Coal Characterization ,Its Mining Impacts, Types And Its Distribution

[1]Sachin Changotra
[1]sachin.chang@gmail.com

ABSTRACT

Coal is a combustible black or brownish-black sedimentary rock usually occurring in rock strata in layers or veins called coal beds or coal seams. The harder forms, such as anthracite coal, can be regarded as metamorphic rock because of later exposure to elevated temperature and pressure. Coal is composed primarily of carbon, along with variable quantities of other elements, chiefly hydrogen, sulfur, oxygen, and nitrogen.[1] A fossil fuel, coal forms when dead plant matter is converted into peat, which in turn is converted into lignite, then sub-bituminous coal, after that bituminous coal, and lastly anthracite. This involves biological and geological processes that take place over time .

Coal is one of the world’s major sources of energy. Coal is used to produce nearly half of all the electrical energy that is generated and used in the United States. Coal is a very complex and diverse energy resource that can vary greatly, even within the same deposit. In general, there are four basic varieties of coal, which are the result of geologic forces having altered plant material in different ways.

Lignite

Increased pressures and heat from overlying strata causes buried peat to dry and harden into lignite. Lignite is a brownish-black coal with generally high moisture and ash content and lower heating value. However, it is an important form of energy for generating electricity. Significant lignite mining operations are located in Texas, North Dakota, Louisiana and Montana.

Sub-bituminous

Under still more pressure, some lignite is changed into the next rank of coal subbituminous. This is a dull black coal with a higher heating value than lignite that is used primarily for generating electricity and for space heating. Most subbituminous reserves are located in Montana, Wyoming, Colorado, New Mexico, Washington and Alaska.

Bituminous

Even greater pressure results in the creation of bituminous, or “soft” coal. This is the type most commonly used for electric power generation in the U.S. It has a higher heating value than either lignite or subbituminous, but less than that of anthracite. Bituminous coal is mined chiefly in Appalachia and the Midwest. It is also used to make coke for steel production.

Anthracite

Sometimes called “hard coal,” anthracite forms from bituminous coal when great pressures developed in folded rock strata during the creation of mountain ranges. This occurs only in limited geographic areas – primarily the Appalachian region of Pennsylvania. Anthracite has the highest energy content of all coals and is used for space heating and generating electricity.

EXTRACTION

Coal is extracted from the ground by coal mining. Since 1983, the world's top coal producer has been China.[3] In 2015 China produced 3,747 million tonnes of coal – 48% of 7,861 million tonnes world coal production. In 2015 other large producers were United States (813 million tonnes), India (678), European Union (539) and Australia (503).[3] In 2010 the largest exporters were Australia with 328 million tonnes (27% of world coal export) and Indonesia with 316 million tonnes (26%),[4] while the largest importers were Japan with 207 million tonnes (18% of world coal import),

COAL TAKES MILLIONS OF YEARS TO FORM

Coal is a combustible black or brownish-black sedimentary rock with a high amount of carbon and hydrocarbons. Coal is classified as a nonrenewable energy source because it takes millions of years to form. Coal contains the energy stored by plants that lived hundreds of millions of years ago in swampy forests.

The plants were covered by layers of dirt and rock over millions of years. The resulting pressure and heat turned the plants into the substance we call coal.

TYPES OF COAL

Coal is classified into four main types, or ranks: anthracite, bituminous, subbituminous, and lignite. The ranking depends on the types and amounts of carbon the coal contains and on the amount of heat energy the coal can produce. The rank of a coal deposit is determined by the amount of pressure and heat that acted on the plants over time.

Anthracite contains 86%–97% carbon, and generally has the highest heating value of all ranks of coal. Anthracite accounted for less than 1% of the coal mined in the United States in 2015. All of the anthracite mines in the United States are in northeastern Pennsylvania. Anthracite is mainly used by the metals industry.

Bituminous coal contains 45%–86% carbon. Bituminous coal in the United States is between 100 and 300 million years old. Bituminous coal is the most abundant rank of coal found in the United States, and it accounted for 45% of total U.S. coal production in 2015. Bituminous coal is used to generate electricity and is an important fuel and raw material for making iron and steel. West Virginia, Kentucky, Illinois, Pennsylvania, and Indiana were the five main bituminous coal-producing states in 2015, accounting for 73% of total bituminous production.

Subbituminous coal typically contains 35%–45% carbon, and it has a lower heating value than bituminous coal. Most subbituminous coal in the United States is at least 100 million years old.

About 47% of total U.S. coal production in 2015 was subbituminous and nearly 90% was produced in Wyoming.

Lignite contains 25%–35% carbon and has the lowest energy content of all coal ranks. Lignite coal deposits tend to be relatively young and were not subjected to extreme heat or pressure. Lignite is crumbly and has high moisture content, which contributes to its low heating value. Lignite accounted for 8% of total U.S. coal production in 2015. About 90% of total lignite production is mined in Texas and North Dakota in 2015, where it is mostly used to generate electricity. A facility in North Dakota also converts lignite to synthetic natural gas and pipes it to natural gas consumers in the eastern United States.

STRUCTURE AND PROPERTIES OF COAL

Organic compounds

The plant material from which coal is derived is composed of a complex mixture of organic compounds, including cellulose, lignin, fats, waxes, and tannins. As peat formation and coalification proceed, these compounds, which have more or less open structures, are broken down, and new compounds—primarily aromatic (benzenelike) and hydroaromatic—are produced. In vitrinite these compounds are connected by cross-linking oxygen, sulfur, and molecules such as methylene. During coalification, volatile phases rich in hydrogen and oxygen (e.g., water, carbon dioxide, and methane) are produced and escape from the mass; hence, the coal becomes progressively richer in carbon. The classification of coal by rank is based on these changes—i.e., as coalification proceeds, the amount of volatile matter gradually decreases and the amount of fixed carbon increases. As volatiles are expelled, more carbon-to-carbon linkages occur in the remaining coal until, having reached the anthracite rank, it takes on many of the characteristics of the end product of the metamorphism of carbonaceous material—namely, graphite. Coals pass through several structural states as the bonds between the aromatic nuclei increase.

PROPERTIES

Many of the properties of coal are strongly rank-dependent, although other factors such as maceral composition and the presence of mineral matter also influence its properties. Several techniques have been developed for studying the physical and chemical properties of coal, including density measurements, X-ray diffraction, scanning and transmission electron microscopy, infrared spectrophotometry, mass spectroscopy, gas chromatography, thermal analysis, and electrical, optical, and magnetic measurements.

Density

Knowledge of the physical properties of coal is important in coal preparation and utilization. For example, coal density ranges from approximately 1.1 to about 1.5 megagrams per cubic metre, or grams per cubic centimetre (1 megagram per cubic metre equals 1 gram per cubic centimetre).

Coal is slightly denser than water (1.0 megagram per cubic metre) and significantly less dense than most rock and mineral matter (e.g., shale has a density of about 2.7 megagrams per cubic metre and pyrite of 5.0 megagrams per cubic metre). Density differences make it possible to improve the quality of a coal by removing most of the rock matter and sulfide-rich fragments by means of heavy liquid separation (fragments with densities greater than about 1.5 megagrams per cubic metre settle out while the coal floats on top of the liquid). Devices such as cyclones and shaker tables also separate coal particles from rock and pyrite on the basis of their different densities.

Porosity

Coal density is controlled in part by the presence of pores that persist throughout coalification. Measurement of pore sizes and pore distribution is difficult; however, there appear to be three size ranges of pores: (1) macropores (diameter greater than 50 nanometres), (2) mesopores (diameter 2 to 50 nanometres), and (3) micropores (diameter less than 2 nanometres). (One nanometre is equal to 10^{-9} metre.) Most of the effective surface area of a coal—about 200 square metres per gram—is not on the outer surface of a piece of coal but is located inside the coal in its pores. The presence of pore space is important in the production of coke, gasification, liquefaction, and the generation of high-surface-area carbon for purifying water and gases. From the standpoint of safety, coal pores may contain significant amounts of adsorbed methane that may be released during mining operations and form explosive mixtures with air. The risk of explosion can be reduced by adequate ventilation during mining or by prior removal of coal-bed methane.

Reflectivity

An important property of coal is its reflectivity (or reflectance)—i.e., its ability to reflect light. Reflectivity is measured by shining a beam of monochromatic light (with a wavelength of 546 nanometres) on a polished surface of the vitrinite macerals in a coal sample and measuring the percentage of the light reflected with a photometer. Vitrinite is used because its reflectivity changes gradually with increasing rank. Fusinite reflectivities are too high due to its origin as charcoal, and liptinites tend to disappear with increasing rank. Although little of the incident light is reflected (ranging from a few tenths of a percent to 12 percent), the value increases with rank and can be used to determine the rank of most coals without measuring the percentage of volatile matter present.

The study of coals (and coaly particles called phyterals) in sedimentary basins containing oil and/or gas reveals a close relationship between coalification and the maturation of liquid and gaseous hydrocarbons. During the initial stages of coalification (to a reflectivity of almost 0.5 and near the boundary between subbituminous and high-volatile C bituminous coal), hydrocarbon generation produces chiefly methane. The maximum generation of liquid petroleum occurs during the development of high-volatile bituminous coals (in the reflectivity range from roughly 0.5 to about 1.3). With increasing depth and temperature, petroleum liquids break down and, finally, only natural gas (methane) remains. Geologists can use coal reflectivity to anticipate the potential for finding liquid or gaseous hydrocarbons as they explore for petroleum.

Other properties

Other properties, such as hardness, grindability, ash-fusion temperature, and free-swelling index (a visual measurement of the amount of swelling that occurs when a coal sample is heated in a covered crucible), may affect coal mining and preparation, as well as the way in which a coal is utilized. Hardness and grindability determine the kinds of equipment used for mining, crushing, and grinding coals in addition to the amount of power consumed in their operation. Ash-fusion temperature influences furnace design and operating conditions. The free-swelling index provides preliminary information concerning the suitability of a coal for coke production.

Effects of coal mining on enviornment

Surface mines (sometimes called *strip mines*) were the source of about 65% of the coal mined in the United States in 2016. These mining operations remove the soil and rock above coal deposits, or *seams*. The largest surface mines in the United States are in Wyoming's Powder River Basin, where coal deposits are close to the surface and are up to 70 feet thick.

Mountaintop removal and valley fill mining has affected large areas of the Appalachian Mountains in West Virginia and Kentucky. In this form of coal extraction, the tops of mountains are removed using explosives. This technique changes the landscape, and streams are sometimes covered with rock and dirt. The water draining from these filled valleys may contain pollutants that can harm aquatic wildlife downstream. Although mountaintop mining has existed since the 1970s, its use became more widespread and controversial beginning in the 1990s.

Emissions from burning coal

Several principal emissions result from coal combustion:

- Sulfur dioxide (SO2), which contributes to acid rain and respiratory illnesses
- Nitrogen oxides (NOx), which contribute to smog and respiratory illnesses
- Particulates, which contribute to smog, haze, and respiratory illnesses and lung disease
- Carbon dioxide (CO2), which is the primary greenhouse gas produced from the burning of fossil fuels (coal, oil, and natural gas)
- Mercury and other heavy metals, which have been linked to both neurological and developmental damage in humans and other animals
- Fly ash and bottom ash, which are residues created when coal is burned at power plants

In the past, fly ash was released into the air through the smokestack, but laws now require that most emissions of fly ash be captured by pollution control devices. In the United States, fly ash and bottom ash are generally stored near power plants or placed in landfills. Pollution leaching from ash storage and landfills into groundwater and the rupture of several large impoundments of ash are environmental concerns.

Major deposits with respect to j&k -

The major coal deposits of the state are found at Kalakote, Jangalgali, Metka, Ladha, Chinka, Dhansal, Swalkote, Chakar, Dandil, Mohogala, San- gar-Marg, and Kura. Coal has also been reported from the Baramulla, Handwara, and Pulwama districts of Kashmir. Lignite is found at Shaliganga, Chowkibal and Nichahama (Kashmir Division). It has been estimated by the Geological Survey of India that the Kalakote coal mines have a workable reserve of about 5.4 million tonnes up to a depth of about 300 m. An analysis of the Kalakote coal reveals that it is of low volatile anthracite grade with ash content varying from 10 to 20 per cent and fixed carbon about 60 to 80 per cent.

In Ladda and Jangligali coal field’s reserves are estimated to be about five million tonnes. The coal of Ladda also has about 50 per cent carbon and about 20 per cent impurities and moisture contents. The Geological Survey of India has carried out explorations at Mohogala and Metka (Poonch District) and arrived at the result that these places, up to a depth of 300 m have about 9 million of coal. The fixed carbon in the coal of these deposits is about 57 per cent, volatile 30 per cent and ash and moisture 10 and 3 per cent respectively.

At present coal is being mined near Kalakote to feed the only thermal power plant of the state at Kalakote. The rated capacity of the plant is 7.5 MW and 35,000 tonnes of coal is being mined annually in its vicinity. The energy generation capacity of the plant may be enhanced substantially if new generators are installed in the Kalakote Plant and new technology is applied for the mining of coal.

Lignite deposits are found mainly in the Valley of Kashmir which occur in the Karewa formations, right from Nichahom upto Lolab. The lignite seams are, however, associated with clays and loams and are inter-bedded in carbonaceous clays in various localities of Kashmir Division. The major lignite deposits are in are in the vicinity of Nichahom, Chowkibal, Budhasheng, Lanylab, Shaliganga, Raithan and Tangmarg.

According to the Geological Survey of India, Nichahom lignite seams occur from north to south, running over a distance of about 85 km and the estimated reserve of lignite in this mine is about 85 km and covering a width of 16 km up to a depth of 8 m. The estimated reserve of lignite in this mine is about 6 million tonnes. In between Nichahom and Chowkibal a reserve of 8 million tonnes has been estimated.

The total estimated reserve of lignite deposits in the state, according to the Directorate of Geology and Mining is about 85 million tonnes, but owing to thin seams and high ash contents, it is mined only at Nichahom in Kashmir. In fact, the lignite of Kashmir Valley contains only 8 to 25 per cent carbon, 30 per cent ash, 15 per cent moisture and 27 per cent volatile matter. Peat—a superficial accumulation consisting of vegetation matter which has become decomposed to a certain limited extent in the cold regions is also found in the Valley of Kashmir. Its deposits are found mainly in the swampy grounds on both the sides of the Jhelum River below Srinagar. Peat is cut and dried before being used as fuel. It is applied in field as a manure. The Kashmiris call peat as demb-tsak.

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