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Coal: Development of Its Use

Györffy Emma [1]

[1*] Independent Research Scholar

*Corresponding Author: e-mail: GyorffyEmma@dayrep.com

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***Abstract*—** Coal is a black or brown rock that is flammable and combustible. When coal is burned, it gives energy in the form of heat. The heat from coal combustion can be used to heat homes, and to make many different products. But the primary use of this heat is in the production of electricity. Coal-burning power plants give two-thirds of the electricity consumed in the world. Coal is also used in the production of coke, which is an essential raw material in the iron and steel industry. Other materials result from the coke production process, which in turn can be used in the manufacture of some products such as medicines, dyes and fertilizers. In the past, coal was the main source of energy in all industrialized countries. Steam engines from coal combustion produced most of the power needed for these countries from the beginning of the nineteenth century until the twentieth century. Since the beginning of the twentieth century, oil and natural gas have become the leading sources of energy in most parts of the world. In contrast to coal; the oil can be converted into petroleum and other fuels needed to operate modern means of transportation. The use of natural gas has replaced coal for thermal power generation. However, the world's oil and natural gas resources are being rapidly depleted. If consumption continues at the current level, oil resources may be exhausted and depleted at the beginning of the twenty-first century. Natural gas resources will also be depleted in the middle of the twenty-first century. As for the world's sources of coal, they remain and continue for about 220 years to come, according to current consumption rates.

***Keywords*—** Coal – Development – Manufacture – Uses - sources of coal

I. INTRODUCTION

The growing use of coal in the production of electricity, in particular, may fill the growing shortage of both gas and oil. However, the use of coal carries with it problems of a special kind; its combustion is a major cause of air pollution. Several methods have been developed to reduce pollution, but they are expensive and have not yet been proven. It is necessary to improve these methods and methods before the

large expansion in the use of coal. In addition, some coal is found deep underground, where it is difficult to extract.

In the past, there were few jobs considered more dangerous and difficult than that of an underground coal miner. In the nineteenth century AD, many miners had to work ten hours a day underground for six days each week. The shovels were the only tools used in the crushing and disintegration of coal. Coal miners had to shovel pulverized coal and load it into wagons. In many cases, children under the age of ten were pulling carts of coal from the mines. Women also worked in loading and wagon transport operations. Over time, thousands of men, women and children lost their lives in mine accidents. Thousands more died of lung disease from inhaling coal ash throughout their working life in the mines.

These days, machines carry out most of the work in coal mines. Safety procedures have been improved in the mines, working hours have decreased, and children have been banned from working in the mines before the end of the nineteenth century AD. The death rate due to mine accidents decreased significantly in the twentieth century. In all these cases, the profession of mining coal from its mines is still a profession of risks.

II. HISTORY AND DEVELOPMENT OF COAL USE

No one knows where and when humans discovered that burning coal produces heat. This discovery may have been made independently or individually in many different parts of the world during prehistoric times. The Chinese were the first to develop the coal industry. By the fourth century AD, the Chinese had begun mining it from its surface deposits, and then used it to heat homes and smelt metals. In the eleventh century AD, coal became the main fuel in China.

Coal mining for trade and profit progressed more slowly in Europe. During the thirteenth century AD, a number of commercial coal mines began to be established in England and in what is now Belgium. Coal was extracted from small open-pit mines dug for this purpose, and then it was used mainly in the smelting and forging of minerals. Most Europeans considered coal a dirty fuel and refused to use it. Wood and the charcoal made from it were the preferred fuels in Europe until the seventeenth century AD. During these years, there was a sharp shortage of wood in Western Europe. For this reason, the countries of Western Europe, especially England, increased their production of coal intensively to overcome the crisis of the shortage of fuel.

During the sixteenth century AD, factories in England consumed large quantities of charcoal in the factories of some products such as bricks, glass, table salt and soap. By the 17th century, wood had become so scarce in England that most factories had no choice but to switch to coal. In the end, England produced about 80% of the world's total production of coal. England remained the leading producer of coal for the next two hundred years.

Charcoal was used extensively in England as a fuel in the drying processes of malt, the main ingredient in beer. Beer producers tried to use coal in this process, but the malt was absorbing its gases, which spoiled the taste of the beer. Brewers realized that undesirable coal gases could be eliminated if preheated in airtight ovens. They did not

realize that this is how they develop the process of producing coke from coal. In the eighteenth century AD, an English iron producer named Abraham Darby succeeded in using coke to smelt iron. Subsequently, coke gradually replaced biochar as the fuel of choice in iron production processes.

The spread of this new method of iron production became part of a major development in England, the Industrial Revolution. This revolution consisted mainly of an enormous increase in factory production. The development of the steam machine in England in the eighteenth century AD greatly increased factory production. Steam engines also provided the power needed to power factory machinery. Steam engines required such a large supply of power that coal was the only available fuel.

During the nineteenth century AD, the Industrial Revolution spread from England to other parts of the world. This revolution was particularly successful in countries that possessed abundant quantities of coal. Thus, coal played the main role in the growth of the industry during that period in Europe and North America.

Coal became necessary, not only for manufacturing and factories, but also for transportation, as merchant ships and other steam engines became the main means of transportation. This required obtaining large quantities of coal for steam transportation as fuel for its boilers. As industry and transportation grew in the United States; Coal production has also grown in parallel. At the beginning of the nineteenth century AD, there were a few coal mines and their uses in the United States. In the latter's end, the United States replaced England as the leading country in its production in the world. The United States remained a leader in the production of coal until the middle of the twentieth century, when its need for it decreased with the increase in the use of oil and natural gas. The former Soviet Union surpassed the United States in coal production from the late 1950s to the late 1970s. In the eighties, China became in first place, followed by the United States in second place.

The growing scarcity of oil and natural gas has led to a sharp rise in coal demand. As a result of this, the world's production of coal increased dramatically from 1970 to 1980. The excess production from it was mainly used to produce electricity.

Currently, electricity is produced using coal as fuel at a lower cost than producing it using natural gas or fuel oil. However, the cost of coal used to produce electricity will certainly increase for several reasons. In order to preserve the environment and reach ideal environmental conditions, electric power plants that burn coal with medium or high sulfur content have to spend huge amounts of money to set up sulfur dioxide washing plants. To obtain coal with a lower sulfur content, power plants must spend money to import it from their main production sites. When coal deposits near the surface of the earth are consumed, deeper mines have to be dug, and certainly the high cost of operating the very deep mines will be added to its prices.

Electricity producers, like other businessmen, place the burden of increased costs on the consumer. Thus we see that,

with the availability of coal, the energy on which its production depends will be steadily costly.

III. HOW IS COAL FORMED?

Coal is the remains of plants that died and were buried 400 million to 1 million years ago. Therefore, coal can be considered a fossil fuel. The plants that formed the coals are believed to have grown in swamps. As the plants died, a thick layer of plant matter gradually formed on the bottom of the swamp. Then that substance began to harden with time and turn into another substance called peat (charred plant tissue). Over time, peat deposits became buried under sand and other minerals. With the accumulation of mineral matter, some of it has turned into rock, such as sandstone and shale. With the increase in the weight of the rock layers and the weight of other overlying materials, peat began to be turned into coal. Coal, sandstone and other rocks formed from sedimentary materials are called sedimentary rocks.

The first stage of coal formation produces a dark brown coal called lignite. Lignite develops from buried peat deposits under intense pressure from the weight of the materials above the peat deposits, as well as from the effect of internal movements of the earth's crust. As the pressure increases, lignite turns into more solid coal called subbituminous or subbituminous coal. Under greater pressures, semi-bituminous coal turns into a more solid and strong coal called bituminous coal. Under the influence of extreme pressures, bituminous coal changes into anthracite, which is the hardest type of coal.

In most cases, anthracite is the oldest type of coal, and lignite is the oldest among other coal types. Some types of anthracite began to form more than 400 million years ago. While some types of lignite was formed during the last million years. The greatest age in which coal was formed was during an era in Earth's history known as the Carboniferous Age, about 290-360 million years ago. The swamps covered large parts of the earth's surface during that age. Tall ferns and tree-like plants also grew in these bogs, and after their death produced huge amounts of peat. Abundant deposits of bituminous coal are now known to have evolved from huge amounts of peat deposits that formed during the Carboniferous period. Approximately 1-2 m of compressed plant material is required to produce a 0.3 m thick layer of bitumen char.

Plant materials are still accumulating in environments suitable for the formation of coal, such as large swampland environments such as the Everglades land in southern Florida in the United States of America. Peat formation can develop in favorable conditions from accumulated plant material, and then turn after hundreds of thousands of years into various other types of coal.

Coal seams are called coal seams or coal veins. The thickness of these sheets ranges between less than 2.5 cm and 120 m or more. Thicker coal flakes consist of sub-continental or lignite species. Many coal deposits consist of two or more layers that are separated from each other by rock layers. These formations arose by means of new favorable coal-forming swamps that developed over other

buried swamps. And every new swamp that became buried evolved into a sediment of independent coal.

Some coal seams lie almost parallel to the earth's surface. Other layers are tilted due to earth movements and are located at an oblique angle with the earth's surface. The deep coal beds usually consist of bituminous anthracite coals. In many cases, we find that earth movements have lifted the deep layers of anthracite coals to a position close to the surface of the earth.

Such ground movements are also responsible for the presence of charcoal sedges in the hills and mountains.

IV. FREQUENT AND GENERAL USES OF CHARCOAL

Coal is widely used in parts of Asia and Europe to heat homes and other buildings. In the United States, natural gas and oil have replaced coal as heating fuels. However, the rising cost of oil and natural gas has led some factories and commercial buildings to return to coal. Anthracite is one of the cleanest burning coals and is therefore preferred in the process of heating homes, although it is the most expensive. For this reason, bituminous coal is preferred over anthracite for heating factories and other commercial buildings. Sub-bituminous coals and lignites have low heat rates and must therefore be burned in large quantities in order to generate heat efficiently enough. As a result, it is rarely used in heating and heating works.

Coal has been used in the past to obtain the heat needed to manufacture many products ranging from the manufacture of glass to the manufacture of canned foods.

Since the beginning of the twentieth century, industrialists have preferred to use natural gas to manufacture most of their products. As for the main uses of coal, they were limited to the cement and paper industries. However, some industries switched to coal in order to avoid the high prices of natural gas.

In the past, coal was the main source of energy in all industrialized countries. Steam engines from coal combustion produced most of the power needed for these countries from the beginning of the nineteenth century until the twentieth century. Since the beginning of the twentieth century, oil and natural gas have become the leading sources of energy in most parts of the world. In contrast to coal; The oil can be converted into petroleum and other fuels needed to operate modern means of transportation. The use of natural gas has replaced coal for thermal power generation. However, the world's oil and natural gas resources are being rapidly depleted. If consumption continues at the current level, oil resources may be exhausted and depleted at the beginning of the twenty-first century. Natural gas resources will also be depleted in the middle of the twenty-first century. As for the world's sources of coal, they remain and continue for about 220 years to come, according to current consumption rates.

Coal as Fuel

Coal is considered a useful fuel due to its abundance and relatively high calorific value. However, coal contains certain impurities that limit its use as a fuel. These impurities include elemental sulfur and various other minerals. When coal is burned, most of the sulfur element

combines with the element oxygen, and they form a toxic gas, sulfur dioxide. Most of the other minerals turn to ash. The coal industry refers to ash-producing materials as ash even before the coal combustion.

Some coals contain less than 1% elemental sulfur. These coals with a low sulfur content can be burned in large quantities without releasing harmful amounts of sulfur dioxide into the air, but there are many coals containing more than 1% of the element sulfur. These medium- and high-sulfur briquettes cause serious air pollution if they are burned in large quantities without proper safety measures. The difficulty and high cost of developing pollution safety measures have limited the use of coal as a fuel. Also, some ash resulting from the combustion of coal powder may leak into the air and pollute it, as is the aforementioned sulfur dioxide. In any case, tools and devices have been developed that can trap fly ash from burning coal in smoke exhaust, which prevents it from leaking into the air, and thus polluting the air. The use of coal as a fuel is concentrated mainly for the production of electric power.

Electricity generation

A transmission system in a coal power plant, in which the coal is transferred to the boilers of the power plant. Power generation from coal combustion produces most of the electrical power used in the world.

The vast majority of electric power plants are steam turbine plants. All nuclear power plants and all other plants that run on coal, gas, or oil fuels are also steam turbines. These stations use strongly pressurized steam, which in turn drives the wheels of the turbines, which in turn drive generators that produce electrical power. Steam turbine plants differ mainly among themselves, in how they generate the heat needed to produce steam. Nuclear plants generate heat from the fission of uranium atoms. As for the other plants, they are based on the combustion of coal, gas or oil. The coal (bituminous) remains the preferred coal for generating electrical power because it is the most abundant coal, and because it has the highest calorific value among other coals, such as sub-bituminous coal and lignite, which contain the lowest calorific value. Among the charcoal.

V. COAL MINING

In the past, there were few jobs considered more dangerous and difficult than that of an underground coal miner. In the nineteenth century AD, many miners had to work ten hours a day underground for six days each week. The shovels were the only tools used in the crushing and disintegration of coal. Coal miners had to shovel pulverized coal and load it into wagons. In many cases, children under the age of ten were pulling carts of coal from the mines. Women also worked in loading and wagon transport operations. Over time, thousands of men, women and children lost their lives in mine accidents. Thousands more died of lung disease from inhaling coal ash throughout their working life in the mines. These days, machines carry out most of the work in coal mines. Safety procedures have been improved in the mines, working hours have decreased, and children have been banned from working in the mines before the end of the nineteenth century AD. The death rate due to mine accidents decreased significantly in the twentieth century. In all these

cases, the profession of mining coal from its mines is still a profession of risks.

Coal mines can be divided into two groups 1 - surface mines. 2- Underground mines.

Surface mining in most cases involves the stripping and removal of soil and rock above the coal deposit. These materials covering coal deposits are known as rock or earth cover. After this cover is removed, the coal can be easily extracted and carried away.

Mining involves digging canals to coal deposits. Surface mining is usually concerned with deposits of coal located in the range 30-60 m below the surface of the earth.

The more rock cover that needs to be removed, the more difficult and costly surface mining becomes. As for coal deposits with a depth of more than 60 m, they are mined by underground mining methods.

Surface mining

All surface mining is often done by stripping, meaning that its operations begin with the scraping and removal of the rock cover and soil from over the ore. Coal deposits unfold on the sides of hills or mountains. These slags are mined from the surface of the earth without any covering removed, and miners use machines called screw drills that extract coal. This method of surface mining is called screw hole mining.

Abstract mining

It depends on the use of powerful machines that uproot the rock cover and throw it outside the pit (the uprooted cover is called damage). With the passage of time, a mine by stripping and synthesizing can cover a large area of land. In addition, the excavation and uprooting of large areas of land may have caused serious environmental problems in the past. As a result, some governments require mine owners to reclaim the lands that have been stripped, meaning to return these lands to their original condition as much as possible. Hence, mining by stripping and scraping includes two approaches: 1 - coal mining 2 - land reclamation.

Coal mining

Most of the mines that mine coal by stripping and skimming follow the same major steps in producing coal. First, the bulldozers clean and level the mining area. Then, small holes are drilled through the rock cover until the coal is drained. Then each hole is filled with explosives. When detonated, the cap rocks shatter. Then powerful giant bulldozers (shawls) and other earthmoving machines begin removing and carrying the soil and rock debris away. Some of these earth-dispersing machines can be as tall as a twenty-story building and can remove more than 3,200 metric tons of rock and earth cover. After a suitable area of coal pulverizer is exposed, small mechanical bulldozers or coal hauling machines scoop it up and load it onto trucks, where coal is loaded onto trucks from the mine to the outside.

Although most of the scraping and mining follow the same basic steps, the methods of stripping and scraping differ among themselves according to whether the land is flat or hilly. Therefore, mining can be classified by stripping and scraping as: 1 - areal mining 2 - contour mining.

Survey mining is applied when the land is relatively flat, and contour mining is applied in mountainous or hilly lands. Contour mining means mining around mountain slopes.

In areal mining, the earthmoving machine uproots all the fractured rock cover along a strip of land at the edge of a coal field, and the resulting deep trench is called a cut. While the scraper is making the cut, it piles up the damage along the cut side, away from the mining area. The damage aggregate forms a prominent edge called the damage pavement. After the cutting is complete, the coal is extracted from it and loaded away onto trucks. Then the dust removal machine drills a second, similar cut along the side of the first cut, and the wear debris from this new cut is piled up in the location of the first finished cut. Thus, this process is repeated throughout the coal field until it is completely mined. Damage piers form chains of long, parallel edges over an area of land that can later be leveled.

Areal mining is considered impractical if the coal deposits lie within the hills. If the coal deposits are near the top of the hill, the scourer can scrape and remove the hilltop, and then the coal is exposed. But in the case of a coal deposit near the base of the hill, it must be mined on the contour; Ie around slopes.

In contour mining, an earthmoving machine removes shattered and fragmented bedrock directly over the area, where the coal seam is exposed around the hill. The resulting cut forms a wide mantel or frieze that runs along the hillside. The damage is collected and stored temporarily on the hillside or used to fill in the plots later. After the coal has been mined and moved away, the earthmoving machine can go up the slope and excavate another cut just above the first cut, however the depth of the rock cover increases sharply with the height of the slope. After the first or second cut the rock cover may become very large; Hence, mechanisms cannot remove it sufficiently. But if the coal stack was thick enough, engineers might dig a mine underground to take out the remaining coal.

Land reclamation

The environmental problems are that scrape mining buries fertile soil under piles of rock. These rocks release acids when exposed to moisture. The rainwater running through the barren slopes carries acid and sludge with it, and fertile soil is washed away from the surrounding areas. This running water pollutes the waters of streams and rivers with the sludge and acid they carry.

The first step in the process of reclamation of the lands in which the mining was carried out by the method of stripping and skimming is to reduce the presence of the steep slopes formed from the piles of damage. Bulldozers level the damaged land from surveying. Damage aggregate from contour mining can be used to fill cuts in mound sides. The upper parts of the soil must be returned to their original position as much as possible, so that it can be replanted.

Screw mining

Coal mining screw bit is a machine similar to a large cork plug bit, used to drill an exposed side of the coal on a slope. And twist the coal in the form of chunks of lumpy. The screw auger is used in contour mines, as well as when the

overhang on the slope is too large to remove. The screw auger penetrates the coal exposed and twists coal that could not have been mined otherwise. Screw bits can drill and penetrate to a depth of 60m or more in the side of a hill or slope.

Screw Mining is concerned with the exploitation of high quality coal smelters that cannot be mined economically in any other way. Although screw mining extracts only small amounts of coal, its method is very successful if it is used in conjunction with the contour mining method.

Underground mining

Underground mining involves more risks than surface mining. Miners may be injured or die from cave collapses, fallen rocks, blasting accidents and toxic gases. To prevent these disasters, every step of the underground mining work must be designed in a way that ensures the protection of workers. Some safety measures are discussed in this chapter of this article. Underground mining requires more labor than surface mining. But with this, the underground mines are highly mechanized, as the machines do all the digging, extraction, loading and transport operations in modern mines.

VI. CONCLUSION

Coal columns support the bedrock above the main entrances. The ceilings of these entrances are also fixed using bars or long bolts, in order to hold these ceilings in place. In order to install this roof, miners drill holes in the roof with a depth of 0.9-1.8 m or more. Then they insert long bars or nails of metal into them, and then fasten the free end of each bar to the ceiling with a nut. In this process, the bars penetrate the layers of the rock cover above the entrances, connecting them to each other, which prevents them from collapsing, thus keeping the entrance ceilings strong and stable. Thus, the miners install the roofs of the main entrances throughout the mine as they progress in their work. A railway or conveyor belt is also established at one of the main entrances to transport coal to the main entrances and exits of the mine. The railways also provide transportation for workers at the main entrances. At least two main entrances provide the necessary ventilation. In the underground mine, it may be necessary to construct some facilities; Such as water drainage ducts, gas intake pipes, compressed air pipes and power cables. These facilities are constructed at the main entrances first, and subsequently extended to other parts of the mine.

Authors Profile

[1] Independent Research Scholar.

