# COAL

## INTRODUCTION

Coal is a principal 'mineral fuel' occurring abundantly in the earth's crust and is an important primary source of heat and energy.

The word 'coal' appears to have originated from the Sanskrit word 'Kala' and later from the Saxon word 'Cole' and English term 'Col'. At present the name Coal is used as a general term to include a number of varieties of this solid fuel.

The occurrence and use of coal has been known to man since very early times. It was known to the Greeks as far back as the fourth century and to the Chisene even before the Christian era. In England it was being used as a domestic fuel in the ninth century. Though known from early times, its use was much discouraged at first and at times even prohibited by law. But with the invention of the steam engine and the consequent advent of the Industrial Revolution of the 19th Century, its use became increasingly widespread and its importance steadily increased.

'Coal' may be defined as plant debris that has been subjected to various biochemical and geological processes due to which it has undergone remarkable changes in physical properties and chemical composition. The changes brought about in the original plant material are, mainly, the darkening of colour; an increase in hardness and compactness; loss of moistures; loss of volatiles like carbondioxide, hydrogen and oxygen; and an increase in carbon content.

In Geology, Coal is considered as a rock as it is a solid substance forming one of the units of the earth's crust. It cannot be strictly considered as a mineral as it is not a homogeneous substance, is not of inorganic origin and does not have a definite chemical composition. However, in trade, industry and legal matters it is regarded as a mineral.

## Physical properties of Coal

The physical characteristics of coal vary with the 'variety' or 'rank' of coal. The varieties of coal are mainly, Peat, Lignite, Bituminous Coal and Anthracite -- all genetically related to one another and sometimes called "humoliths". The first two are generally termed 'Low rank' coals and the last two as 'High rank' coals. The chief physical properties of coal are given below :-

Colour - Colour of coal varies from yellowish brown in 'low rank' coals to greyish black to jet black in 'high rank' coals.

Lustre - Lustre of coal may be dull, brilliant or glossy It helps in distinguishing the megascopic constituents coal.



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Fracture, Cleat, Cleavage - Fracture may be splintery to irregular in low rank coals, blocky or cubical in high rank coals. Cleavage in coal includes vertical jointing (cleats) due to which a laminated coal breaks with a more or less smooth surface along certain definite directions. Cleavage planes may be close together or far apart.

Hardness - Hardness varies widely with the rank of coal. Whereas some lignites may be as soft as rotten wood with hardness less than 0.5, bituminous coals have an average h ness of 2.0 and anthracites may have an hardness upto 3.0

Specific gravity - Specific gravity varies with the ran coal. It may be 0.5 to 1.30 in lignites, 1.15 to 1.50 in minous coals and 1.40 to 1.7/ in anthracites. Generally bi ous coals have a specific gravity from 1.25 to 1.35. The specific gravity usually increases with the ash and moist content of coal but high aluminous-ash coals have a lowe specific gravity than high iron-ash coals. The specific of coal is of importance in estimating the tonnage of co reserves as well as in the planning of coal washing.

Softening property - When coal is heated, it softens, s nd ats. Softening is due to liquefaction of soluble f t temperatures ranging from 320° to 420°C.

aking property - The effect of heat on coal and the n f the resulting product is of special significance to ndustries which use coke. Coke is the name given to th esidue that is obtained by heating coal to a temperatu 25°C in the total absence of air till ... akes place. A typical ...



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## VARIETIES AND RANKS

Rank is the role at which the coalification proce

According to the nature of the original plant material from which they have been formed, coals may be divided into two types -- the Humic coals (woody coals) and Sapropelic coals (non-woody coals). The humic coals are by far the most important and they are mainly formed by the wood and bark of land and swampy plants. They are composed predominantly of humic degradation matter and are sometimes called 'humoliths'. The sapropelic coals are derived from non-woody matter as leaves, spores, cuticles etc. of plants as well as from organic oozes, algae, fungii and other minute floating plankton. These coals contain less carbon than normal coals and often are so rich in volatiles as to be ignited by a matchstick.. They are typically massive and unbanded, and on distillation yield petroleum. Examples of such coals are Torbanite and Cannel coal. The sapropelic coals may be considered as a more or less transitory stage between true coal and petroleum, and like mineral oil they are supposed to have originated from sapropeliam. They are sometimes also called 'sapropelite'.

Based upon the extent to which the physical and chemical changes have proceeded in the transformation of vegetal matter into coals, the following varieties of coal are distinguished :-

Peat - Strictly considered, peat cannot be classified as a variety of coal since it is generally admitted that all coals have been derived from peat. However, we can consider it as the first distinct product in the process of coal formation and it may be defined as a mass of vegetal matter that has undergone a varying degree of disintegration and decomposition.

[illegible] appearance, it is a light, porous and fibrous substance, varying from light brown to dark brown in colour. The remains of original vegetal matter are distinctly seen. It contains a high percentage of moisture, approximately 5%; about 10.4% volatile matter; 46% fixed carbon; and has a calorific value of about 3500 B.Th.U.

Peat is not an economic fuel, but is sometimes made into briquettes. Peat is mostly used as a fertiliser or in the manufacture of fertiliser because of its rich nitrogen content (upto 2%). Peat deposits occur in the Nilgiri hills of South India, and also at shallow depths on both sides of the Hooghly river in and around Calcutta.



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Lignite - It is also sometimes called 'brown coal' because of its characteristic brown colour. It is generally woody of composed of finely divided plant tissues. It contains 25-45% moisture, and on drying shrinks and breaks up in an irregular manner.

It is likely to ignite spontaneously as it readily absorbs oxygen and hence it cannot be stored in the open or transported for long distances. It burns with a long smoky flame and has a low heating power, the calorific value ranging from 6000-7000 B.Th.U. It can be carbonised at low temperature 550-600°C and is extensively used in the manufacture of Producer Gas. As it readily crumbles to powder, lignite is largely used as briquettes. Lignite seams occur in India in the Tertiary rocks of Assam region, Kashmir, Rajasthan, Tamil Nadu and Kerala.

Sub-bituminous coal - This term includes the glossy black coal and is of an intermediate grade between the lignites and bituminous coals. It is characterised by its black colour, and on weathering breaks parallel to the bedding plane, unlike the bituminous coal which breaks up into cubes. It shows a distinctly pitchy lustre and often a conchoidal fracture. It contains 12-25% moisture. Sub-bituminous coal is a good fuel, igniting easily and with a calorific value ranging from 8000-10,000 B.Th.U. Some of the Lower Gondwana coals and some of the Eocene coals of India are of this type.

Bituminous coal - This term comes from the word 'bitumen', and though it actually lacks in true "bitumens" in its composition, it burns with a smoky yellow flame similar to that of bitumen. Moreover, on distillation it yields coal-tar as one of its products which is of a bituminous nature. The bituminous coal is the ordinary household coal and is pitch black to dark grey in colour, usually more or less laminated showing layers of bright or dull coals. The lustre varies from dull to brilliant or resinous. The fracture is splintery. The coal breaks along vertical joints called cleats giving rise to rectangular or cubical blocks.

Bituminous coals are harder, denser, and better able to stand exposure and transport than lignites and sub-bituminous coals. They are good steam, gas and by-product coals. The fuel ratio is generally below 2.5 and calorific value varies from 11,000-15,000 B.Th.U. They may be coking or non-coking. The bituminous coal may be considered as the 'all purpose' coal, and because of its excellent heating quality and the ease with which it can be handled, it is the most extensively used fuel in the world. Bituminous coals are classified into 'high volatile' and 'low volatile' coals. The high volatile coals have a fuel ratio less than 2 and the low volatile coals have a fuel ratio more than 2. The high volatile coals are used in the gas industry and in the coal-tar distillation works. The low volatile bituminous coals are used in the manufacture of metallurgical coke. In India, the Lower Gondwana coals are generally bituminous coals.

Semi-bituminous coal - It is the term applied for the highest grade of bituminous coal containing from 11-18 percent volatile matter. It burns with a short smokeless flame and



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is generally friable and has a fuel ratio 2.5-5. Its calorif
value varies from 12,000-15,400 B.Th.U. This type of coal ma
be coking or non-coking. This is sometimes called 'Super-
bituminous coal'.

Semi-anthracite - It is harder than bituminous coa
gnites more quickly than anthracite and burns with a short
ellow flame at first and then with a blue flame. The conch
al fracture is not so well developed as in anthracite and
leats are numerous. Its fuel ratio varies from 5 to 10,
olatile matter 6-11%, and the specific gravity is about 1.

Anthracite - It is a hard coal with an iron-black
olour and sub-metallic to brilliant lustre. It does not s
he finger and commonly breaks with a conchoidal fracture.
difficult to ignite and burns with a short, pale blue
thout smoke. Fuel ratio is over 10. Hardness varies fro
75-3 and the specific gravity from 1.27-1.7. The calori
lue ranges from 14,000-15,000 B.Th.U. Because of its hi
ating value and the absence of smoke the anthracite is
ghly suitable for metallurgical purposes, steam raising
ow combustion stoves. In India, coals of super-bitumino
anthracitic variety occur in the Eocene formation of
shmir along the Himalayan foot hills, as well as in the
er Gondwana strata in the Eastern Himalayan region of
gal and Sikkim.

The average chemical composition of various rank
l is given in Table No. 2



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