Coal Terminology and Related Information

An electric drill prepares overburden for blasting by boring holes in a prescribed pattern, making it easier to excavate. The spoil pile in the background is overburden removed from another part of the mine.

Coal Terminology and Related Information

Acid Mine Drainage: This refers to water pollution that results when sulfur-bearing minerals associated with coal are exposed to air and water and form sulfuric acid and ferrous sulfate. The ferrous sulfate can further react to form ferric hydroxide, or *yellowboy*, a yellow-orange iron precipitate found in streams and rivers polluted by acid mine drainage.

Acid Rain: Also called *acid precipitation* or *acid deposition*, acid rain is precipitation containing harmful amounts of nitric and sulfuric acids formed primarily by nitrogen oxides and sulfur oxides released into the atmosphere when fossil fuels are burned. It can be wet precipitation (rain, snow, or fog) or dry precipitation (absorbed gaseous and particulate matter, aerosol particles, or dust). Acid rain has a pH below 5.6. Normal rain has a pH of about 5.6, which is slightly acidic. The term pH is a measure of acidity or alkalinity on a range from 0 to 14. Readings below 7, which is neutral, indicate increased acidity; readings above 7 indicate increased alkalinity.

As-Received Coal: Coal in the condition as received by the consumer or the laboratory analyzing the coal.

Bone Coal: Coal with a high ash content (25 to 50 percent, by weight); it is dull in appearance, hard, and compact.

Btu (British thermal unit): A measure of energy, the Btu is the amount of heat needed to raise the temperature of 1 pound of water (approximately 1 pint) by 1 degree Fahrenheit. The Btu is a convenient measure by which to compare the energy content of various fuels. One Btu of energy is approximately equivalent to the heat from one match tip. Heat available from coal, expressed as Btu per pound or ton, is a major factor in coal price.

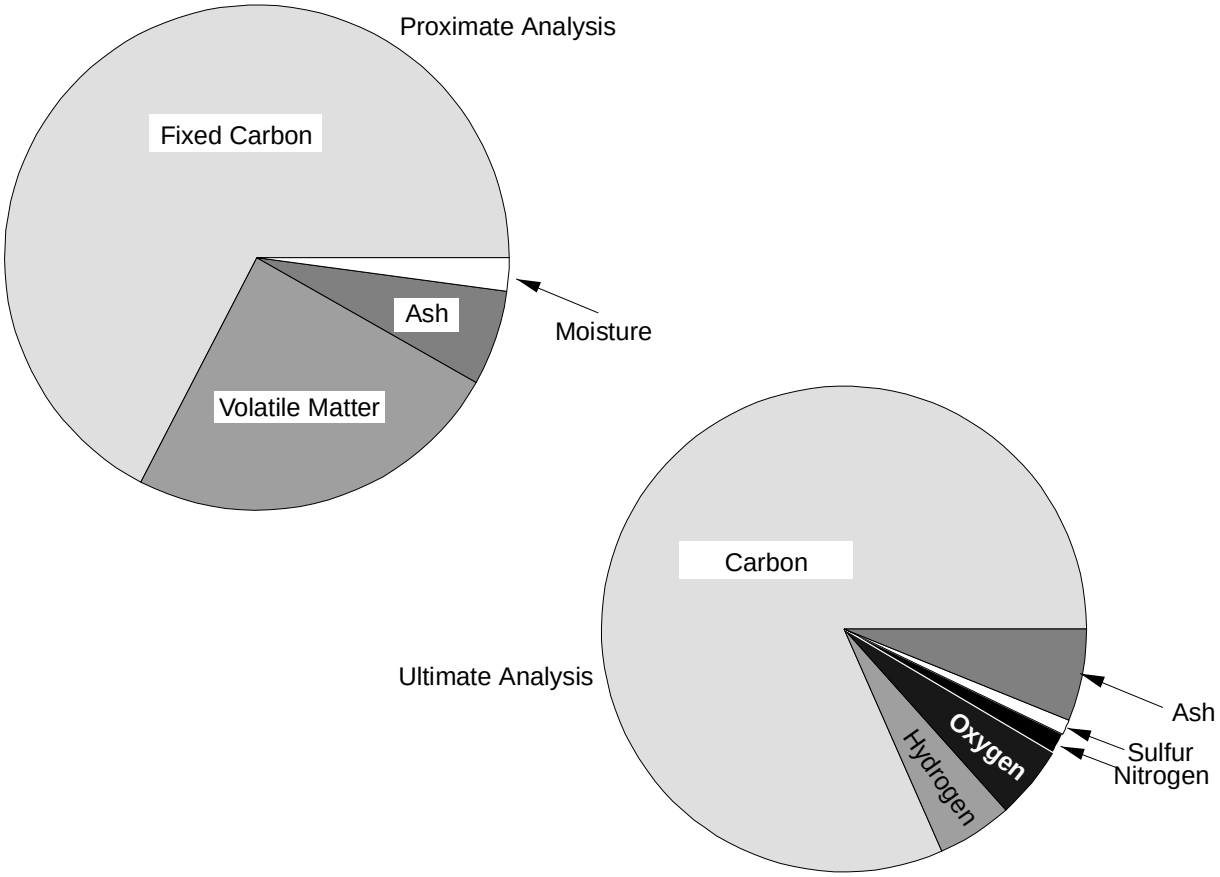
Captive Coal: This refers to coal produced and consumed by the mine operator, a subsidiary, or the parent company (for example, steel companies and electric utilities).

Coal Analysis: This determines the composition and properties of coal so it can be ranked and used most effectively.

Proximate analysis determines the behavior of a coal when burned. It measures (in percent) the moisture content, volatile matter (gases released when coal is heated, principally hydrogen, carbon dioxide, carbon monoxide, and various compounds of carbon and hydrogen), fixed carbon (solid combustible residue remaining after the volatile matter is driven off—principally carbon, but may contain sulfur, hydrogen, nitrogen, and oxygen), and ash (incombustible matter consisting of silica, iron, alumina, and other material similar to ordinary sand, silt, and clay). The moisture content affects the ease with which coal can be handled and burned. Volatile matter and fixed carbon provide guidelines for determining the intensity of the heat produced (volatile matter influences the ignitability and overall combustion of a coal and contributes about 25 to 40 percent of the heat; fixed carbon, 60 to 75 percent). Ash increases the weight of coal, adds to the cost of handling, and can cause fuel bed and furnace problems due to the formation of clinkers (fused ash) and slag (melted ash that sticks to furnace walls). Proximate analysis may be reported in several ways, such as "as received," "dry," and "dry, mineral-matter-free (dmmf)." Proximate analysis is commonly used in industrial applications, such as in the purchase of coal for electricity generation.

Ultimate analysis determines the percentage of carbon, hydrogen, oxygen, nitrogen, sulfur, and ash. It may be reported in several ways, such as "as received," "dry," and "dry, mineral-matter-free (dmmf)." Ultimate analysis is used for a more thorough scientific investigation of coal.

Heating value, or *heat content*, is determined in terms of Btu, both on an as-received basis (including moisture) and on a dry basis. It is the amount of heat released by the complete combustion of a specified quantity of coal (usually 1 pound or 1 short ton) as carbon and hydrogen combine with oxygen in the air to produce carbon dioxide and water. *Higher heating value (HHV), or gross heat content*, includes the amount of energy used to transform the water into steam. *Lower heating value, or net heat content*, excludes the energy used to vaporize the water and is generally calculated to be 93 to 97 percent of the gross heat value. EIA conversion factors typically represent gross heat content.



Two different types of analyses of a bituminous coal.

Agglomerating refers to coal that softens when heated and forms a hard gray coke; this coal is called *caking coal.* Not all caking coals are coking coals. The agglomerating value is used to differentiate between coal ranks and also is a guide to determine how a particular coal reacts in a furnace.

Agglutinating refers to the binding qualities of a coal. The agglutinating value is an indication of how well a coke made from a particular coal will perform in a blast furnace. It is also called a *caking index.*

Other analyses include the determination of the ash-softening temperature, the ash-fusion temperature (the temperature at which the ash forms clinkers or slag), the free-swelling index (a guide to a coal's coking characteristics), the Gray-King assay (determines the suitability of coal for making coke), and the Hardgrove Grindability Index, or HGI (a measure of the ease with which coal can be pulverized as compared with a "standard" coal with a 100 HGI value; the lower the index, the harder to grind and vice-versa). In a *petrographic analysis,* thin sections of coal or highly polished blocks of coal are studied with a microscope to determine the physical composition, both for scientific purposes and for estimating the rank and coking potential.

Coal Blending: The process of combining two or more coals with different characteristics to obtain coal with a certain quality, such as a low sulfur content.

Coal Chemicals: Coal chemicals are obtained from the gases and vapor recovered from the manufacturing of coke. Generally, crude tar, ammonia, crude light oil, and gas are the basic products recovered. They are refined or processed to yield a variety of chemical materials.

Coal Classification: In the United States, coals are classified by rank progressively from lignite (least carbonaceous) to anthracite (most carbonaceous) based on the proximate analyses of various properties (fixed carbon, volatile matter, heating value, and agglomerating character), following methods prescribed by the American Society for Testing and Materials. The International Coal Classification of the Economic Commission for Europe recognizes two broad categories of coal, "brown coal" and "hard coal." In terms of U.S. coal classification, the international classification of brown coal includes lignite and lower-ranked subbituminous coal, whereas hard coal includes all higher rank coals.

Coal Face: This is the exposed area from which coal is extracted.

Coal Fines: Coal with a maximum particle size usually less than one-sixteenth inch and rarely above one-eighth inch.

Coal Grade: This classification refers to coal quality and use. The classification includes the following categories:

Briquettes are made from compressed coal dust, with or without a binding agent such as asphalt.

Cleaned coal or *prepared coal* has been processed to reduce the amount of impurities present and improve the burning characteristics.

Compliance coal is a coal, or a blend of coal, that meets sulfur dioxide emission standards for air quality without the need for flue gas desulfurization.

Culm and silt are waste materials from preparation plants. In the anthracite region, culm consists of coarse rock fragments containing as much as 30 percent small-sized coal. Silt is a mixture of very fine coal particles (approximately 40 percent) and rock dust that has settled out from waste water from the plants. The terms culm and silt are sometimes used interchangeably and are sometimes called refuse. Culm and silt have a heat value ranging from 8 to 17 million Btu per ton.

Low-ash coal contains less than 8 percent ash by weight; *medium-ash coal*, 8 percent to less than 15 percent by weight; *high-ash coal*, more than 15 percent ash by weight.

Low-sulfur coal contains 1 percent or less sulfur by weight. For air quality standards, "low-sulfur coal" contains 0.6 pounds or less sulfur per million Btu (equivalent to 1.2 pounds of sulfur dioxide per million Btu). *Medium-sulfur coal* contains more than 1 percent to less than 3 percent sulfur by weight; 0.61 to 1.67 pounds of sulfur per million Btu. *High-sulfur coal* contains more than 3 percent sulfur by weight; more than 1.67 pounds of sulfur per million Btu.

Metallurgical coal (or coking coal) is a coal that can be converted into coke. It must have a low ash and sulfur content and form a coke that is strong enough to support the weight of iron ore and limestone in a blast furnace. A blend of two or more bituminous coals is usually required to make coke.

Pulverized coal is coal that has been crushed to a fine dust in a grinding mill. It is blown into the combustion zone of a furnace and burns very rapidly and efficiently.

Slack coal usually refers to bituminous coal one-half inch or smaller in size.

Steam coal refers to coal used in boilers to generate steam to produce electricity or for other purposes.

Stoker coal refers to coal that has been crushed to specific sizes (but not powdered) for burning on a grate in automatic firing equipment.

Coal Preparation (Cleaning/Beneficiation/Processing) Processes:
Dense (heavy) medium processes use a thick solution, usually a mixture of magnetite and water, to separate coal from impurities by gravity separation.

Flotation processes treat fine-sized coal with an oil-based reagent that attracts air bubbles in a liquid medium; the coal floats to the surface as a froth, leaving the refuse below.

Hydraulic processes use currents of water to separate coal from impurities.

Pneumatic processes use currents of air to separate coal from impurities.

Coal Rank: This classification is based on the fixed carbon, volatile matter, and heating value. It is an indication of the progressive alteration, or coalification, from lignite to anthracite. Rank can also be determined by measuring the *reflectance of vitrinite*, one of the several organic components (macerals) of coal.

Lignite, the lowest rank of coal, is brownish black and has a high moisture content, sometimes as high as 45

percent. It tends to disintegrate when exposed to weather. The heat content of lignite ranges from 9 to 17 million Btu per ton as received and averages about 14 million Btu per ton. The ignition temperature is approximately 600 degrees Fahrenheit. Lignite is mined in California, Louisiana, Montana, North Dakota, and Texas, and is used mainly to generate electricity in power plants that are relatively close to the mines. The term "lignite" is used interchangeably with "brown coal" in other countries.

Subbituminous coal, or *black lignite,* is dull black and usually contains 20 to 30 percent moisture. The heat content of subbituminous coal ranges from 16 to 24 million Btu per ton as received and averages about 18 million Btu per ton. Subbituminous coal, mined in western coal fields (notably the Powder River Basin), is used mostly for generating electricity.

Bituminous coal, or *soft coal,* is the most common coal. It is dense, black, often with well-defined bands of bright and dull material. Its moisture content usually is less than 20 percent. The heating value ranges from 19 to 30 million Btu per ton as received and averages about 24 million Btu per ton. The ignition temperature ranges from about 700 to almost 900 degrees Fahrenheit. Bituminous coal is mined chiefly in Appalachian and interior coal fields. It is used for generating electricity, making coke, and space heating.

Anthracite, or *hard coal,* is the highest rank of economically usable coal. It is jet black with a high luster. The moisture content generally is less than 15 percent. Anthracite contains approximately 22 to 28 million Btu per ton as received and averages about 25 million Btu per ton. Its ignition temperature is approximately 925 to 970 degrees Fahrenheit. Virtually all of the anthracite mined is from northeastern Pennsylvania. It is used mostly for space heating and generating electricity.

Meta-anthracite, the highest rank of coal, is a low-quality fuel. It is dull gray or black, and has a high ash content. It was intermittently mined in the Narragansett Basin of Rhode Island and Massachusetts. The last mine, at Cranston, Rhode Island, closed in 1959. Coal from the area averaged about 19 million Btu per ton as received.

Coal Sulfur: *Coal sulfur* occurs in three forms: *organic, sulfate,* and *pyritic.* Organic sulfur is an integral part of the coal matrix and cannot be removed by conventional physical separation. Sulfate sulfur is usually negligible. Pyritic sulfur occurs as the minerals pyrite and marcasite; larger sizes generally can be removed by cleaning the coal.

Coal Type: This classification is based on physical characteristics or microscopic constituents. Examples of coal types are *banded coal, boghead coal, bright coal, cannel coal,* and *splint coal.* The term is also used to classify coal according to heat and sulfur content. (See Coal Grade.)

Coalbed Degasification: This refers to the removal of methane, or *coalbed gas,* from a coal mine before or during mining.

Coalbed Methane: Methane is generated during coal formation and is contained in the coal microstructure. Typical recovery entails pumping water out of the coal to allow the gas to escape. Methane is the principal component of natural gas. Coalbed methane can be added to natural gas pipelines without any special treatment.

Coke: Coke is a combustible residue consisting of residual ash and fixed carbon made from bituminous coal (or blends of bituminous coal) from which the volatile constituents are driven off by baking in an oven at temperatures as high as 2,000 degrees Fahrenheit. The process is called *carbonization.* Coke is hard and porous, has a gray, submetallic luster, and is strong enough to support a load of iron ore in a blast furnace. It is used chiefly as a fuel and reducing agent in smelting iron ore in a blast furnace. Coke has a heat value of about 25 million Btu per ton.

Coke Battery: A series of adjacent coke ovens, usually 45 or more, sharing coal charging and byproduct control equipment.

Coke Breeze: The term refers to the fine sizes of crushed coke that will pass through a ½-inch or ¾-inch screen opening. It is commonly used for sintering (agglomerating) iron ore, a process in which fine ore is mixed with coke and ignited to produce semifused lumps of ore.

Coke Button: A button-shaped piece of coke resulting from a standard laboratory test that indicates the coking or free-swelling characteristics of a coal; expressed in numbers and compared with a standard.

Coke Oven: An individual coking chamber made of silica brick walls and ranging from 4 to 14 feet in height, 30 to 45 feet in length, and 1 to 2 feet in width. *Byproduct ovens* contain a series of long, narrow chambers arranged in rows and heated by flues in which are burned a portion of the combustible gases generated by the coking of coal. All the volatile

products are collected as ammonia, tar, and gas, and may be further processed into other byproducts.

Coke-Oven Gas: This by-product of coke production is used as fuel for heating coke ovens, generating steam, and producing heat for other purposes.

Fossil Fuel: Fuel such as coal, crude oil, or natural gas, formed from the fossil remains of organic material.

Foundry Coke: This is a special coke, generally 3 inches and larger in size, that is used in furnaces to produce cast and ductile iron products. It is a source of heat and also helps maintain the required carbon content of the metal product. Foundry coke production requires lower temperatures and longer times than blast furnace coke.

Fuel Ratio: The ratio of fixed carbon to volatile matter in coal.

Gob: This refers to the caved area of broken rock in an underground mine. A *gob pile* is a heap of waste from preparation plants.

Interburden: The material that separates the coalbeds of a surface deposit.

Middlings: In coal preparation, this material, also called *mid-coal*, is neither clean coal nor refuse; due to their intermediate specific gravity, middlings sink only partway in the washing vessels and are removed by auxiliary means.

Open-Market Coal: Coal that is sold on the commercial market, in contrast to captive coal.

Overburden: Any material, consolidated or unconsolidated, that overlies a coal deposit. *Overburden ratio (stripping ratio)* refers to the amount of overburden that must be removed to excavate a given quantity of coal. It is commonly expressed in cubic yards per ton of coal, but is sometimes expressed as a ratio comparing the thickness of the overburden with the thickness of the coalbed. *Spoil* is the overburden removed in gaining access to a coalbed in surface mining. *Swell factor* is the ratio of the increase in volume, normally expressed as a percentage, that occurs in the overburden material when it is excavated and deposited in a loose state.

Parting: A layer of rock within a coalbed that lies roughly parallel to the coalbed and has the effect of splitting the bed into two divisions.

Peat: Peat is partially decomposed plant debris, and is considered an early stage in the development of coal. Peat is distinguished from lignite by the presence of free cellulose and a high moisture content (exceeding 70 percent). The heat content of air-dried peat (about 50 percent moisture) is about 9 million Btu per ton. Most U.S. peat is used as a soil conditioner. The first U.S. electric power plant fueled by peat began operation in Maine in 1990.

Raw Coal: Coal that has received no preparation other than possibly screening.

Round Test Mesh: A sieving screen with round holes, the dimensions of which are of specific sizes to allow certain sizes of coal to pass through while retaining other sizes.

Run-of-Mine Coal: Coal as it comes from the mine prior to screening or any other treatment.

Screenings: The undersized coal from a screening process, usually one-half inch or smaller.

Solvent Refined Coal (SRC): A tar-like fuel produced from coal when it is crushed and mixed with a hydrocarbon solvent at high temperature and pressure.

Spontaneous Combustion, or Self-Heating, of Coal: A naturally occurring process caused by the oxidation of coal. It is most common in low-rank coals and is a potential problem in storing and transporting coal for extended periods. Factors involved in spontaneous combustion include the size of the coal (the smaller sizes are more susceptible), the moisture content, and the sulfur content. Heat buildup in stored coal can degrade the quality of coal, cause it to smolder, and lead to a fire.

Surface Mining Equipment:

An *auger machine* is a large horizontal drill, generally 3 feet or more in diameter and up to about 100 feet long. It can remove coal at a rate of more than 25 tons per minute.

A *bucket-wheel excavator* is a continuous-digging machine equipped with a boom that has a rotating wheel with buckets along its edge. The buckets scoop up material, then empty onto a conveyor leading to a spoil bank. This excavator is best suited for removing overburden that does not require blasting. It is also used in combination with conveyors to move topsoil from areas to be mined to storage.

A *bulldozer* is a tractor with a movable steel blade mounted on the front. It can be used to remove overburden that needs little or no blasting.

A *carryall scraper* (or *pan scraper*) is a self-loading machine, usually self-propelled, with a scraper-like retractable bottom. It is used to excavate and haul overburden.

A *continuous surface miner,* used in some lignite mines, is equipped with crawlers, a rotating cutting head, and a conveyor. It travels over the bed, excavating a swath up to 13 feet wide and 2 feet deep.

A *dragline excavator* removes overburden to expose the coal by means of a scoop bucket that is suspended from a long boom. The dragline digs by pulling the bucket toward the machine by means of a wire rope.

A *walking dragline* is equipped with large outrigger platforms, or walking beams, instead of crawler tracks. It "walks" by the alternate movement of the walking beams.

A *drilling rig* is used to determine the amount and type of overburden overlying a coal deposit and the extent of the deposit, to delineate major geologic features, and to drill holes for explosives to fragment the overburden for easier removal.

A *front-end loader* is a tractor with a digging bucket mounted and operated on the front. It is often used to remove overburden in contour mining and to load coal.

A *hydraulic shovel* excavates and loads by means of a bucket attached to a rigid arm that is hinged to a boom.

A *power shovel* removes overburden and loads coal by means of a digging bucket mounted at the end of an arm suspended from a boom. The shovel digs by pushing the bucket forward and upward. It does not dig below the level at which it stands.

A *thin-seam miner* resembles an auger machine but has a drum-type cutting head that cuts a rectangular cross section.

Surface Mining Methods:

An *auger mine* recovers coal through the use of a large-diameter drill driven into a coalbed in the side of a surface mine pit. It usually follows contour surface mining, particularly when the overburden is too costly to excavate. (See also *punch mine,* a type of underground mine.)

Area mining is practiced on relatively flat or gently rolling terrain. It recovers coal by mining long strips successively; the material excavated from the strip being mined is deposited in the strip pit previously mined.

A *bench* is a ledge in a surface mine that forms a step from which excavation will take place at a constant level.

A *box cut* is the first cut made to remove the overburden from the coal where no open side exists; this results in a highwall on both sides of the cut. The overburden is placed on unmined land, normally outside the area to be mined.

Contour mining is practiced when the coal is mined on hillsides. The mining follows the contour of the hillside until the overburden becomes uneconomical to remove. This method creates a shelf, or bench, on the hillside. Several variations of contour mining have been developed to control environmental problems. These methods include *slope reduction* (overburden is spread so that the angle of the slope on the hillside is reduced), *head-of-hollow fill* (overburden is placed in narrow V-shaped valleys to control erosion), and *block-cut* (overburden from current mining is backfilled into a previously mined cut).

Explosives casting is a technique designed to blast up to 65 percent of the overburden into the mine pit for easier removal. It differs from conventional overburden blasting, which only fractures the overburden before it is removed by excavating equipment.

A *highwall* is the unexcavated face of exposed overburden and coal in a surface mine.

Mountaintop mining, sometimes considered a variation of contour mining, refers to the mining of a coalbed that underlies the top of a mountain. The overburden, which is the mountaintop, is completely removed so that all of the coal can be recovered. The overburden material is later replaced in the mined-out area. This method leaves large plateaus of level land.

Open-pit coal mining is essentially a combination of contour and area mining methods and is used to mine thick, steeply inclined coalbeds. The overburden is removed by power shovels and trucks.

Tipple: Originally, the place on the surface where mine cars were tipped or emptied of their coal, but now expanded to include the place where trucks, railroad cars, or conveyors hauling coal from a mine dump

the coal. Sometimes applied to the surface structures of a mine, including the preparation plant and loading tracks.

Underground Mining Equipment:
An *armored face conveyor* is used to transport coal from the face of a longwall operation and also to support the shearing machine or plow.

A *coal-cutting machine* is used in conventional mining to undercut, topcut, or shear the coal face so that coal can be fractured easily when blasted. It cuts 9 to 13 feet into the bed.

A *continuous auger machine* is used in mining coalbeds less than 3 feet thick. The auger has a cutting depth of about 5 feet and is 20 to 28 inches in diameter. Continuous auger mining usually uses a conveyor belt to haul the coal to the surface.

A *continuous-mining machine,* used during *continuous mining,* cuts or rips coal from the face and loads it into shuttle cars or conveyors in one operation. It eliminates the use of blasting devices and performs many functions of other equipment such as drills, cutting machines, and loaders. A continuous-mining machine typically has a turning "drum" with sharp bits that cut and dig out the coal for 16 to 22 feet before mining stops so that the mined area can be supported with roof bolts. This machine can mine coal at the rate of 8 to 15 tons per minute.

Conveyor systems consist of two types. A *mainline conveyor* is usually a permanent installation that carries coal to the surface. A *section conveyor* connects the working face to the mainline conveyor.

A *face drill* is used in conventional mining to drill shotholes in the coalbed for explosive charges.

A *loading machine* is used in conventional mining to scoop broken coal from the working area and load it into a *shuttle car,* which hauls the coal to mine cars or conveyors for delivery to the surface.

A *mine locomotive,* operating on tracks, is used to haul mine cars containing coal and other material, and to move personnel in specially designed "mantrip" cars. Large locomotives can haul more than 20 tons at a speed of about 10 miles per hour. Most mine locomotives run on electricity provided by a trolley wire; some are battery-powered.

A *plow* is a longwall-mining machine with a blade that has fixed bits or a saw-toothed edge.

A *ram car,* or *shuttle ram,* is a rubber-tired haulage vehicle that is unloaded through the use of a movable steel plate located at the back of the haulage bed.

A *roof-bolting machine,* or *roof bolter,* is used to drill holes and place bolts to support the mine roof. Roof bolting units can be installed on a continuous-mining machine.

A *scoop* is a rubber-tired haulage vehicle used in thin coalbeds.

A *shearer* is a longwall-mining machine with one or two rotating cutting drums.

A *shield* is a movable roof support used in longwall mining.

A *shortwall-mining machine* generally is a continuous-mining machine used with a powered, self-advancing roof support system. It shears coal from a short coal face (up to about 150 feet long). The broken coal is hauled by shuttle cars to a conveyor belt.

A *shuttle car* is a rubber-tired haulage vehicle that is unloaded by a built-in conveyor.

Underground Mining Methods:
A *cross cut* in an underground mine is a short tunnel connecting two parallel entries.

Development refers to the mining needed to provide access to the area to be produced. It includes driving shafts and slopes.

A *drift mine* is driven horizontally into coal that is exposed or accessible in a hillside.

An *entry* in an underground mine is a tunnel-like passage, usually driven entirely within the coalbed and rectangular in cross section, typically about 6 feet high and 20 feet wide. The number of entries is determined by the requirements for ventilation, haulage, escapeways, and mine services such as power, water, and drainage.

In a *hydraulic mine,* high-pressure water jets break the coal from a steeply inclined, thick coalbed that would be difficult to mine with the usual underground methods. The coal is then transported to the surface by a system of flumes or by pipeline. Although currently not in commercial use in the United States, hydraulic mining is used in western Canada.

In *longwall mining,* a panel, or block, of coal generally about 700 feet wide and often over 1 mile long is

completely extracted, leaving no pillars to support the mined-out area. The working area is protected by a movable, powered roof support system. The caved area (gob) compacts and, after initial subsidence, supports the overlying strata. Longwall mining is used where the coalbed is thick and generally flat, and where surface subsidence is acceptable.

A *portal* is the surface entrance to an underground mine. It is the point where the main haulage and ventilation entries of the mine intersect the earth's surface.

A *punch mine* is a type of small drift mine used to recover coal from strip-mine highwalls or from small, otherwise uneconomical, coal deposits.

Rock dusting, sprayed in an underground coal mine, reduces the possibility of coal dust explosions. Rock dust is a very fine noncombustible material, usually pulverized limestone.

Roof bolting is the principal method of supporting the mine roof. In roof bolting, long bolts, 2 to 10 feet long with an expansion shell or with resin grouting, are placed in the mine roof. The bolts reinforce the roof by pulling together rock strata to make a strong beam, or by fastening weak strata to strong strata.

In a *room-and-pillar mining system*, the most common method, the mine roof is supported mainly by coal pillars left at regular intervals. Rooms are places where the coal is mined; pillars are areas of coal left between the rooms. Room-and-pillar mining is done either by (1) *conventional mining*, which involves a series of operations that require cutting the working face of the coalbed so that it breaks easily when blasted with explosives or high-pressure air, and then loading the broken coal or (2) *continuous mining*, in which a continuous mining machine extracts and removes coal from the working face in one operation. When a section of a mine has been fully developed, additional coal may be extracted by mining the supportive pillars until the roof caves in; this procedure is called *room-and-pillar retreat mining.*

A *shaft mine* is driven vertically to the coal deposit.

A *shortwall mining system* generally refers to room-and-pillar mining in which the working face is wider than usual but smaller (less than 150 feet) than that in longwall mining.

A *slope mine* is driven at an angle to reach the coal deposit.

Ventilation, accomplished with large fans, is essential to supply fresh air and to remove gases and dust from the mine.

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