

# COAL BENEFICIATION

Delhi Chapter at IIM  
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# WHAT IS BENEFICIATION



Segregation of good quality coal from not so good quality coal or rejects.



# WHY BENEFICIATE/WASH

Quality requirement by end use plants using Coal

Ever increasing concern about the environment

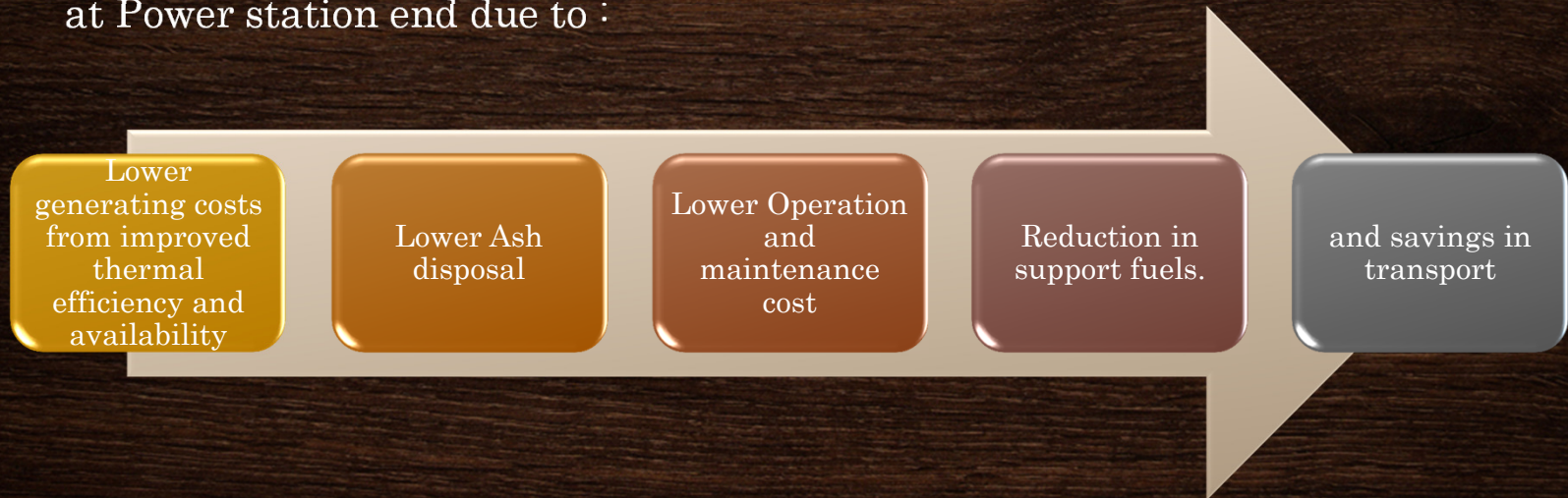
Greater emphasis on increasing production has resulted in deterioration of Raw Coal

To reduce stress on already overstretched railway system



# ADVANTAGES OF COAL BENEFICIATION

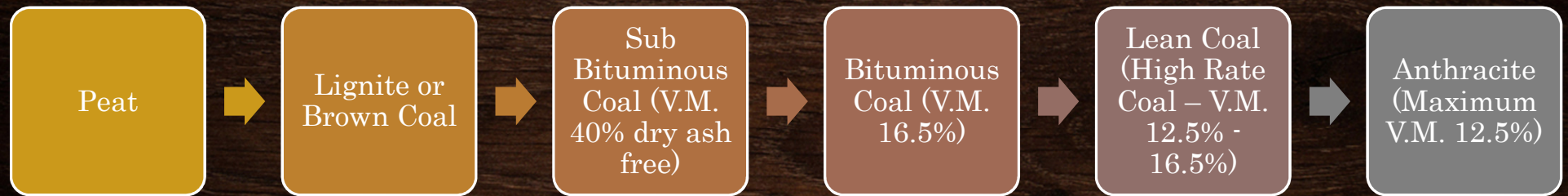
- Lower Ash content
- Better consistency in quality of coal thereby resulting in operational savings at Power station end due to :



- However immediate perceived benefits from lower ash coal is that there will be reduction in freight costs. Besides transport costs very low monetary value is given to other benefits viz savings in ash disposal costs, reduced land requirements, reduced transport and handling costs, social benefits like reduced settlement costs and reduced effects on cultivation in the impact zone and improved health and living conditions.



# STAGES IN THE FORMATION OF COAL





# INERT MATTER

When coal is ignited, it does not burn completely. There is always some material in coal which is inert to combustion. The material consists of water and mineral matter which remains in altered form as ash on the grates. The object of coal preparation is to reduce the amount of this inert material to a value acceptable to the consumer at least cost.

## MOISTURE

Coal always contains water which is referred to as moisture content. Water will not burn, thus higher the moisture content the less material is available for combustion and heating. During combustion water is converted into steam and part of heat available is used up for this conversion.

## INHERENT MINERAL MATTER

It is mineral matter intimately mixed with coal. It consists of minerals present in the original vegetation from which coal seams are formed and finely divided clays and similar material carried with the swamps by water and wind. Those clays are intimately mixed with coal and cannot be removed by coal preparation techniques.

## EXTRANEANOUS MINERAL MATTER

It consists of dirt bands, shales and sand stones and intermediate rocks introduced into the mined product from roof and floor of the seam. Most of the material is free and can be removed by coal preparation techniques.



# FLOAT & SINK ANALYSIS

(3 Main Reasons)

Determination  
of washability  
characteristics  
of coal

Evaluation of  
Efficiency of  
the washers

Plant control



# COAL PREPARATION

## Prescreens

- To screen out lumpy coal so that they may be crushed to sizes suitable for treatment.
- To remove finer sizes that may not require to be washed.
- And to classify the ROM coal in the required sizes for different washing units e.g. +12.5mm would be washed in dense media bath type washers, 12.5 to 0.5 mm in D.M. cyclones and -0.5 mm to be treated by Froth floatation or other means

## Drain and Rinse Screening

## Dewatering Screens

## Desliming Screens



# WASHING TECHNOLOGY

Basic principle involved in coal washing operation of all equipment depend upon difference in relative density between particles and the liquids/ media in which they are immersed.

## TYPES OF COAL WASHER

### BARREL WASHER

A steel spiral is attached to the inner surface of a barrel and as barrel rotates, the spiral acts as a screw conveyor and carries the discards towards the upper end for discharge. A stream of water is used to carry clean coal to the barrel outlet.

Barrel washer performs well only if coal is virtually free from middling's or deshaling is to be carried out i.e. suitable for coals of low NGM

### JIGS

The Jig is a gravity separator in water using the principle of fluidized bed. Raw coal is continuously fed onto the jiggling deck and submitted to water pulsations. The denser fractions shale/ middlings where applicable stratify with lower layers while the lighter fraction (clean coal) migrate to the top.



# TYPES OF JIGS

## MOVABLE SCREEN JIGS

- Washing deck is mechanically moved upwards and then downwards in water

## FIXED SCREEN JIGS

- The hutch water is mechanically or pneumatically pulsed through the deck.



# ADVANTAGES OF JIGGING

Jigs can achieve one, two or even three separators

Jigs size can extend from 10 TPH to 800-900 TPH for large industrial scale units

Jigs will separate at densities down to 1.4 if washability is easy and will separate even better at densities upto 2 and above

Washing in water takes away the problem of heavy media loss incurred on porous coals

Operating costs are generally lower as Jigs consume no media

Wear in Jigs is low owing to slow motion of the Jigs



# DENSE MEDIUM SEPARATION

- Dense medium separation of coal is essentially a matter of separating the feed coal into particles “lighter” than the medium which tend to float and particles “heavier” than the medium which tend to sink

## DENSE MEDIUM SEPARATORS

### DENSE MEDIA BATH

Many designs have been developed of D. M. baths. They fall into two main classes viz Deep baths and Shallow baths. Most Dense Media Baths cannot make efficient separation on coal substantially smaller than 6 mm size.

### DENSE MEDIA CYCLONE

Cyclonic D. M. washers make use of centrifugal force so that the heavier particles move rapidly towards the wall of the cyclonic vessel and lighter particles move rapidly towards the centre of the vessel. These are suitable for treating coal over a wide size range

80 mm-0.1 mm



## FROTH FLOATATION

- Flootation depends upon the principle that some minerals attach themselves to air bubbles while others attach themselves to water. It is because coal particles attach themselves to air bubbles and ash constituents are wetted by water. Frothers are used to produce stable bubbles.
- Unfortunately Pyrites that contains inorganic sulphur is also hydrophobic which means froth floatation is not effective in reducing sulphur content.

## DRY CLEANING

- Separation of impurities from coal by manual or mechanical means



# PNEUMATIC JIGS

Raw coal fed on to the vibrating bed having crosswise and vertical slope. Air supplied through air holes in the beneficiation bed which agitates the raw coal resulting in stratification of coal as per its relative densities - lighter coal forms the upper layer and heavier coal forms the lower layer. Upper good coal goes to conveying trough and higher density coal moves to waste side.

Cost Effective

Useful in water scarcity areas

Best suited for coal which have high% of NGM

In comparison to wet methods – does not add water to beneficiated coal i.e. no reduction in heat value due to added moisture

## DISADVANTAGES

Separation efficiency is low. Could be used as for deshaling purposes.

## MAGNETIC & ELECTROSTATIC

Separators have also been experimented from time to time but have not been put to commercial use on a big scale



## Statutory Provision in Law for Power Grade Coal

In November, 1997, Ministry of Environment and Forests (MoEF) Govt. of India mandated that all power plants located at a distance of 1000 km and beyond from the pit heads or located in urban areas, environmentally sensitive and critically polluted areas, irrespective of distance (except pit head stations) must use coal less than 34% from 1<sup>st</sup> June, 2001.

These provisions have further been amended in January, 2014 that

- stand alone thermal plant or captive thermal plant of installed capacity of 100 MW or above located between 750-1000 km from pit head w.e.f. 1<sup>st</sup> January, 2015 shall be supplied with and use raw coal or blended coal or beneficiated coal less than 34% ash on quarterly basis.
- The above specified distance has further been reduced to 500-749 km from pit head from 5<sup>th</sup> day of June, 2016.