

Mineral matter in coal:

The amount mode of occurrence and composition of the mineral matter in coal are factors of great practical importance in determining its market acceptability and economic value. The yields and qualities of products obtainable by cleaning the coal are also dependent upon the characteristics of mineral matter.

According to its mode of origin, mineral matter within a coal seam may be classified into the following two categories:

- 1) **Inherent mineral matter** :- Consisting of organic constituents that previously formed part of the tissues of the plants from which the coal was derived. Most mineral matter is chemically or colloiddally combined with coal substance. (UNCLEANABLE BY WASHING)
- 2) **ADVENTITIOUS MINERAL MATTER:** Derived from sources outside the swamps in which the coal forming plants decayed. Adventitious mineral matter occurs in the following four forms:
 - (a) in chemical or colloidal combination with the coal substance; (UNCLEANABLE BY WASHING)
 - (b) as fine particles, often disseminated fairly evenly throughout the coal; (CANNOT BE REMOVED EXCEPT BY FINE GRINDING OF THE COAL)
 - (c) as parting, bands and lenticles of mudstone, 'shale' , silstone, sandstone, etc. within he seam, resulting from deposition of sediments between period of coal formation; (THIS 'FREE' DIRT IS USUALLY REMOVABLE)
 - (d) as material that has been introduced into peres, fissures (cracks or split) and planes of weakness in the seam during or subsequent to colification; (USUALLY REMOVABLE AFTER COMMUNUTION)
 - (e) as mineral matter derived from strata above and/or below the seam due to modern system of mining; (THIS EXTRANEIOUS DIRT OR CONTAMINATION IS USUALLY REMOVABLE)

COMPOSITION: The principal mineral found in coal seams are listed in table 2.4, together with the chemical composition of each mineral. In addition to the elements in these minerals, coals contain other elements in very small amounts. These 'trace elements' includes the metals antimony, beryllium, bismuth, chromium, cobalt, copper, gallium, germanium, lead, molybdenum, nickel, silver, strontium, tin, uranium, vanadium, zinc and zirconium. Some of them may be inherent or adventitious or both in nature.

Relationship of mineral matter with ash:

Mineral matter and ash are sometimes wrongly considered same. Mineral matter content is commonly, but incorrectly, termed as ash 'content'. **Coals contain mineral matter but not ash;** ash is the solid residue, different from the mineral matter in both amount and composition, that is derived from it (i.e., MM) on combustion of the coal.

Nature of ash forming impurities :-

The impurities with which coal is contaminated as it comes from the mine are not of haphazard origin, each can be traced to a specific occurrence in the coal bed or its enclosing roof and floor. Shale, sandstone, bone and bony coal frequently occur as strata lying between the horizontal benches of coal on the bed or between the coal and the main roof or floor of the bed. Such a stratum may only be a thin coating along the bedding plane or it may be thick enough divide the deposit into two benches. Clay and shale also occur through less frequently as the filling of vertical fissures (cracks or splits) in the bed when material from the roof or floor has been forced into fissures by pressure.

Specific gravity of the ash impurities, i.e. Mineral matter:

- (1) Shale (sp. Gr. 2.6)
- (2) Sandstone (sp. Gr. 2.4 – 2.5)
- (3) Pyrite (sp. Gr. 4.8-5.1)
- (4) Siderite (sp. Gr. 3.7-3.9)
- (5) Calcite (sp. Gr. 3.7)
- (6) Pure Bituminous coal (1.25 – 1.30 sp. Gr.)

Average Composition of Indian Coal Ash

Constituent	Percentage
SiO ₂	: 40-65
Al ₂ O ₂	: 17-38
Fe ₂ O ₃	: 4-18
CaO	: 0.8-8
MgO	: 0.9-4
TiO ₂	: 0.7-2.7
Mn ₂	: Trace
Alkalies	: 1-4
SO ₃	: -

Effect of Toxic Trace Elements:

- Excessive release of arsenic into the atmosphere may lead to increase arsenic level in hair, urine and blood along with auditory changes leading to deafness in children. Increase of arsenic concentration in the pasture land results in concentration of arsenic in human beings through the milk of cows.

Arsenic, chromium and nickel in fly ash possess carcinogenic property.

- Nickel carbonyl, one of the compounds of nickel, is highly toxic to human beings, exposure to 30/λg/g of this compound for 30 minutes may cause death.
- Beryllium in excess of 0.01/λg/g may cause damage to lungs on inhalation.
- Presence of vanadium in the air may cause rheumatic symptoms with intense pain in bones and may affect kidneys.
- Cobalt containing dust and fumes are extremely irritating to skin, eyes and noes and may also cause lung cancer.
- Lead poisoning may effect the children and young people by brain damage, blindness, paralysis and even death.

TRACE ELEMENTS IN INDIAN COALS:

Elements	ppm in Ash	Remark
1. Gallium, Lanthanum, Molybdenum, Cobalt, Boron	0 to 150	Characteristically Low
2. Copper, Lead	Less than 120	Low Concentration
3. Manganese	Less than 100	-
4. Vanadium, Strontium	100-200	-
5. Tin, Yttrium	0-50	Very Low
6. Chromium	Below 170	Characteristically Low
7. Nickel general	Less than 100	Usually less for Indian Coals with exceptions in Tertiary coals of makum coalfields which is in the higher side.
8. Niobium	0-50	Generally Low
9. Arsenic	Less than 100	Generally around 50 ppm
10. Cadmium	Less than 17	-