

quality consideration. Coast based power stations and cement plants are also importing non-coking coal on consideration of transport logistics, commercial prudence. In 2019-2020, international prices of both coking and non-coking coal declined but in the first quarter of the year 2020 they picked up and remained stable. In case of India, import of both types of coal declined till around September 2019 and then picked up and remained more or less stable.

## 1.6 Notified Price of Coal

1.6.1 Under the Colliery Control Order,

1945, the Central Government was empowered to fix the prices of coal grade-wise and colliery-wise. As per recommendations of Bureau of Industrial Costs and Prices and the Committee on Integrated Coal Policy, prices of different grades of coal had been subjected to deregulation since 22.03.1996, in a phased manner. The pricing of coal has been fully deregulated after the notification of the Colliery Control Order, 2000 in place of Colliery Control Order, 1945.

## B. Concepts, Definitions and Practices

### 1.7 Coal

Coal is a combustible sedimentary rock formed from ancient vegetation which has been consolidated between other rock strata and transformed by the combined effects of microbial action, pressure and heat over a considerable time period. This process is commonly called 'coalification'. Coal occurs as layers or seams, ranging in thickness from millimeters to many tens of metres. It is composed mostly of carbon (50–98 per cent), hydrogen (3–13 per cent) and oxygen, and smaller amounts of nitrogen, Sulphur and other elements. It also contains water and particles of other inorganic matter. When burnt, coal releases energy as heat which has a variety of uses.

### 1.8 Classification of Coal

1.8.1 Coal refers to a whole range of combustible sedimentary rock materials spanning over a continuous quality scale. For convenience, this continuous series is often divided into two main categories, namely **Hard Coal** and **Brown Coal**. These are further divided into two subcategories

as given below.

- **Hard Coal**
  - Anthracite
  - Bituminous coal
  - Coking coal
  - Other bituminous coal
- **Brown coal**
  - Sub-bituminous coal
  - Lignite

1.8.2 In practice, hard coal is calculated as the sum of anthracite and bituminous coals. Anthracite is a high-rank, hard coal used mainly for industrial and residential heat raising. Bituminous coal is a medium-rank coal used for gasification, industrial coking and heat raising and residential heat raising. Bituminous coal that can be used in the production of a coke capable of supporting a blast furnace charge is known as **coking coal**. Other bituminous coal, not included under coking coal, is also commonly known as **thermal coal**. This also includes recovered slurries, middling and other low-grade, higher-rank coal products not further classified by type.

**1.8.3** Classifying different types of coal into practical categories for use at an international level is difficult because divisions between coal categories vary between classification systems, both national and international, based on calorific value, volatile matter content, fixed carbon content, caking and coking properties, or some combination of two or more of these criteria.

**1.8.4** Although the relative value of the coals within a particular category depends on the degree of dilution by moisture and ash and contamination by sulphur, chlorine, phosphorous and certain trace elements, these factors do not affect the divisions between categories.

**1.8.5** The International Coal Classification of the Economic Commission for Europe (UNECE) recognizes two broad categories of coal:

- i) **Hard coal** – Coal of gross calorific value not less than 5700 kcal/kg (23.9 GJ/t) on an ash-free but moist basis and with a mean random reflectance of vitrinite of at least 0.6.
- ii) **Brown coal** – Non-agglomerating coal with a gross calorific value less than 5700 kcal/kg (23.9 GJ/t) containing more than 31% volatile matter on a dry mineral matter free basis.

**1.8.6** It should be stressed that the above classification system is based on the inherent qualities of the coal in question and not on the final use of the coal. In this way the classification system attempts to be objective and simple to apply.

## 1.9 Classification of Coal in India

**1.9.1** In India coal is broadly classified into two types – Coking and Non-Coking. The former constitutes only a small part of the total coal resources of the country. These two are further subdivided as follows on the

basis of certain physical and chemical parameter as per the requirement of the industry.

**1.9.2 Coking Coal:** Coking coal, when heated in the absence of air, form coherent beads, free from volatiles, with strong and porous mass, called coke. Coking coal has coking properties and is mainly used in steel making and metallurgical industries.

**1.9.3 Semi Coking Coal:** Semi Coking Coal, when heated in the absence of air, form coherent beads not strong enough to be directly fed into the blast furnace. Such coal is blended with coking coal in adequate proportion to make coke. Clearly, Semi Coking Coal has comparatively fewer coking properties than coking coal. It is mainly used as blendable coal in steel making, merchant coke manufacturing and other metallurgical industries.

**1.9.4 Non-Coking Coal:** Non-Coking Coal does not have coking properties and is mainly used for power generation. It is also used for cement, fertilizer, glass, ceramic, paper, chemical and brick manufacturing, and for other heating purposes.

**1.9.5 Washed Coal:** Processing of coal through water separation mechanism to improve the quality of coal by removing denser material (rocks) and high ash produces washed coal which has less ash, higher moisture, better sizing, better consistency, less abrasive, etc. The washed coking coal is used in manufacturing of hard coke for steel making. Washed non-coking coal is used mainly for power generation but is also used by cement, sponge iron and other industrial plants.

### 1.9.6 Middlings and Rejects:

In the process of coal washing, apart from Clean Coal we also get two by-products, namely, Middlings and Rejects. Clean coal has low density whereas rejects have high density. Middlings have intermediate density. Rejects contain high ash, mineral impurities, fraction of raw coal feed, etc. and

are used for Fluidized Bed Combustion (FBC) Boilers for power generation, road repairs, briquette (domestic fuel) making, land filling, etc. Middlings are fraction of raw coal feed having values of classificatory parameters between that of clan coals and rejects. It is used for power generation. It is also used by domestic fuel plants, brick manufacturing units, cement plants, industrial plants, etc.

**1.9.7 Hard Coke:** Solid product obtained from carbonisation of coal, used mainly in the iron & steel industry.

## 1.10 Categorisation of Coal in India

**1.10.1** In India, **coking coal** has been categorized or graded on the basis of ash content as per following scheme:

Grade	Ash Content
Steel Gr I	Ash content < 15%
Steel Gr II	15% ≤ Ash content < 18%
Washery Gr. I	18% ≤ Ash content < 21%
Washery Gr. II	21% ≤ Ash content < 24%
Washery Gr. III	24% ≤ Ash content < 28%
Washery Gr. IV	28% ≤ Ash content < 35%
Washery Gr. V	35% ≤ Ash content < 42%
Washery Gr. VI	42% ≤ Ash content < 49%

**1.10.2** In India, **semi coking coal** has been categorized or graded on the basis of ash and moisture content as per following scheme:

Grade	Ash + Moisture content
Semi coking Gr. I	less than 19%
Semi coking Gr. II	Between 19% and 24%

**1.10.3** In India, **non-coking coal** had been categorized or graded on the basis of Useful Heat Value (UHV) as per following scheme:

Grade	Useful Heat Value
A	UHV > 6200 KCal/Kg
B	6200 ≥ UHV (KCal/Kg) > 5600
C	5600 ≥ UHV (KCal/Kg) > 4940
D	4940 ≥ UHV (KCal/Kg) > 4200
E	4200 ≥ UHV (KCal/Kg) > 3360
F	3360 ≥ UHV (KCal/Kg) > 2400
G	2400 ≥ UHV (KCal/Kg) > 1300

**N.B:**

1. "Useful heat value" is defined as:

$$UHV = 8900 - 138 (A + M)$$

Where UHV = Useful heat value in KCal/kg,

A = Ash content (%);

M = Moisture content (%).

2. In the case of coal having moisture less than 2 percent and volatile content less than 19 percent the useful heat value shall be the value arrived as above reduced by 150 kilo calories per kilogram for each 1 percent reduction in volatile content below 19 percent fraction pro-rata.

3. Both moisture and ash are determined after equilibrating at 60 percent relative humidity and 40 degree C temperature.

4. Ash percentage of coking coals and hard coke shall be determined after air drying as per IS: 1350 - 1959. If the moisture so determined is more than 2 per cent, the determination shall be after equilibrating at 60 percent relative humidity at 40 degree C temperature as per IS: 1350 - 1959.

**1.10.4** In order to adopt the best international practices, India decided to switch over from the grading based on Useful Heat Value (UHV) to the grading based on Gross Calorific Value (GCV) and therefore on 16.01.2011 the Ministry of Coal notified the switch over. As per the

new system, following nomenclature has been introduced for gradation of **non-coking coal**.

Grades	GCV Range (Kcal/Kg)
G1	GCV exceeding 7000
G2	GCV between 6701 & 7000
G3	GCV between 6401 & 6700
G4	GCV between 6101 & 6400
G5	GCV between 5801 & 6100
G6	GCV between 5501 & 5800
G7	GCV between 5201 & 5500
G8	GCV between 4901 & 5200
G9	GCV between 4601 & 4900
G10	GCV between 4301 & 4600
G11	GCV between 4001 & 4300
G12	GCV between 3700 & 4000
G13	GCV between 3400 & 3700
G14	GCV between 3101 & 3400
G15	GCV between 2801 & 3100
G16	GCV between 2501 & 2800
G17	GCV between 2201 & 2500

**1.10.5** Based on the GCV ranges of proposed gradation and erstwhile gradation, a concordance table is generated for better understanding. However, it may be noted that this concordance does not depict exact one-to-one relation between the two systems.

Table 5: Concordance Table	
Old Grading based on UHV	New Grading based on GCV
A	G1
	G2
	G3
B	G4
	G5
C	G6
D	G7
	G8
E	G9
	G10
F	G11
	G12
G	G13
	G14
	G15
Non-coking Coal Ungraded	G16
	G17

## 1.11 Some General Concepts

**1.11.1 Run-of-Mine (ROM) Coal:** The coal delivered from the mine to the Coal Preparation Plant (CPP) is called run-of-mine (ROM) coal. This is the raw material for the CPP and consists of coal, rocks, middlings, minerals and contamination. Contamination is usually introduced by the mining process and may include machine parts, used consumables and parts of ground engaging tools. ROM coal can have a large variability of moisture and particle size.

**1.11.2 Opencast Mining:** Open-pit mining, open-cut mining or opencast mining is a surface mining technique of extracting rock or minerals from the earth by their removal from an open pit or borrow. This form of mining differs from extractive methods that require tunneling into the earth such as long wall mining. Open-pit mines are used when deposits of commercially useful

minerals or rock are found near the surface; that is, where the overburden (surface material covering the valuable deposit) is relatively thin or the material of interest is structurally unsuitable for tunneling (as would be the case for sand, cinder, and gravel). For minerals that occur deep below the surface - where the overburden is thick or the mineral occurs as veins in hard rock - underground mining methods extract the valued material.

**1.11.3 Underground Mining of Coal:** It refers to a group of underground mining techniques such as Longwall Mining, Room-And-Pillar Mining, etc. used to extract coal from sedimentary ("soft") rocks in which the overlying rock is left in place, and the mineral (coal) is removed through shafts or tunnels.

**1.11.4 Stripping Ratio:** In mining, stripping ratio or strip ratio refers to the ratio of the volume of overburden (waste materials) required to be handled in order to extract some tonnage of coal. For example, a 3:1 stripping ratio means that mining one tonnes of coal will require mining three tonnes of waste materials. This is a phenomenon related to mainly Opencast (OC) mining which requires removal of overburden prior to extraction of coal. Underground mining operations tend to have lower stripping ratio due to increased selectivity.

**1.11.5 Output Per Man Shift (OMS):** Productivity means the ratio between input and output and can be interpreted in different ways in different contexts. In case of production of coal, we use Output per Man Shift (OMS). This is defined (in Tonnes) as the ratio of Production (in Million Tonnes) to Manshift (in Millions).

**1.11.6 Despatch and Off-take:** The term "Despatch" (say, of raw coal) is used in this compilation to mean all the despatch of coal to different sectors but exclude collieries' own consumption (boiler coal used in collieries and supply to employees). On

the other hand, "Off-take" means total quantity of raw coal used/ lifted for consumption and naturally includes collieries own consumption. Therefore, Off-take = Despatch + Colliery Consumption.

**1.11.7 Change of Stock:** Change of Stock means the difference between opening and closing stock of an item.

**1.11.8 Pit-Head Stock:** The term "Pit-head Closing Stock" of raw coal is used in this compilation to mean all the raw coal stock at pit-head of collieries.

**1.11.9 Pit-head Value:** Pit-head Value of coal is the value of coal at pit-head of the colliery. It is computed on the basis of base price and therefore it does not involve any cost of loading, transportation from pit-head, Cess, Royalty, GST, etc. This approach is followed by all non-captive coal companies, viz., CIL Subsidiaries, The Singareni Collieries Companies Ltd. (SCCL), Jharkhand State Mineral Development Corporation Ltd. (JSMDCL) and Jammu & Kashmir Mineral Ltd. (JKML).

**1.11.9.1** In case of captive collieries, pit-head value of coal depends upon their accounting policy. If the costing of coal is done on no-profit-no-loss basis then pit-head value is calculated accordingly. This practice is found to be followed in captive collieries of public sector units.

**1.11.9.2** On the other hand, if the captive colliery is treated as independent commercial unit then pit-head value is calculated on the basis of unit value of realization, which includes cost price and profit/loss per unit but excludes any transportation cost from pit-head, Cess, Royalty, GST, etc. This is particularly followed in private captive colliery which is in contract to supply coal to any priority sector for which captive colliery is permitted (Steel, Iron, Power, Cement, etc.).

**1.11.9.3** Even there are private sector collieries being managed by the parent company engaged in manufacturing of Steel