the acronym, CCPs, was first used in the USA only in 1998; however, CCPs now is the preferred term throughout the world for coal ash that is used.

The terms and phrases in this glossary are associated both with the production, handling, storage and use of CCPs, and with coal ash disposal. Additionally, some environmental and regulatory terms associated with the use and disposal of these materials are included. [Members of standing ACAA committees review this document annually.](#) Comments or suggested revisions to this document are welcomed by ACAA & maybe sent to the following address – [info@ACAA-USA.org](mailto:info@ACAA-USA.org). This glossary is a continuing effort and it is intesion of of the ACAA to reflect common usage in the industry.

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**acid mine drainage (AMD)** - water exhibiting a pH of less than 6.0 and in which total acidity exceeds total alkalinity, discharged from an active, inactive or abandoned coal mine and reclamation operation or from an area affected by surface coal mining and reclamation operations.

**acid mine water** - (*See AMD*)

**activator** - a material that causes a catalyst to begin a function, which in the case of a coal combustion product based flowable fill or controlled low strength material (CLSM), causes cementitious reactions to occur.

**admixture** - a material other than water, aggregates, hydraulic cement and fiber reinforcement, used as an ingredient of concrete or mortar, and added to the batch immediately before or during its mixing. Fly ash is used as an admixture in concrete.

**advanced sulfur control products (ASC)** - products generated from advanced coal conversion technologies including Fluidized Bed Combustion (FBC) and products from advanced environmental emissions cleanup technologies such as duct injection and lime injection multiphase burners (LIMB). The type of product is technology dependent and could be a bed ash and high lime fly ash for an FBC technology.

**aeration** - the process of exposing a substance or area to air circulation; the process of mixing air with a pulverized fuel or a powdered material such as fly ash in a transport pipe or storage bin. Example: the aeration of the fly ash in a silo to facilitate flow, aeration equipment in a fly ash silo.

**aggregate** - granular material such as sand, gravel, crushed stone, crushed hydraulic-cement concrete, iron blast furnace slag, or coal bottom ash and boiler slag used as a component in concrete or mortar with a hydraulic cementing medium to produce either concrete or mortar.

**lightweight aggregate (LWA)** - aggregate of low density used to produce lightweight concrete or concrete products. Examples of LWA include coal bottom ash, pumice, scoria, volcanic cinders, tuff, and diatomite; expanded or sintered clay, shale, slate, diatomaceous shale, perlite, vermiculite, or slag; and bonded or sintered coal combustion products (CCPs) used to produce lightweight concrete or component products.

**air entraining** - the capability of a material or process to develop a system of microscopic bubbles of air in cement paste, mortar or concrete during mixing.

**air entrainment** - the incorporation of air in the form of microscopic bubbles (generally smaller than 1 mm) during the mixing of concrete or mortar.

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**air-entraining agent (AEA)** - an addition for hydraulic cement; also an admixture for concrete or mortar which causes air to be entrained in the concrete or mortar during mixing, usually to increase workability and frost resistance. The quantity of unburned carbon in fly ash can affect the dosage of the AEA in the concrete and the quality of the concrete.

**air separator** - an apparatus that separates various size fractions of ground material pneumatically; fine particles are discharged as product; oversize is returned to the mill as tailings.

**alkali** - salts of alkali metals, principally sodium and potassium; a hydroxide or carbonate of an alkali metal.

**alkali metal** - a metal in Group 1A of the Periodic Table, that is, lithium, sodium, potassium, rubidium, cesium, and francium.

**alkalinity** - the capacity of water to neutralize acids, a property imparted by the water's content of carbonates, bicarbonates, hydroxides and occasionally borates, silicates and phosphates. It is often expressed in milligrams per liter of equivalent calcium carbonate.

**alkali-silicate reaction (ASR)** - the reaction between the alkalis (sodium and potassium) in Portland cement and certain siliceous rocks and minerals, such as opaline chert, strained quartz, and acidic volcanic glass, present in some aggregates; the products of the reaction may cause abnormal expansion and cracking of concrete in service. Class F fly ash is used in concrete to reduce the occurrence of ASR.

**alkali-silicate reactivity (ASR)** - another name for alkali-silicate reaction.

**ammoniated ash** - ash that contains ammonia and/or ammonium salts as a result of the addition of ammonia or ammonium salts to the flue gas at the power plant for purposes that include removing Nitrogen Oxides (NO<sub>x</sub>) from the combustion flue gases, conditioning the flue gas in order to improve the performance of Electrostatic Precipitators (ESP) or to reduce the opacity of the emissions from the Stack. Ammonia levels occur primarily in the fly ash due to the adsorption of the ammonia on the surface of the fly ash particles in the ESP, although there could be some minor carryover of the ammonia to the scrubber residue when scrubbers are installed downstream of the ESP. Ammonia levels in fly ash has been reported to exceed 800 ppm for gas conditioning applications and to be less than 100 ppm for the Nitrogen Oxides removal applications. The latter applies to the Selective Catalytic Reduction (SCR) process only. Fly ash with ammonia levels of less than 100 ppm- has been reported to be used in concrete that is placed in a closed environment (building enclosure) without causing health and safety concerns (this is based on the European experience). Also fly ash with ammonia levels of as much as 300 ppm has been reported to be used in concrete without affecting the structural performance of the concrete.

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**ammonia slip** - the unreacted ammonia that occurs in the flue gas downstream of the Selective Catalytic Reduction (SCR) reactor and from the Selective Non-Catalytic Reduction (SNCR) Nitrogen Oxides control technologies. An ammonia slip results in the adsorption of the ammonia onto the surface of the fly ash particles in the ESP. An ammonia slip of 2 ppm yields 100 ppm adsorbed onto the fly ash based on the European experience with SCR. This 100 ppm level of ammonia in fly ash has allowed for the unrestricted use of this ammoniated fly ash in concrete in Europe.

**angle of repose** - the maximum angle from horizontal at which a given material (such as fly ash, bottom ash, or fixated FGD material) will rest on a particular stationary surface without sliding or rolling.

**aquifer** - a geologic formation, group of formations, or part of a formation that is saturated with water and capable of providing a significant quantity of water.

**ash** - the incombustible inorganic matter in fuels such as coal.

**ash free basis** - the method of reporting fuel analysis whereby ash is deducted and other constituents are recalculated to 100%.

**ash fuel** - the use of high carbon ash to produce energy.

**ash pond** - an impoundment or surface impoundment used to store or dispose of ash primarily from the combustion of coal. A type of waste management facility consisting of an excavated, a dammed or diked reservoir in which coal ashes are stored for future removal or disposed of as a slurry or sludge. The coal ash solids settle out and leave relatively clear water at the surface that is discharged through a designed and managed outlet structure to a nearby stream, surface water or plant process water system. Ash pond designs reflect local site conditions, federal and state regulations and whether fly ash, bottom ash, boiler slag or a combination of coal ashes are disposed in the ash pond. While some electric utility generating power companies combine the ashes during storage or disposal, other power companies use separate ash ponds for fly ash, bottom ash and boiler slag. The ash pond is referred to as a bottom ash pond, fly ash pond, boiler slag pond when it receives one type of ash. Also a large ash pond is referred to as an ash impoundment, ash reservoir, or surface impoundment. (*See surface impoundment and ponded ash*)

**ash pond water outlet works** - this consists of either a stop-logged vertical riser or sloping shaft within the pond, a pipe or conduit that runs from the base of the riser inside the pond to a receiving stream or other plant process water system and which is used to decant the ash transport water and normal precipitation; the skimming device at the vertical riser or sloping shaft, within the pond that prevents the floating fraction of ash or other material to enter the discharge from the pond.

**ash processing facility** - a facility that uses technology to enhance the physical characteristics of boiler slag, bottom ash or fly ash in order to meet specifications for the

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particular market that it is targeted. The initial ash processing facilities were boiler slag screening plants that produced materials for use as blasting grit and roofing granules.

**bag filter** - a device/equipment containing one or more cloth bags for recovering particles (fly ash) from the dust laden gas or air which is blown through it. Bag filters are used in the fly ash transport system in series with mechanical equipment (dust collectors and referred to as primary and secondary dust collectors) to remove fine particulate fly ash from the conveying air. The bag filter dust collector is usually referred to as a tertiary dust collector in this case. This fly ash is generally less than 10 microns, an ideal size for use as a mineral filler.

**baghouse** - a facility constructed at some coal-fired power plants to remove particulate matter (fly ash) from the flue gas by the use of fabric filter bags that mechanically trap particulate (fly ash) carried in the flue gases; a facility that removes fly ash from the flue gas by the use of fabric filter bags..

**basin ash** - another name for ponded ash. (*See ponded ash*)

**batch** - quantity of either concrete, mortar, ash grout or flowable fill mixed at one time.

**bed ash** - the spent bed material that is produced by Fluidized Bed Combustion Generating Plants. The bed ash is usually collected separately and can be considered as being equivalent to bottom ash in a Dry Bottom Furnace or a Wet Bottom Wall Fired Furnace. The bed ash is composed of calcium oxide (35% or greater by weight), calcium sulfate (30% or greater by weight), coal ash (26% or greater by weight), calcium carbonate (5% or greater by weight) and carbon (4% or greater by weight). Also because of the free lime content, heat is evolved when water is added. The collected bed ash is conveyed to a silo (which may only store the bed ash or may store a combination of bed ash and fly ash) from where it is loaded into trucks or other vehicles and transported to ground storage for reuse or to a disposal site.

**beneficial use of a CCP-** the use of or substitution of the coal combustion product (CCP) for another product based on performance criteria . For purposes of this definition , beneficial use includes, but is not restricted to , raw feed for cement clinker, concrete, grout, flowable fill, controlled low strength material; structural fill; road base/sub-base; soil- modification; mineral filler; snow and ice traction control; blasting grit and abrasives; roofing granules; mining applications; wallboard; waste stabilization/solidification; soil amendment and agriculture.

**beneficiation** - improvement of the chemical or physical properties of a raw material or intermediate product by the removal or modification of undesirable components or impurities. The removal of unburned carbon in fly ash is an example of beneficiation of the raw fly ash.

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**Bevill exclusion** - an exemption from regulation as hazardous wastes of all wastes or residues that result from the combustion of coal and other fossil fuels.

**biomass** - a synonym for biological solids. All material that originated from the growth of agricultural crops (including food crops), trees, grasses, aquatic plants and their residues or waste materials. Includes residues from crop harvesting, forest maintenance, road or land clearing, utility line maintenance, as well as post-consumer materials such as used wood, food processing, paper mill sludge industrial byproducts and other waste materials that may result from the processing of these goods. Also typically refers to agricultural and forest products or residues derived from living plants

**biomass coal co-firing** - the firing of two dissimilar fuels at the same time in the same boiler, coal and biomass.

**blended fly ash** - fly ash resulting from the combustion of a mixture of different classification coals such as bituminous and sub-bituminous coals. Also the mixing of ash from different sources. (*See fly ash sub-bituminous/bituminous coal blends*)

**boiler slag** - a molten ash collected at the base of slag tap and cyclone furnaces that is quenched with water and shatters into black, angular particles having a smooth, glassy appearance. Boiler slag is in high demand for beneficial use (blasting grit, roofing granules, etc.), but supplies are decreasing because of the removal from service of power plants (due to their age) that produce boiler slag.

**boiler slag fines** - the small boiler slag particles that are produced as a result of dry or wet boiler slag screening processes whose end product is directed to several markets that include use as a blasting grit. Beneficial use of the fines include its use in the glass industry.

**borrow** - an area designated as a source for soil in construction or mine reclamation projects; a source or sources of material other than the required excavation.

**bottom ash** - agglomerated ash particles formed in pulverized coal furnaces that are too large to be carried in the flue gases and impinge on the furnace walls or fall through open grates to an ash hopper at the bottom of the furnace. Bottom ash is typically grey to black in color, is quite angular, and has a porous surface structure. Bottom ash is used as an aggregate, as feed stock for cement manufacturing or in construction applications in lieu of other constituents (such as sand, gravel).

**bottom ash dewatering bin/tank** - an elevated sedimentation tank that is designed with baffles and other devices to receive the bottom ash slurry, settle out and store hours or days of bottom ash production, and discharge the stored and dewatered bottom ash into trucks. This tank is usually in series with a separate tank or tanks that settles out the very small bottom ash particles. Bottom ash dewatering bins are used where there are space limitations at a coal fired power plant and where other process or site requirements do not allow for the use of ponds.

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**bottom ash fines** - the small bottom ash particles that is produced as a result of dry or wet bottom ash screening processes whose end product is an aggregate.

**bottom ash pond** - an impoundment or surface impoundment used to store or dispose of bottom ash primarily from the combustion of coal. (*See ash pond.*)

**bulk density** - the mass of a material per unit volume including voids. Bulk density is usually reported on a dry basis.

**bulk density of aggregate** - the mass of a unit volume of bulk aggregate material (the unit volume includes the volume of the individual particles and the volume of the voids between particles).

**byproduct** - a material that is not one of the primary products of a production process and that is not solely or separately produced by the production process.

**byproduct utilization** - the recycling or use of coal combustion wastes.

**cake** - the solids discharged from dewatering equipment such as rotating drum vacuum filters, where the material is then referred to as filter cake.

**calcium carbonate equivalent (CCE)** - the content of carbonate in a liming material or calcareous soil calculated as if all the carbonate is in the form of  $\text{CaCO}_3$ .

**calcium sulfate dihydrate ( $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ )** - gypsum; the primary byproduct of a forced oxidation wet flue gas desulfurization system in which additional air is introduced and lime or limestone is used as the reagent. (*See FGD gypsum and gypsum.*)

**calcium sulfite ( $\text{CaSO}_3$ )** - the primary product (or byproduct) of a wet flue gas desulfurization system where there is no forced oxidation and lime or limestone is used as the reagent.

**cap** - a layer of clay, or other impermeable material installed over the top of a closed landfill to prevent entry of rainwater and minimize leachate.

**captive facilities** - facilities that are located upon lands owned by the generator of coal combustion byproducts or coal combustion/flue gas cleaning wastes and which are operated to provide for the treatment or disposal solely of the generator's byproducts or wastes. (Example: captive landfill)

**carbon** - element. The principal combustible constituent of all fuels.

**carbon burn-out (CBO) process** - a proprietary technology and patented process to combust residual carbon in high-carbon fly ash thereby producing a concrete grade fly ash (defined as a fly ash with an LOI of equal to or less than 3%). Commercial CBO plant

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data reports feed ash LOI ranging from 6.5% to 18% (averages 10.9%) while product fly ash averages 2.5%. Heat from the carbon combustion is recovered back to the power plant.

**carbon dioxide (CO<sub>2</sub>)** - a colorless, odorless, incombustible gas formed during combustion in fossil-fuel electric generation plants.

**carbon in ash (unburned carbon in ash-UBC)** - the unburned carbons in fly ash include both carbon carried over as uncombusted “inertinite” and chars or cokes resulting from the incomplete combustion of thermoplastic, largely vitrinite-derived phases. The latter include “isotropic coke” and “anisotropic coke”.

**carbon reduction process** – a process to reduce the concentration of carbon in high-carbon fly ash.

**cell** - a portion of a landfill which is isolated, usually by means of soil or an impermeable barrier, from its surroundings.

**cementitious ash** - fly ash, which hardens irreversibly when mixed with water. Also referred to as self-cementing ash.

**cementitious material** (hydraulic) - an inorganic material or a mixture of inorganic materials that sets and develops strength by chemical reaction with water by formation of hydrates, and is capable of doing so under water.

**cementitious mixture** - A combination of more than any one of the following materials to make a cement paste: hydraulic cement; Portland cement; coal fly ash; FBC ash; lime; ground granulated blast furnace slag; lime kiln dust; cement kiln dust. It may be used by itself for grout, or used to bind aggregates or fine materials to make concrete or controlled low strength materials (CLSM), or used for soil stabilization and solidification.

**cenospheres** - a portion of fly ash, that was once referred to as the floating fraction of the fly ash because of its occurrence on the surface of fly ash ponds and from where it was and still is harvested for beneficial use. Cenospheres are lightweight (23 to 28 pounds per cubic foot), inert, hollow, essentially thin-walled glass spheres (10 - 350 microns) comprised largely of silica and alumina and filled with air and/or gasses. Cenospheres are formed from the ash when it is in a molten state. The thickness of cenosphere walls may be very small and the resultant bulk densities are less than 1 gm/cm<sup>3</sup>. Cenospheres that are harvested from the surfaces of ash ponds are processed (drying, classifying, etc) and marketed as a high value product in applications for performance enhancement of products such as paints, coatings, adhesives etc. Cenospheres are also now extracted from dry fly ash by companies with proprietary processes and marketed under registered trade names. The proportion of 1 gm/cm<sup>3</sup> cenospheres that exists in fly ash has not been quantified definitively but the literature indicates a percentage of about 2% maximum. (*See Microspheres*)

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**char** - the solid carbonaceous residue that results from incomplete combustion of organic material which includes coal. It can be burned for heat or if pure, processed for production of activated carbon for use as a filtering medium. In the electric generation industry the term applies to the fixed carbon in the coal and current usage in coal combustion will be ‘the time to burn out the char’. Also it can apply to the unburned portion of the coal and would have the same usage as unburned carbon in ash.

**char/fly ash** - another term for the carbon in the fly ash which is now commonly referred to as unburned carbon (UBC) in ash.

**cinders** - an old term, in ash marketing, for the ash from utility stoker boilers and which were used as an aggregate especially in concrete block manufacturing and hence the term cinder blocks. This term is still used in ash marketing to refer to bottom ash and boiler slag especially. However the usage of this term by the American Boiler Manufacturers Association is for “particles of partially burned fuel from which volatile gases have been driven off, which are carried from the furnace by the products of combustion”.

**class C fly ash** - fly ash, which meets criteria defined in ASTM C 618, for use in concrete

**class F fly ash** - fly ash, which meets criteria defined in ASTM C 618 for use in concrete,.

**clean coal combustion** - the burning of coal, coal culm, or coal fines in a furnace designed to operate to minimize emissions (that is a fluidized bed or aerated fluidized bed, etc.) or coal burned in the presence of alkaline materials, which combine to reduce emissions.

**clean coal technology** - a government and industry co-funded effort to demonstrate a new generation of innovative coal utilization processes in “showcase” projects conducted across the country.

**clean coal technology combustion products** - products generated from any technology including technologies applied at the pre-combustion, combustion, or post combustion stage, at a new or existing facility which will achieve significant reductions in air emissions of sulfur dioxide or oxides of nitrogen associated with the utilization of coal in the generation of electricity, or process steam which was not in widespread use as of November 15, 1990.

**clinker** - a hard compact congealed mass of fused furnace refuse usually slag. Bottom ash and boiler slag usually contains clinker.

**cement clinker** - the fused particles or pellets produced from the sintering or burning zone (2200<sup>0</sup>F to 2700<sup>0</sup>F) of a rotary kiln in the cement manufacturing process. Raw materials (limestone, shale, iron ore, sand) are proportioned and ground to a powder and blended before being processed through the rotary kiln.

**closure** - the decommissioning of a disposal facility.

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**closure plan** - a written plan that describes the steps the owner or operator of the disposal facility will take to close the facility in accordance with regulatory or other requirements.

**coal** - a brown to black combustible sedimentary rock (in the geologic sense) composed principally of consolidated and chemically altered plant remains; solid hydrocarbon fuel formed by ancient decomposition of woody substance under conditions of heat and pressure. All solid fuels are classified as anthracite, bituminous, sub-bituminous or lignite by ASTM and in ASTM D388-77.

**coal ash** - a collective term referring to any solid materials or residues (such as fly ash, bottom ash or boiler slag) produced primarily from the combustion of coal. Collective term referring to any materials or residues produced directly from the combustion of coal and especially from coal-fired power plants. It is much like volcanic ash. It consists of limestone, iron, aluminum, silica sand and clay. In addition it contains trace quantities (in the parts per million range) of the oxidized forms of other naturally occurring elements. These same elements exist in soil, rock and coal. The coal can be bituminous, sub-bituminous, lignite or a mixture of these coals. The residues of mixtures of small quantities of other fuels such as petroleum coke, fuel oil, etc. with coal are also referred to as coal ash. Current usage of the coal ash collective term is synonymous with the term coal combustion ash and coal combustion residue (CCR). Also coal ash is a component of the term coal combustion byproduct (CCB) covering only the materials or residues associated with the combustion of coal and not the residues from flue gas cleaning. (*See coal combustion ash, CCR, and CCBs.*)

**coal ash landfills** - a landfill that receives only coal ash. It is usually regulated by a State Governmental Agency and subjected to the waste management practices and alternative disposal practices of the particular state. (*See mono-fill*)

**coal combustion ash** - collective term referring to any materials or residues produced from the combustion of coal. (*See coal ash and CCR*)

**coal combustion byproducts (CCBs)** - collective term referring to fly ash, bottom ash, boiler slag, fluidized bed combustion ash or flue gas desulfurization (FGD) material resulting from the combustion of coal and the cleaning of the stack gases. Also a collective term referring to any large volume material or residue produced from the combustion of coal or the cleaning of the stack gasses regardless of ultimate commercial application or disposal. Coal combustion products (CCPs) have replaced the term coal combustion byproducts and this usage is intended to clearly identify the products from the combustion of coal or the cleaning of the stack gasses that are manufactured or processed to meet standards, guidelines etc. and used commercially. However many government agencies (Federal and State) and other organizations continue to use the term CCBs. In addition federal regulations also use the term coal combustion wastes (CCWs) and fossil fuel combustion wastes (FFCWs) in the same context as the term CCBs. As a result of the interchangeable use of these terms (CCBs, CCPs, CCWs & FFCWs) there is an industry movement to provide clarity based on use of the products. This

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clarification, based on current usage by the Department of Energy (DOE), National Energy Technology Laboratory (NETL) is that the term “Products” applies when the material is used and “Wastes” applies when the material is discarded. (*See coal combustion products*)

**coal combustion products (CCPs)** – fly ash, bottom ash, boiler slag, fluidized-bed combustion (FBC) ash, or flue gas desulfurization (FGD) material produced primarily from the combustion of coal or the cleaning of the stack gases. Also a collective term referring to fly ash, bottom ash, boiler slag, fluidized bed combustion (FBC) ash or flue gas desulfurization (FGD) material produced primarily from the combustion of coal and the cleaning of the stack gases and are manufactured either as a part of the coal fired power plants operating processes or otherwise to meet standards, guidelines etc. and used commercially. (Examples include but are not limited to the production of FGD gypsum; the production of specification fly ash either as a part of the power plants normal basis of operation or through the use of beneficiation processes; the production of commercial materials through screening, drying, classifying of bottom ash, boiler slag or fly ash.) Coal combustion products (CCPs) have replaced the term coal combustion byproducts (CCBs).

**coal combustion residue (CCR)** - collective term referring to any materials or residues produced from the combustion of coal. CCR has been a term used in scientific literature and by the United States Environmental Protection Agency (EPA) and environmental groups; but used little by the coal ash industry. (*See coal ash*)

**coal combustion wastes (CCWs)** - a collective term for materials or residues produced from the combustion of coal or the cleaning of stack gases that are disposed of as a solid waste. This term is used in federal and state regulations by environmental groups. (*See CCBs and FFCWs*)

**coal fly ash** - a product of burning finely ground coal in a boiler to produce electricity. It is removed from the plant exhaust gases primarily by electrostatic precipitators or baghouses and secondarily by wet scrubbers. Physically, fly ash is a very fine, powdery material, composed mostly of silica, and nearly all particles are spherical in shape. Coal fly ash is a pozzolan. (*See fly ash*)

**fly ash-bituminous coal** – fly ash resulting from the combustion of a bituminous coal in a boiler for the production of electricity, it is generally low in lime (less than 2%); its chemistry would make it fall under but may not conform with the ASTM C 618 classification of a Class F fly ash; this fly ash does have pozzolanic characteristics.

**fly ash-sub-bituminous/bituminous coal blends** – the proportions of the coal blends affects the lime content of the fly ash; for example a 70% sub-bituminous powder river basin: 30% bituminous coal blend can result in a lime content of the fly ash that can range from 11% to 13%; the chemistry of the fly ash depending on the proportion of the blend could make it fall under, but may not conform with, the

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ASTM C618 classification of either a Class C or a Class F fly ash while having a lime content that exceeds that normally associated with a Class F fly ash.

**coal mine** - an area of land and all structures, facilities, machinery, tools, equipment, shafts, slopes, tunnels, excavations, and other property, real or personal, placed upon, under, or above the surface of such land by any person, used in extracting coal from its natural deposits in the earth by any means or method, and the work of preparing the coal so extracted, including coal preparation facilities. The British term is “colliery”. Coal combustion products are sometimes used in construction projects at coal mines and coal combustion byproducts are sometimes disposed in coal mines.

**coal mine drainage** –water discharge from coal mines, ranging in composition from acidic to alkaline typically with elevated concentrations of sulfate, iron, manganese, and aluminum as well as common elements such as calcium, sodium, potassium and magnesium. The pH is most commonly either in the ranges 3 to 4.5 or 6 to 7, with fewer intermediate or extreme values.

**coal mine waste** - the coal processing waste and underground development waste.

**coal processing waste** – the earth materials which are separated and wasted from the coal during cleaning, concentrating, or other processing or preparation of coal.

**coal refuse** - waste products of coal mining, cleaning, and coal preparation operation (for example culm, gob, etc) containing coal, matrix material, clay and other organic and inorganic material. This does not include overburden from surface mines.

**coal utilization byproducts (CUB)** – a collective term that is being used by the United States Department of Energy (USDOE) and the National Energy Technology Laboratory (NETL) to refer to byproducts from the utilization of coal. It includes coal combustion byproducts and byproducts from coal gasification.

**co-firing** - the term that is applied to the firing of two dissimilar fuels, such as biomass and coal, at the same time in the same boiler.

**coke** - a carbonaceous solid produced from coal, petroleum or other materials by thermal decomposition with passage through a plastic state; fuel consisting largely of the fixed carbon and ash in coal obtained by the destructive distillation of bituminous coal.

**compaction** - the densification of a soil or coal combustion product by means of mechanical manipulation; reduction in bulk volume of solid waste by rolling and tamping. Also, reduction in bulk volume or thickness of a body of fine-grained sediments in response to increasing weight of overlaying material.

**compliance coal** - a coal or a blend of coals that meets sulfur dioxide emission standards for air quality without the need for flue gas desulfurization.

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**compost** - relative stable decomposed organic material, often associated with agriculture or gardening soil enrichment. Sometimes ash is blended with materials such as leaves, wood chips, peanut shell, poultry waste, etc to form compost.

**composting** - an aerobic process involving the biological stabilization of sludge and other wastes by microorganisms. Generally the process comprises of spreading or windrowing the material; sometimes the sludge or other waste is mixed with a bulking agent such as coal ash to maximize air contact.

**Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)** - A Federal law enacted in 1980 that governs the cleanup of hazardous, toxic, and radioactive substances. The act and its amendments created a trust fund, commonly known as Superfund, to finance the investigation and cleanup of abandoned and uncontrolled hazardous waste sites. Under this act the Department conducts remedial investigations and feasibility studies to determine the sources and extent of contamination and ultimately the cleanup alternatives.

**conditioned ash** - ash that has been moistened with water during the load out process at the temporary storage silo at the power plant to allow for its handling, transport, and placement without causing fugitive dusting. The water that is added can vary from 5% to 30% by weight of the dry ash which can be fly ash from an Electrostatic Precipitators (ESP), fluidized bed material which could be a combination of fly ash and bed ash, and bag-house material from a dry scrubber that could be a combination of fly ash, unreacted lime (as calcium hydroxide), calcium sulfate and calcium sulfite.

**conditioned ash (Cont'd)** - The water is added in a pugmill or pugmill type equipment as the ash is fed from the silo and loaded into open body trucks or other hauling equipment. The conditioned ash is usually designated for placing in a landfill, although it can be used in beneficial applications. (*See Pugmill*)

**conditioned fly ash** - dry fly ash that has been moistened with water during the load out process at the temporary storage silo at the power plant to allow for its handling, transport and placement without causing fugitive dusting. The water that is added can vary from 5% to 30% by weight of the dry fly ash. Water contents of 5% to 10% is sometimes added for high lime fly ashes because of the quick setting that occurs and to allow a designated time that the hauling equipment can easily discharge the conditioned ash without it all sticking in the truck bed. Water contents for low lime fly ash is generally from 10% to 30%. The water is added in a pugmill or pugmill type of equipment (dustless unloader) as the dry fly ash is fed from the silo and loaded into open body trucks or other hauling equipment for placing in a landfill or for beneficial use. (*See dustless unloader and pugmill*)

**consolidation** - the reduction in volume of a fill caused by movement of water out of the fill mass. Consolidation generally occurs due to an increase in the vertical stress on a fill. It is the movement of water rather than the compression of air filled voids that distinguishes consolidation from compaction.

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**continuous emission monitoring (CEM)** - the measurement on a continuous basis of pollutants emitted into the atmosphere in the exhaust of gases for combustion processes or as the byproduct of industrial processes.

**controlled low-strength material (CLSM)** – a flowable fill conforming to ACI 229 R

**culm** - anthracite tailings, especially prevalent in Eastern Pennsylvania, that are a source of energy which could be used for example in fluidized bed boilers.

**cyclone** - a cone-shaped air-cleaning apparatus that operates by centrifugal separation and is used in particle collecting and fine-grinding operations. Cyclone particle collection equipment is widely used in CCPs handling and storage systems.

**cyclone boiler** - a type of coal-fired boiler. The coarsely pulverized coal undergoes slagging combustion in a cylindrical (cyclone) burner. Some wet-bottom boilers are not cyclone-fired. The primary byproduct is a glassy slag referred to as boiler slag, which is in great demand for beneficial use, but the supplies are declining because of the retirement from service of cyclone boiler electric power generating plants.

**cyclone dust collector** - a type of particle collection equipment that is used in particle transport systems and is usually in series with other types of dust collection equipment such as a baghouse dust collector. It is used in CCP handling and storage systems.

**deep mine injection** - placement of materials such as ash and flue gas cleaning material into underground depleted mine cavities, through boreholes, either pneumatically or hydraulically. Proper filling may help control acid mine drainage by reducing oxidation of pyrite, addition of alkalinity or reducing groundwater flow through the mine. This is a beneficial use of coal ash when performed for mine subsidence control.

**density** – the mass per unit volume; weight per unit volume, expressed as grams per cubic centimeter or pounds per cubic foot for solids and liquids and usually as grams per liter for gases.

**dewatering** - a physical process which removes sufficient water from a sludge, FGD material or ponded ash and FGD solids so that its physical form is changed from essentially that of a fluid to that of a damp solid. Some major types of equipment and facilities used are: rotary drum vacuum filters, centrifuges, horizontal belt filters, lagoons, ponds, etc.

**dike** - an embankment or ridge of either natural or synthetic materials used to contain or hold a liquid, slurry, sludge or other material in ponds.

**discharge** - the release of any solid, liquid or gas waste stream or any constituent thereof to the environment. (Example: a coal combustion byproduct surface impoundment will have a water discharge that has a permit issued by a state or federal agency.)

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**disposal** - the discharge, deposit, injection, dumping, spilling, leaking, or placing of any solid waste or hazardous waste into or on any land or water so that such solid waste or hazardous waste or any constituent thereof may not enter the environment or be emitted into the air or be discharged into any waters including groundwater.

**disposal facility** - a facility or part of a facility at which waste is intentionally placed into or on any land or water, and at which waste will remain after closure ; the necessary equipment and associated land area which serves to receive and manage waste. The facility may have available one, many or all of a large number of disposal methods. A coal combustion byproducts (CCBs) disposal facility is usually either a landfill or surface impoundment and may be located on site or off site from the power plant that produced the CCBs. However some power plants have elected to use abandoned mines for ash and/or FGD materials which could involve the placing of either material in excavated mine shafts or in depleted strip mines.

**double liners** - a combination of two synthetic and/or natural buffers acting independently to separate waste from underlying soil and groundwater.

**drainage blanket** - a uniform layer of permeable material such as sand, crushed stone, or bottom ash/boiler slag installed with properly designed filter media at the base of a structural fill to maintain the fill in a drained condition.

**dredging** - an excavation practice employed by the electric power generation industry to remove coal combustion byproducts from a temporary storage to a long term disposal facility.

**dry ash removal** - the method of accumulating and removing dry ash from a dry bottom pulverized fuel fired furnace.

**dry bottom furnace** - a pulverized fuel fired furnace in which the ash particles (bottom ash) are deposited on the furnace bottom in a dry non adherent condition.

**dry fly ash** - fly ash that has been collected by the particulate removal equipment such as Electrostatic Precipitators (ESP), Baghouses, Mechanical Collectors or Fabric Filters at coal-fired power plants. The collected fly ash is in a dry state, less than 3% moisture, and it is transported via an ash removal system to either a silo for temporary storage or to a wetting water eductor for sluicing to an ash pond. The fly ash in the silo is loaded out through specially designed equipment either in its present dry state into pneumatic or bulk carriers (truck or rail) for beneficial reuse or moistened with water for disposal and/or beneficial reuse. Also high lime fly ash, especially Class C fly ash, that is not beneficially used are sometimes transported by pneumatic bulk trucks to a facility where the ash is mixed with water to form a slurry and then discharged into a pond – the pond is then dewatered and the hardened material is excavated and placed in a landfill or beneficially used. (*See fly ash*)

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**dry fly ash removal systems** - the equipment system used to remove and to convey the fly ash from the hoppers of the particulate collection equipment, ESP or other, to a silo including the silo aeration and unloading equipment or to a wetting water eductor.

**dry fly ash disposal system** - the overall fly ash transport and storage systems that involve the dry fly ash removal system at the coal fired power plant, the truck (vehicular) transport of the conditioned fly ash and the placing of the conditioned fly ash in a landfill.

**dust** - particles of gas borne solid matter larger than one micron in diameter.

**dustless unloader** - a term used by the American Boiler Manufacturers Association for a device for wetting dust so the particles are adherent to each other, to prevent dissipation by atmospheric current while conveying. The typical usage is for the pugmill type equipment used to wet (condition) fly ash as it is being removed from a silo and loaded into trucks or other vehicles. (*See conditioned fly ash*)

**economizer** - a heat recovery device designed to transfer heat from the products of combustion to a fluid, usually feedwater.

**economizer ash** - ash which is collected in the economizer section of a boiler. It is the ash, which is collected in the ash hoppers that are located below the economizer. The majority of the economizer ash is plus 200 mesh and it is referred to as having a popcorn consistency. Generally the economizer ash is removed from its hopper(s) as a part of the fly ash removal system and it is conveyed along with the fly ash to a silo (for dry removal systems) and to a pond (for wet removal systems). However the size of the economizer ash particles when combined with the dry fly ash in a silo can cause the fly ash to be out of specification with standards for use in concrete. As a result the economizer ash is conveyed either to the bottom ash transport system and combined with the bottom ash or to a dedicated silo.

**effluent** - the final discharge from any process such as from an ash impoundment.

**electrostatic precipitator (ESP)** - a facility that removes fly ash from the flue gas by producing an electric charge on the fly ash and collecting it electrostatically.

**encapsulation** - complete coating or enclosure of a toxic particle by an additive so as to sequester that particle from any environmental receptors that may otherwise have been negatively impacted by that particle; the complete enclosure of a waste in another material in such a way as to isolate it from external effects such as those of water or air.

**ettringite** - a high-calcium sulfoaluminate mineral ( $\text{Ca}_6\text{Al}_2(\text{SO}_4)_3(\text{OH})_{12}\cdot 26\text{H}_2\text{O}$ ) that is expansive because of its crystal structure; a mineral composed of hydrous basic calcium and aluminum sulfate that expands when wet upon forming its crystalline structure.

**ettringite formation** - the phenomenon that leads to the formation of ettringite and can occur in coal ash/lime/sulfur mixtures. Ettringite is formed by the combination of aluminum from the coal ash, lime and sulfates from the scrubber process and

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water. These four substances are required for ettringite to form. Swelling problems due to ettringite formation have occurred with coal ash that contains scrubber or FBC residue. Swelling problems rarely occur with coal ash that does not contain scrubber or FBC residue.

**exothermic** - a process or chemical reaction which is accompanied by the evolution of heat, for example combustion reactions.

**ex situ** - a Latin term meaning off-location. (Example: ex situ oxidation (Wet FGD Scrubbers))

**facility** - all contiguous land, and structures, other appurtenances and improvements on the land used for treating, storing, or disposing of wastes. The US EPA defines a facility for the purposes of TRI reporting as – “ all buildings, equipment, structures and other stationary items which are located on a single site or contiguous or adjacent sites and which are owned or operated by the same person (or any persons which controls, is controlled by, or under control with such person)”.

**filler** - a substance added to a system or product to increase bulk, weight, viscosity, opacity, or strength and often used to reduce cost. CCPs are used as fillers in many applications, for example in solidification/stabilization of wastes; in concrete, flowable fills/controlled low strength materials. Also fly ash in particular is being used as a mineral filler.

**final closure** - the measures which are specified by the permitting agency of a waste management facility and implemented by the owner of the facility to render a part of or the entire facility environmentally innocuous when it is no longer used to accept waste for treatment, storage or disposal.

**final cover** - cover material that is applied upon closure of a landfill or surface impoundment.

**financial assurance** - demonstration by an owner of a waste management facility to the permitting governmental agency of financial assets to guarantee closure and post closure care.

**fineness** - the percentage by weight of a standard sample of a pulverized material which passes through a standard screen of specific mesh when subjected to a prescribed sampling and screening procedures. It is an important quality factor for the use of fly ash in concrete. The fineness of a particular fly ash is related to the operating condition of the coal crushers and the grindability of the coal itself. It is a measure of the percent retained on the number 325 sieve. A coarser gradation can result in a less reactive fly ash.

**fixated CCPs** - CCPs that are blended with a cementitious binder to induce or enhance a pozzolanic reaction.

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**fixation** - a physical immobilizing of particulates achieved by the development of chemical cementation bonds. This term is used by the US EPA to mean either solidification or stabilization.

**fixed carbon** - the part of the carbon that remains behind when coal is heated in a closed vessel until all of the volatile matter is driven off.

**flowable fill** - a material that flows like a liquid, is self-leveling, requires no compaction or vibration to achieve maximum density, hardens to a predetermined strength and is sometimes a controlled low strength material (CLSM). Coal Combustion Products (CCPs) are used in manufacturing flowable fills. The proportion of the CCPs in the flowable fill mixture can be 100% for an all ash flowable fill that consists of a combination of a Class C (high lime) fly ash and a Class F fly ash and water. It can be a major portion of a mixture that consists primarily of fly ash or fly ash and bottom ash and a small amount of cement or cement and lime. Also it may consist of only a high lime Class C fly ash (derived from the burning of Powder River Basin sub-bituminous coal) and sand with no addition of cement. The term flowable fill also applies to Fixated FGD material that is enhanced with added lime or cement and that is used in underground mine filling applications.

**flue gas conditioning** - the process of adding chemicals such as sulfur trioxide or ammonia to the flue gas in order to improve the performance of the electrostatic precipitator (ESP) or reduce the opacity of the emissions from the stack.

**flue gas desulfurization (FGD)** - removal of gaseous sulfur dioxide from boiler exhaust gas. Primary types of FGD processes are wet scrubbers, dry scrubbers, and sorbent injection. Sorbents include lime, limestone, sodium-based compounds, and high-calcium coal fly ash

**dry FGD** - an FGD system in which calcium or sodium based sorbents, usually hydrated lime are introduced to the flue gas. Dry FGD systems use less water than wet systems, usually remove fly ash and sulfur dioxide simultaneously and generate a dry byproduct. Spray dryer systems are the most common design. In a spray dryer, slaked lime slurry is sprayed into the flue gas and the resulting byproduct, dried by the heat of the flue gas is collected in a particulate control device with the fly ash. Other dry systems inject dry sodium sorbent directly into the boiler exhaust duct. The byproduct of a dry FGD system is referred to by various names that include dry FGD ash, dry FGD material, dry scrubber material.

**dry sodium injection** - (*See dry FGD*)

**ex situ oxidation (wet FGD)** - forced oxidation that occurs outside of the scrubber and used to produce FGD gypsum.

**forced oxidation** - a process employed to supply additional air in wet FGD systems, resulting in a predominantly calcium sulfate dihydrate (gypsum) byproduct with improved storage characteristics as well as greater commercial potential.

**in situ oxidation (wet FGD)** - a process in which both SO<sub>2</sub> absorption and oxidation are carried out within the scrubber.

**spray dryer** - a type of dry FGD system. (*See dry FGD*)

**wet FGD** - an FGD system which uses a wet scrubber to introduce an aqueous solution of either slaked lime (calcium hydroxide) or limestone (principally calcium carbonate) into the flue gas in a spray tower. The sorbent reacts with or oxidizes the sulfur dioxide in the flue gas and converts it to a byproduct that is referred to as scrubber sludge, scrubber material, wet FGD material.

**scrubber** - any of several forms of chemical/physical devices that remove sulfur compounds formed during coal combustion and especially from coal fired power plants. (*See wet FGD and wet scrubbers*)

**FGD material** – a product of an FGD process typically using a high-calcium sorbent such as lime or limestone. Sodium-based sorbent and high-calcium coal fly ashes are also used in some systems. The physical nature of these materials varies from a wet thixotropic sludge to a dry powdered material depending on the process. The wet thixotropic sludge is usually from a lime-based reagent wet scrubbing process and is predominantly calcium sulfite. It is the end product of dewatering equipment such as vacuum filters or centrifuges, although it can be the end product of a sedimentation pond. This dewatered end product is usually stabilized by mixing with lime and fly ash or other materials for disposal in landfills. (There are systems where the end product is not dewatered but is highly concentrated in solids as the underflow from a thickener - it is then mixed with fly ash and another material and pumped to a surface impoundment for disposal). The wet product from limestone based reagent wet scrubbing processes is predominantly calcium sulfate which is gypsum. This material readily dewateres and there are systems in use where the slurry is transported to a pond and construction equipment is used to excavate and stockpile the gypsum. The production of commercial grade FGD gypsum used for wallboard manufacturing usually requires forced oxidation in the scrubbers or external to the scrubbers and dewatering by filtration equipment such as vacuum filters or centrifuges and sedimentation ponds. The dry material from dry scrubbers that is captured in a baghouse along with fly ash consists of a mixture of sulfites and sulfates in addition to fly ash. This powdered material is referred to as dry FGD ash, dry FGD Material, lime spray dryer ash, lime spray dryer, or lime spray dryer residue.

**dry FGD ash** – (*See dry FGD material*)

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**dry FGD material** – the product that is produced from dry FGD systems and consists primarily of calcium sulfite, fly ash, portlandite ( $\text{Ca}(\text{OH})_2$ ), and/or calcite. Lime based sorbent systems dry FGD material main constituents are calcium sulfite and dry fly ash, along with minor quantities of calcium sulfate. Sodium based sorbent systems main constituents are sodium sulfite and dry fly ash along with minor quantities of sodium sulfate. Dry FGD material is being used in construction, engineering and agricultural applications; however most of the material is stored in landfills.

**FGD byproducts**, - the term for the byproducts from wet and dry FGD systems. (*See Wet and Dry FGD byproducts*)

**FGD gypsum** – gypsum formed from an oxidizing and calcium-based flue gas desulfurization process. Also a precipitated gypsum formed through the neutralization of sulfuric acid in flue gas desulfurization processes at coal fired power plants. This gypsum can vary in purity, which is defined as the percentage of  $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$  and generally is over 94 % for use in wallboard manufacturing. The less pure gypsum can be stockpiled (gypsum stacking), placed in ponds or captive landfills or utilized in Agriculture or construction. The nearly pure or pure FGD Gypsum is utilized beneficially. The pure FGD Gypsum is manufactured to meet the specifications of wallboard manufacturing companies and is used for wallboard manufacturing, for cement production and as plasters. Large quantities of FGD Gypsum are produced and utilized. See gypsum and synthetic gypsum.

**FGD material dry scrubbers** - the dry powdered material from dry scrubbers that is collected in a baghouse along with fly ash and consists of a mixture of sulfites, sulfates, and fly ash. (*See dry FGD ash*)

**FGD products** - another term for the byproducts from wet and dry FGD systems.

**FGD sludge** - another name for scrubber sludge, wet FGD material or filter cake. (*See wet FGD material*)

**filter cake** - the material produced by filtering equipment such as vacuum filters for dewatering wet FGD material. (*See wet FGD material*)

**fixated FGD material** - a designed mixture of dewatered FGD sludge that is primarily calcium sulfite with either a high lime (class C) fly ash, or a low lime fly ash (Class F), combined with a cementitious material (such as cement kiln dust, lime kiln dust or FBC ash). FGD sludge is also known as scrubber sludge, scrubber material, FGD solids, filter cake or centrifuge cake. The designed mixture is produced in a mixing facility that is sometimes referred to as a Sludge Treatment Plant (STP), transported by a belt conveyor to an area where it is stockpiled for a number of hours or days to undergo an initial chemical set. The stockpiled material is then excavated, loaded onto trucks or other earthmoving equipment for placement as a fill in beneficial use applications or for placement in a Landfill for

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storage or disposal where it undergoes a further chemical set. After placement, the fixated material forms a stable, monolithic mass of low permeability.

**fixated scrubber sludge**, - another name for fixated FGD material.

**lime spray dryer ash** - the residue from a spray dryer FGD system. The resulting byproduct is dried by the heat of the flue gas and it is collected in a particulate control device with the fly ash. (*See dry FGD material*)

**lime spray dryer residue** - another name for lime spray dryer ash.

**wet FGD material** - the byproduct of wet FGD processes or systems. It is composed primarily of water, calcium sulfite/sulfate solids and small quantities of fly ash. It has the consistency of a sludge when allowed to settle in a pond or when the water is removed by filtering equipment such as vacuum filters. It is commonly referred to as scrubber sludge. Depending on the composition of the injected lime or limestone, some byproducts will also contain magnesium sulfite and/ or sulfate and possibly traces of barium sulfite or boron in sulfate addition to some trace metals.

**scrubber sludge** - another name for wet FGD material. (*See wet FGD material*)

**stabilized FGD material** - another name for fixated FGD material. (*See fixated FGD material*)

**fixated FGD material pad area** - the engineered area that receives the fixated FGD material from the processing facility (Sludge Treatment Plant) where the filter cake is mixed with fly ash and lime or other material, via a belt conveyor and radial stacker. The material is stockpiled on this pad and allowed to cure (hours or days). The cured material is then excavated, loaded onto trucks or other transportation equipment for beneficial use or disposal.

**fluidized-bed combustion (FBC) boiler** - a type of coal boiler which accomplishes coal combustion by mixing the coal with a sorbent such as limestone or other bed material. The fuel and bed material mixture is fluidized during the combustion process to allow complete combustion and removal of sulfur gases. Atmospheric FBC (AFBC) systems may be bubbling (BFBC) or circulating (CFBC). Pressurized FBC (PFBC) is an emerging coal combustion technology.

**fluidized bed combustion (FBC) ash** – the fly ash and bed ash produced by an FBC boiler. FBC fly ash is collected in the flue of an FBC boiler using a baghouse filter or electrostatic precipitator. FBC bed ash is the residue that is removed from the bottom of the FBC boiler. Some FBC fly ashes exhibit self-hardening properties in the presence of moisture.

**fluidized-bed combustion (FBC) bed ash** – the spent bed material that is produced by an FBC boiler. The bed ash is usually collected separately and can be considered as being equivalent to bottom ash in dry bottom or wet-bottom wall-fired furnace.

**fluidized bed combustion (FBC) materials** - the unburned coal, ash, and spent bed material produced by an FBC boiler. The bed ash is usually collected separately and can be considered as being equivalent to bottom ash in dry bottom or wet-bottom wall-fired furnace.

**fluidized-bed combustion (FBC) products** - the unburned coal, ash, spent bed material, and unreacted sorbent produced by an FBC boiler.

**fluidizing** - the causing of a mass of finely divided solid particles to assume some of the properties of a fluid, as aeration. (Example: the fly ash in a silo is usually fluidized to facilitate its flow and allow for the loadout of the ash from the silo.)

**fly ash** - coal ash that exits a combustion chamber in the flue gas and is captured by air pollution control equipment such as Electrostatic Precipitators, Baghouses, and wet scrubbers. Fly ash is typically a pozzolan. Some fly ashes also exhibit self-hardening properties in the presence of moisture. (*See coal fly ash*)

**fly ash–high lime** - fly ash resulting from the combustion of sub-bituminous and some lignite coal that contains a significantly higher percentage of calcium compounds than the fly ash resulting from the combustion of bituminous coal; its chemistry would make it fall under, but may not conform with, the ASTM C 618 classification of a Class C fly ash; it may contain in excess of 20% CaO.

**fly ash–low lime** – fly ash resulting from the combustion of anthracite or bituminous coal and it is relatively low in lime (less than 2%); its chemistry would make it fall under, but may not conform with, the ASTM C 618 classification of a Class F fly ash. This fly ash does have pozzolanic characteristics.

**fly ash-lime content** – the total calcium content of fly ash including reactive and non-reactive calcium species expressed as calcium oxide (CaO).

**forced oxidation** - a process employed to supply additional air in wet FGD systems, resulting in the production of gypsum.

**fossil fuel combustion wastes (FFCWs)** - a collective term utilized by the EPA for materials or residues produced from the combustion of coal or the cleaning of stack gasses. (*See coal combustion wastes (CCWs), coal combustion byproducts (CCBs)*)

**free lime**, reactive lime and hydroxide species available to react with a pozzolan to form a cementitious product, usually expressed as a percentage by total weight of the product.

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**friable** - easily crumbled or pulverized. (Example: some coal bottom ashes are reported to be friable)

**fuel switching** - a pre-combustion process whereby a low-sulfur coal is used in place of a higher sulfur coal in a power plant to reduce sulfur dioxide emissions.

**fugitive emissions** - emissions other than those from stacks or vents. (Example: dust emissions from unpaved roads, from the surfaces of landfills, etc.)

**gasification** - the conversion of coal to a combustible gas, volatiles, char, and ash/slag; any of various processes by which coal is turned into low, medium, or high Btu gases. Byproducts from gasification systems vary widely. Gasification is a clean coal technology.

**grab sample** - a single sample of material or liquid taken at neither set time nor rate.

**ground granulated blast furnace slag (GGBFS)** - the granular material formed when molten iron blast furnace slag is rapidly chilled (quenched) by immersion in water. It is a granular product with very limited crystal formation, is highly cementitious in nature and, ground to cement fineness, hydrates like Portland cement. GGBFS use as a mineral admixture in concrete and water is covered by ASTM C 989-82 and AASHTO M302.

**Portland blast furnace slag cement** - the blended cement that is made by intergrinding blast furnace slag with cement clinker.

**ground water** - that part of the subsurface water that is in the saturated zone; water directly below the earth's surface that is in the saturation zone.

**grout** - a mixture of cementitious material and water, with or without aggregate, sometimes incorporating CCPs, proportioned to produce a pourable consistency without segregation of the constituents. It is used for filling voids and spaces. Grouts can be considered as a controlled low strength material (CLSM) as defined by ACI 229 R when the compressive strength is less than 1200 psi. Grouts are referred to by various names depending on the mix design and constituents of the mixture that includes but is not limited to high strength grout, fluid grout, stiff grout, production grout, barrier grout, sand grout, FGD grout, ash grout, low strength grout etc. Mix designs are formulated to meet specific design considerations and are referred to by various names.

**gypsum** - name for calcium sulfate dihydrate ( $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ ); the common name for the mineral consisting primarily of fully hydrated calcium sulfate,  $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$  or calcium sulfate dihydrate. Gypsum occurs naturally in many areas, and is produced by some wet Flue Gas Desulfurization (FGD) processes. (*See FGD gypsum and Synthetic gypsum*)

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**gypsum stacking** - the method used in the phosphate fertilizer industry and applied to the power industry for stacking the wet FGD byproduct (material) that is predominantly calcium sulfate (gypsum). It involves placement of the FGD byproduct slurry in an impoundment and stacking of the reclaimed settled solid in two operations. The primary operation accepts the FGD byproduct slurry directly from the scrubber in a diked or bermed ponding area (settling ponds). These settling ponds provide for primary settling of the FGD solids. The effluent from the ponds are decanted from the pond and either recycled back to the scrubber operation or sent to treatment and discharge. The solids that are settled in the primary/ponding operation are periodically excavated and placed into piles or stacks typically adjoining the ponds to minimize the distance for transporting the dewatered material. Draining/excavating and stacking/drying operations alternate between diked areas to enable continuous storage and excavated material is used to raise dikes and to increase the site capacity.

**heat of hydration** - heat evolved by chemical reactions with water such as that evolved during the setting and hardening of Portland cement, Class C fly ash, dry FGD material, quicklime with or without pozzolans.

**high volume waste** - a regulatory term for fly ash, bottom ash, boiler slag and flue gas desulfurization wastes.

**highwall** – the unexcavated face of exposed overburden and coal in a surface mine or in a face or bank on the uphill side of a contour mine excavation.

**hygroscopic** - the term describing a compound that can absorb water vapor from the atmosphere, for example some high lime fly ashes when stored in buildings will absorb moisture in the air.

**impoundment** - the restraint of a flowable material such as a slurry or sludge behind a structural barrier, such as a dam, dike etc. (*See ash pond*)

**in situ** - a Latin term meaning in place.

**landfill** - a disposal facility where waste is placed in or on land; a facility where “dry” (actually moistened) coal combustion or flue gas cleaning byproducts (CCBs) are placed for disposal in or on land. CCBs are transported to this facility directly from the coal-fired plant after they are produced or after they are dredged from storage impoundments that are used as interim facilities. The disposed CCBs remain in the landfill after closure. Also these CCBs are dry (moistened) and have the consistency of soil. As a result dikes are not required to provide stability. Most large landfills are divided into sections or cells and the CCBs are placed in layers that are referred to as lifts that can vary in thickness. Typically captive CCBs landfills are designed and permitted to receive only CCBs and are classified as mono-fills.

**leachate** - the liquid including any suspended components in the liquid that has percolated through or drained from a pile or cell of solid materials; the liquid stream which issues

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from a pile (stockpile of ash, coal, etc) or cell of solid materials (an ash landfill) and which contains water, dissolved solid and decomposition products of the solids. Leachate may enter the groundwater and contaminate drinking water supplies.

**leaching** - the operation, natural or designed, of producing leachate.

**lift** - the construction/earth moving industry term for placing or spreading soil and other materials in layers in a fill; the depth of soil and other materials placed in an embankment or fill that can be compacted to the specified density with the available equipment.

**light weight aggregate** – (*See aggregate*)

**lime** - calcium oxide (CaO); also loosely, a general term for the various chemical and physical forms of quicklime, hydrated lime and hydraulic hydrated lime.

**liner** - a structure of natural and/or manufactured products that serve as a barriers to minimize leachate from reaching or mixing with the groundwater.

**Loss on Ignition (LOI)** - the weight change of a material when it is heated under prescribed conditions; a measurement of unburned carbon (coal) remaining in fly ash and is perhaps the single most critical characteristic of fly ash when used in concrete. Higher carbon contents can result in significant air-entrainment problems and can adversely affect the performance of concrete incorporating the ash. The carbon level found in coal combustion products (primarily fly ash) is determined in accordance with ASTM D 3178, Instrumental Method.

**Low NO<sub>x</sub> Burners (LNB)** - a combustion technology for reducing the emissions of nitrogen oxides (NO and NO<sub>2</sub>, collectively referred to as NO<sub>x</sub>) from coal fired power plants. The principle of LNB involves decreasing the amount of air introduced into the primary combustion zone, thereby creating a fuel-rich, reducing environment and lowering the temperature both of which suppress NO<sub>x</sub> formation. The remaining air required for complete burnout of combustibles is added after the primary combustion zone, where the temperature is sufficiently low so that additional NO<sub>x</sub> formation is minimized.

**manufactured aggregates from CCPs** - a commercial product made by the intentional size-enlargement and hardening of fine-particulate coal combustion products (CCP) for use as a substitute for crushed stone, sand and gravel, and lightweight aggregate in the construction materials industry. The commercial products that use CCPs all have trade names.

**microspheres** - micrometer-sized fly ash particles that are formed from the fly ash when it is in the molten state. In this state, a spherical shape is formed because it minimizes surface tension. These ash particles have diameters near or less than about 5µm. Although they may contain gas bubbles, in which case they would be considered cenospheres, it is usually the case that microspheres are solid in form. Their bulk densities approach or are

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equal to that of the pure compounds. Microspheres are recovered from fly ash by air classification and other techniques. Microspheres have a high intrinsic value and have many known applications. (*See cenospheres*)

**milligrams per liter (mg/l)** - essentially the same as parts per million when applied to water solutions whose specific gravity is 1.

**mill rejects** - the waste product from a pulverizer mill, which consists of coal, rocks and pyrites. The mill rejects are sometimes combined with the bottom ash. (*See pyrites*)

**mine subsidence** – the downward displacement of the natural land surface in response to the removal of underlying supporting material by mining.

**mono-fill** - a landfill that is composed of a single material. (Example: a fixated FGD material landfill or an ash landfill)

**national pollutant discharge elimination system (NPDES)** - the national program for issuing, modifying, revoking, and reissuing, terminating, monitoring and enforcing permits, and imposing and enforcing pretreatment requirements, under the Clean Air Act.

**naturally occurring radioactive (NORM)** - the trace quantities of naturally occurring radionuclides  $^{238}\text{U}$ ,  $^{232}\text{Th}$  and  $^{40}\text{K}$  as well as their associated decay chain products that are emitted from coal and as a result its ash. The US EPA considers coal ash to be a diffuse naturally occurring radioactive material – its most benign classification. The US Geological Survey (USGS) fact sheet FS – 163-97 states that “the vast majority of coal and the majority of fly ash are not significantly enriched in radioactive elements or in associated radioactivity, compared with common soils or rocks”.

**new source performance standards (NSPS)** - uniform national US EPA air emission and water effluent standards which limit the amount of pollution allowed from new sources or from modified existing sources.

**non-point sources** - diffuse pollution sources (i.e., without a single point of origin or not introduced into a receiving stream from a specific outlet). The pollutants are generally carried off the land by storm water. Common non-point sources are agriculture, forestry, urban, mining, construction, dams, channels, land disposal, saltwater intrusion, and city streets.

**non-self-cementing fly ash** - a coal combustion product resulting from the combustion of anthracite or bituminous coal and some lignite coal in a boiler for the production of electricity or steam. This fly ash does have pozzolanic characteristics; it is usually relatively low in lime (less than 2%); its chemistry would make it fall under the ASTM C 618 classification of a Class F fly ash; generally it will not harden or gain strength over time following contact with water.

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**off-gases** - vapors and gases (including air) given off during a process. (Example: ammonia gas that is given off when ammoniated fly ash is mixed with cement and water)

**organic** - chemical compounds which contain carbon and hydrogen; chemicals associated with living entities.

**outfall** - the point at which a sewer, ash impoundment or drainage channel discharges to a river or other body of work. Also, the narrow part of a stream, lake, or other body of water where it drops away into a larger body.

**particle size** - this term refers in this context to the composition of the solid particles of the products from coal combustion or flue gas cleaning. The smaller the particle, the greater will be the exposed surface area of a given volume.

**particulate matter** - the solid and liquid matter of organic or inorganic composition that is suspended as the result of stack or fugitive emissions. The matter may be individual elements and/or compounds and may or may not be emitted along with gaseous contaminants.

**parts per billion (PPB)** -  $1 \times 10^{-9}$  a proportion by weight measurement equivalent to one unit weight of analyte per billion unit weights of matrix. In water treatment terminology, one pound per one billion pounds of water.

**parts per million (PPM)**, -  $1 \times 10^{-6}$  - a proportion by weight measurement equivalent to one unit weight of analyte per million unit weights of matrix. In water treatment terminology, one pound per one million pounds of water or one milligram per liter of water.

**permissible exposure limit (PEL)** - the workplace exposure limit established by Occupational Safety and Health Administration (OSHA) for each of 600 industrial chemicals.

**permits** - the official approval of and permission to proceed with an activity controlled by the permitting authority. Permits may be required from several government agencies for landfills and surface impoundments at coal fired power plants.

**permit to install (PTI)** - a permit that is issued by some states regarding the construction of CCBs storage and disposal or waster water facilities.

**petrographic analysis** - the determination of the structural, mineralogical and chemical character of coal, ash or slag.

**petrology** - the branch of geology that deals with rocks, in particular their formation and chemical and physical structure.

**petroleum coke (pet-coke)** - the solid carbonaceous residues remaining in oil refining stills after the distillation process and sometimes used in combination with coal at some coal fired power plants. The fly ash from pet-coke/sub-bituminous coal blends where the percentage of pet-coke in the blend was less than 3 per cent by weight have been marketed for use in fly ash concrete. The carbon in the fly ash from the blend consisted primarily of unburned pet-coke.

**pH** - the logarithm of the reciprocal of the hydrogen ion activity in aqueous solutions. A measure of the strength or intensity of a water's acidity or alkalinity. Water with a pH of 7.0 is neutral. A pH less than 7.0 indicates an acidic water, while a pH greater than 7.0 indicates an alkaline water.

**pneumatic conveying** - the transportation of a powdered material which would include ash, through a conduit by air.

**point source** - a stationary location or fixed facility from which pollutants are discharged; any single identifiable source of pollution. (Example: a pipe from an ash pond)

**ponded ash** – ash that is in an ash pond or that has been excavated from an ash pond . The ash pond is usually prepared to facilitate excavation of the ash by removing the surface water and lowering the water table within the pond. The ash, if it is predominantly fly ash still retains moisture in excess of 30% unless construction practices of removing the ash in layers, and stockpiling the ash are followed. The ponded ash tends to be segregated by particle size in the pond with the coarser ash particles being located in the environs of the discharge of the ash transport pipeline(s) and the finer ash particles being located in the environs of the outfall from the pond. Also the ponded ash may contain other materials that are transported to the ash pond as a part of the wastewater sedimentation process for the particular coal fired power plant. The other materials could include coal fines from the coal pile runoff control system, solids from the cooling tower blowdown and wastewater collection systems.

**ponded bottom ash** - bottom ash that has been excavated from an ash pond.

**ponded fly ash** - fly ash that has been excavated from an ash pond.

**pozzolan** – primarily siliceous or siliceous and aluminous materials that will in finely divided form and in the presence of moisture, chemically react with calcium oxide at ordinary temperatures to form compounds possessing cementitious properties

**pozzolanic activity** - the phenomenon of strength development that occurs when lime and certain aluminosilicates react at ambient temperatures in the presence of water.

**pozzolanic-activity index** - an index that measures pozzolanic activity based on the strength of cementitious mixtures containing hydraulic cement with and without the pozzolan, or containing the pozzolan with lime.

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**processed ash** - ash that has been put through a cleaning, sieving or other commercial manufacturing process to make the ash meet specifications for a particular beneficial use or to make a proprietary product that is marketed for niche or other applications. (Example: the fly ash produced from the commercial processes of removing carbon from fly ash in order to make it conform to ASTM C618)

**product** - any object possessing intrinsic value, capable of delivery either as an assembled whole or as a component part or parts and produced for introduction into trade or commerce.

**pugmill** - a mixer having a stationary cylindrical mixing compartment, with the axis of the cylinder horizontal, and one or more rotating horizontal shafts to which mixing blades or paddles are attached. Pugmill type equipment is used at coal-fired power plants for mixing fly ash and water, FGD cake/lime/fly ash or other to facilitate the handling of the CCBs without creating fugitive dusting and/or providing for stabilizing of FGD material in particular.

**pulverized coal (PC) combustion** - refers to any combustion process that uses very finely ground (pulverized) coal in the process. Pulverized coal combustion processes usually result in the production of bottom and fly ashes.

**pulverized fuel ash (PFA)** - another name for fly ash and used primarily in the United Kingdom.

**pulverizer** - a machine which reduces a solid fuel such as coal to a fineness suitable for burning in suspension.

**pyrite** - a common mineral that consists of iron disulfide with a pale brass-yellow color and metallic luster which is usually rejected by coal pulverizers at the coal fired power plant and discarded. The present usage in the electric generation industry is that it is the waste product from a pulverizer mill, which consists of coal, rocks and pyrites.

**pyrite (Cont'd)** - This mixture is now commonly referred to as "mill rejects". Generally there is a separate pyrites (mill rejects) collection and transport system. In some of the newer vintage power plants the pyrites are conveyed to a dedicated collection tank/dewatering bin or pond from where it is removed for final disposal or reuse. In many power plants the practice is to convey the pyrites to the bottom ash collection tank from where it is conveyed as a part of the bottom ash handling system to either a bottom ash-dewatering bin or to a pond for temporary storage. The bottom ash pyrites mixture is removed on a frequent basis (daily or less than a week) for the dewatering bin system and on an infrequent basis (monthly or yearly) for the pond. The levels of pyrites in the bottom ash or boiler slag can affect reuse because of the staining that occurs due to iron pyrites or because of the low pH in the leachate.

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**ready-mixed concrete** - concrete manufactured for delivery to a purchaser in a plastic and unhardened state. The use of fly ash in ready-mixed concrete is one of the largest markets for fly ash in the United States.

**reagent** - a substance used, because of its chemical activity, typically to reduce emissions or improve opacity from coal fired power plants. Examples of reagents include lime and limestone used for wet scrubbing of the combustion flue gas to remove sulfur dioxide. Also it is a term applied to the substances used in solidification or stabilization of wastes. These materials may include liquids or solids such as sodium silicate, cement, fly ash, etc.

**reclamation** – actions taken to restore mined land to a post mining land use approved by the regulatory authority.

**reuse** - the utilization of a coal combustion product as is or slightly refurbished by a different company from the generator of the CCPs.

**rim ditching** - a method for stacking gypsum that uses a combination of ditches and berms to make the gypsum slurry flow along an elevated ditch around an inside perimeter dike of a surface impoundment. Coarse particles settle in the ditch around the rim and finer particles are directed to the center of the impoundment. As the coarse materials settle in the rim ditch it is excavated from the ditch and continually used to construct the rim berm. After the rim berm is constructed the rim ditch is dammed to allow the ditch to fill with material. The operation then moves to the center of the impoundment to develop another rim ditch and berm. The process continues, as the material is stacked higher and closer to the center of the impoundment.

**run-off** - water which, having fallen on a landfill (or other) surface, flows across the surface, picking up materials and will, if not collected, continue into a watercourse. Also any rainwater, leachate or other liquid that drains over land from any part of a facility

**sample, composite** - a sample that is constructed by combining equal portions of grab or regular samples.

**sample, grab** - a single sample of a material or liquid (coal combustion product, coal combustion byproduct, coal combustion waste) taken at neither set time nor rate. (Example: a grab sample is taken in a single operation from a conveyor delivering fly ash to bulk storage)

**sample, regular** - a sample that is constructed by combining equal portions of grab samples that were taken at predetermined times or locations from any single lot.

**scrubber** – (*See flue gas desulfurization*)

**scrubber cake** - another name for scrubber sludge. (*See flue gas desulfurization*)

**scrubber material** - another name for scrubber sludge. (*See flue gas desulfurization*)

**scrubber sludge** - another name for FGD material. (*See flue gas desulfurization*)

**sedimentation** - gravitational settling of solid particles in a liquid system. This is a widely used method in wet ash or flue gas cleaning material handling and disposal.

**selective catalytic reduction (SCR)** - a post combustion technology for control of nitrogen oxides ( $\text{NO}_x$ ) emissions from coal fired boilers, gas fired industrial and utility boilers and combustion turbines. The SCR process consists of injecting ammonia ( $\text{NH}_3$ ) into boiler flue gas and passing the flue gas through a catalyst bed where the  $\text{NO}_x$  and  $\text{NH}_3$  react to form nitrogen and water vapor. Unreacted ammonia will pass through the SCR reactor with the flue gases with most of it being deposited on the fly ash in the electrostatic precipitators. The levels of ammonia in the fly ash have an effect on ash quality, especially its use as a pozzolan.

**selective non catalytic reduction (SNCR)** - a post combustion technology for control of nitrogen oxides ( $\text{NO}_x$ ) emissions from coal fired boilers, gas fired industrial and utility boilers. The process consists of the injection of ammonia ( $\text{NH}_3$ ) or Urea in an optimal temperature window ( $850^{\circ}\text{C}$  to  $1,100^{\circ}\text{C}$ ) to produce a non-catalytic reaction between  $\text{NH}_2$  radicals and  $\text{NO}_x$ . Ammonium bisulfate precipitation on the fly ash occurs with this process and this can have an effect on disposal and beneficial use of the fly ash.

**self-cementing coal fly ash** - fly ash resulting from the combustion of lignite or sub-bituminous coal in a boiler for the production of electricity or steam. Such fly ash in addition to having pozzolanic characteristics hardens and gains strength over time following contact with water. Self-cementing fly ash as described here does not include fly ash from fluidized bed combustion boilers, nor fly ash from boilers that inject lime or other sorbents (either wet or dry), nor does it include fly ash collected with a flue gas desulfurization material. (*See cementitious ash*)

**silo** - a storage vessel, generally tall relative to its cross section, for dry solids such as fly ash, FBC ash, etc. The dry solids are fed into the top of silo and withdrawn from the bottom through a controlled mechanism. Silos are extensively used in dry fly ash removal/storage systems. They may be flat bottomed or cone bottomed and may be made of concrete or steel.

**silo aeration and unloading equipment** - the collective term for the equipment used especially in flat bottomed fly ash silos for fluidizing the fly ash to facilitate flow and for removing the fly ash from the silo in either a conditioned or dry state.

**slag** - the nonmetallic product resulting from the interaction of flux and impurities in the smelting and refining of metals. Also the molten or fused ash in the furnace of a coal fired power plant. (*See boiler slag*)

**sludge** - any solid or semisolid or liquid waste generated from a municipal, commercial, or industrial wastewater treatment plant, water supply treatment plant or air pollution

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control facility (wet scrubbers) or any other such waste having similar characteristics and effect.

**slurry** - a mixture of water and any finely divided insoluble material (fly ash, slaked lime, etc) in suspension.

**soil cover** - the clean earth fill, or combination of earth and other materials capable of supporting vegetation that is used to cover the surface of a completed landfill, surface impoundment or other waste management facility.

**soil modification** - a change to the physical or chemical characteristics of soils; any change to in situ soils that results in immediate effects that can expedite construction operations. These changes can be measured in terms of moisture reduction, improved California Bearing Ratio (CBR) and/or decrease in plasticity. CCPs are used to modify soils in applications such as surface mine land reclamation, soil stabilization and base stabilization.

**solidification** - the conversion of, liquids, slurries or sludges into a material that can be more easily handled or compacted for disposal or use; a process for converting a liquid waste to a solidified material. Also a process in which materials are added to the waste to produce a solid. In the Solidification/Stabilization Industry this process is usually monitored for completion by applying the “paint filter test” and engineering tests such as unconfined compressive strengths; fly ash is often used as a reagent or filler.

**sorbent** - the term applied in some combustion systems, to the chemical compounds that are added to the gas side of the steam generator to reduce (sorb) emissions. (Example: Limestone is used in fluidized-bed steam generators to reduce sulfur dioxide emissions.)

**spoil** - material overlying a coal seam that is removed during a surface coal mining operation.

**stabilization** - a process for treating a waste to minimize an undesirable attribute of that waste. In the Stabilization/Solidification Industry, typically the stabilization process is monitored for completion by applying leachate testing; “Stabilization” of biological wastes may infer the elimination of pathogens (or their minimization); fly ash is used as a reagent or filler. In the power generation industry, typically the terminology is applied to the treating of solids from wet scrubbing or other air pollution control processes.

**soil stabilization** - a permanent change to in-situ soils which improves their physical characteristics. Soil stabilization allows the soil layer to be assigned a structural support value as an integral part of a pavement structure. CCPs are used as reagents in soil stabilization.

**stabilized CCPs** - CCPs that are blended with a cementitious binder to induce or enhance a pozzolanic reaction. (Example: wet FGD material mixed with fly ash and lime). See fixated CCPs

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**stoker boiler** - a type of coal fired boiler in which the combustion of coal takes place on a grate, which may be stationary or moving.

**structural fill** - an engineered fill with a projected beneficial end use that is typically constructed in layers of uniform thickness and compacted to a desired unit weight in a manner to control the compressibility, strength, and hydraulic conductivity.

**subsidence** - the downward displacement of the overburden (rock or soil or both) lying above an underground excavation or adjoining a surface excavation. The sinking of the earth's crust. The lowering of the natural land surface in response to: earth movements; lowering of fluid pressure; removal of underlying supporting material by mining; or added load on the land surface. CCPs are used in a grout or flowable fill to reduce subsidence.

**subtitle C** - the portion of RCRA that regulates hazardous waste management facilities and units.

**subtitle D** - the portion of RCRA that regulates non-hazardous waste management facilities and units.

**sulfate attack** - either a chemical or physical reaction or both between sulfates usually in soil or ground water, and concrete and mortar; the chemical reaction is primarily with calcium aluminate hydrates in the cement – paste matrix, often causing a deterioration.

**sulfate resistance** - ability of concrete or mortar to withstand sulfate attack. Fly ash concrete helps to reduce sulfate attack. (*See alkali-silicate reaction (ASR)*)

**sulfur** - one of the elements present in varying quantities in coal that contributes to environmental degradation when coal is burned. EIA classifies coal, in terms of pounds of sulfur per million Btu as low (less than or equal to 0.60 pounds of sulfur), medium (between 0.61 and 1.67 pounds of sulfur), and high (greater than or equal to 1.68 pounds of sulfur). When coal is sampled, sulfur content is measured as a percent by weight of coal on an “as received” or “dry” (moisture-free) basis. Sulfur occurs in coal in three forms: (1) iron sulfides (pyrite and marcasite), (2) secondary sulfates (gypsum and hydrous ferrous sulfate), and (3) organic sulfur chemically bonded to the coal forming plant material.

**surface impoundment** - a facility or part of a facility which is a natural topographic depression, man-made excavation, or diked area formed primarily of earthen materials (although it may be lined with man-made materials) which is designed to hold an accumulation of liquid wastes or materials containing free liquids and which is not an injection well; a type of waste management facility consisting of an excavated, a dammed or diked reservoir in which coal combustion and flue gas cleaning wastes are disposed of as a slurry or sludge. (*See ash pond*)

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**surface mine** - a coal mine that is usually within a few hundred feet of the surface. Earth and rock above or around the coal (overburden) is removed to expose the coalbed, which is then mined with surface excavation equipment such as draglines, power shovels, bulldozers, loaders, and augers. Surface mines include: area, contour, open-pit, strip, or auger mine.

**surfactant** - a material added to a liquid usually water to reduce its surface tension enabling it to wet a solid surface effectively rather than running off the surface in droplets; a substance that affects markedly the interfacial or surface tension of solutions even when present in very low concentrations. Surfactants are added at some installations, to the water in the fly ash loadout process from a silo to wet the conditioned fly ash more effectively.

**supernatant** - the liquid remaining above a layer of settleable solids after the solids collect at the bottom of a pond or vessel. (Example: the clear water at the outlet area/water discharge structure of an ash pond.)

**suspended solids** - solids that either float on the surface of or are in suspension in water, wastewater or other liquids and which are largely removed by laboratory filtering. Also the quantity of material removed from wastewater in a laboratory test as prescribed in "Standard Methods for the Examination of Water and Wastewater" and referred to as nonfilterable residue.

**suspended solids, total (TSS)** - the sum of all insoluble particles suspended in a water.

**synthetic gypsum** - a precipitated gypsum formed through the neutralization of sulfuric acid in an industrial process. (Examples are Phosphorus (phospho) gypsum from phosphoric acid production, titano gypsum from titanium oxide production, citro gypsum for citric acid production, flue gas desulfurization (FGD) Gypsum from flue gas cleaning of utility boilers.) In North America there are large quantities of synthetic gypsum such as phospho-gypsum that are being produced and stockpiled and not being used. The exception is FGD Gypsum where large volumes are being generated and utilized in wallboard manufacturing, cement production and plasters. (*See gypsum and FGD gypsum*)

**thickener** - a vessel or apparatus for reducing the proportion of water in a slurry. Thickeners are used in Wet FGD Systems.

**thickener underflow** - the settled solids that are extracted from the bottom of a thickener as a slurry and measured in percentage solids by weight. The thickener underflow in a wet FGD process is either conveyed for dewatering to equipment such as vacuum filters or to a pond.

**thixotropic** - the property of a material that enables it to stiffen in a relatively short time on standing, but upon agitation or manipulation to change to a very soft consistency or to a

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fluid of high viscosity, the process being completely reversible. Some CCPs are thixotropic.

**top ash** - another name for fly ash. (*See fly ash*)

**toxic** - term describing a harmful effect by a substance as the result of physical contact, ingestion, or inhalation.

**toxicity characteristic leaching procedure (TCLP)** - a laboratory procedure that is designed to simulate leaching under actual disposal conditions. The concentrations in the effluent produced by this test are compared to a list of 14 toxic metals and 25 organic constituents and their respective maximum containment levels (MCLs), as measured against primary drinking water standards (PDWS) established by the Safe Drinking Water Act. Effluent at concentrations equal to or greater than the given limit are classified as toxic.

**toxic release inventory (TRI)** - collection of annual reports on chemical releases that regulated companies must file under the Superfund Amendments and Reauthorization Act (SARA), Title 111.

**trace element** - an element present in extremely small quantities. Metals are the predominant, naturally occurring trace elements in coal; they are also in its ash. Most of the trace elements in FGD sludge/cake originate from the small amounts of coal ash that elude the particulate collection device.

**treatment** - any method, technique, or process designed to change the physical or chemical or biological character of a waste to neutralize the waste, render it less hazardous, make it safer to transport or manage, or reduce its volume.

**triboelectric separation process** - an electrostatic technology with patented processes to remove carbon from high Loss on Ignition (LOI) fly ash and to produce a concrete grade fly ash.

**unburned carbon (UBC) in fly ash** - the unburned carbon in fly ash includes both carbon carried over as uncombusted “inertinite” and chars or cokes resulting from the incomplete combustion of thermoplastic, largely vitrinite-derived phases. The latter include “isotropic coke” and “anisotropic coke.”; a measure of the actual amount of carbon found in coal fly ash or other coal combustion products determined by a mineral analysis of the material. UBC levels can affect the beneficial use of fly ash. (*See loss on ignition*)

**waste** - material that has no identifiable future use for which suitable disposal must be found. Wastes would include: inorganic solutions/solids/sludges, organic wastes, sewage sludge, animal wastes, waste contaminated soils, wastewater treatment sludge, complex mixtures, sludges from air pollution control facilities. CCPs are used in the stabilization/solidification of wastes.

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**wet ash removal systems** - the overall system of mixing the ash and water, and transporting the ash via a slurry tank(s), pump(s) and pipeline(s) to a pond, surface impoundment or dewatering bin/tank (for bottom ash only).

**wet ash disposal system** - the overall coal ash transport and storage systems that involve the conveying of the ash in a fluid (slurry) state by pipeline to a surface impoundment or a holding pond for future excavation.

**wet bottom furnaces** - a pulverized fuel fired furnace in which the ash particles are deposited and retained on the floor thereof and molten ash is removed by tapping either continuously or intermittently.

**wet disposal systems** - the overall coal combustion and/or flue gas cleaning byproducts (CCBs) transport and storage systems that involve the conveying of the CCBs in a fluid (slurry) state by pipeline to a surface impoundment.

**wet fly ash disposal system** - the overall fly ash transport and storage systems that involve the conveying of the fly ash in a fluid (slurry) state by pipeline to a surface impoundment.

**wet scrubbers** - equipment that is used to remove ash from the combustion flue gas of coal-fired power plants, where fuels are burned in suspension, by collecting it with a suitable liquid. Also equipment used to remove sulfur oxides from the combustion flue gas of fossil-fueled power plants in a gas-liquid contactor using lime, or limestone. The use of wet scrubbers for particulate removal results in the collected fly ash being in a slurry form that requires as a general practice, wet disposal of the fly ash and very limited opportunity for beneficial use. (*See FGD*)

**wetland** - those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

**XRD** - x-ray diffraction.