Use of Blended Coal in Thermal Power Plants

CENTRAL ELECTRICITY AUTHORITY

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OVERVIEW

- Status of coal based power capacity (MW) in country
- Need for coal blending.
- Effect of coal quality parameters on boilers.
- Blending Methodologies.
- Experience with blended coal.
- Approach for future.
- General indicators of good blending.

Status of Coal based power capacity in the country Installed as on 30.09.2014

Coal based	-	152970.89	(60.2%)
Gas based	-	22607.92	(8.9%)
Diesel	-	1199.75	(0.5%)
Hydro	-	40798.76	(16.1)
Nuclear	-	4780.00	(1.9%)
RES	-	31692.14	(12.5)

		254049.46	(100%)

Status of coal based power capacity (MW) in country

Likely power capacity (MW) addition in 12th Plan:

Coal / Lignite based	**-**	**70000 MW**
Gas based	**-**	**2500 MW**
Hydro	**-**	**11000 MW**
Nuclear	**-**	**5000 MW**

Total conventional	**-**	**88500 MW**
Renewable	**-**	**30000 MW**

		118500 MW

Status of Coal based power capacity in the country

- **Capacity Additions**
  - 10th Plan - Total – 21,180 MW, Thermal - 12,114 MW
  - 11th Plan - Total – 54,964 MW, Thermal - 48,540 MW
  - 12th Plan (Likely) - ~Total 88,500 MW , Thermal - 72,000
- **Renewable Capacity - ~ 24,000 MW (in 11th Plan)**

  (~30,000 MW (in 12th Plan)

IEP/CEA Estimates for 2031-32

Total Capacity – 800 GW, Coal Based- ~ 470 GW

Coal Consumption – 2 Bt – Substantial imports

Coal is and will remain the main fuel for power

Need for coal blending.

- There is a mismatch in the coal requirement and domestic coal supply.
- Thus coal import is a necessity.
- Import of steam coal was 87.09 MT during the first half of 2014-15 (April to Sept.) which was 72.16 MT during this period in 2013-14. Irrespective of the fact that coal production was increased during this period.
- It becomes necessary to find ways and means of using imported coal in existing boilers and design new boilers for the changed scenario.

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Need For Coal Blending

- Firing of imported coal in a boiler designed for it - No issue.
- Firing of imported coal in a boiler designed for indigenous coal - An issue.
- "Group for studying range of blending of imported coal with domestic coal" looked into various aspects of the issue and concluded that as a general practice about 10 to 15 % (by weight) or 15 to 22% on heat value basis of imported coal can be blended comfortably.
- For new units to be designed for indigenous coal an advisory was issued by CEA which reads as follows:
  " for all future indigenous coal based thermal power plants, a stipulation shall be made that the boilers (including auxiliaries) shall be designed for blend ratio of 30:70 (or higher) imported:indigenous coal. The station facilities shall also be designed for unloading, handling and blending of imported/high GCV coal."

Effect of coal quality parameters on boilers

Impact of coal quality parameters on design/performance of Boilers needs to be studied carefully, specially while blending two coals with widely varying characteristics.

- High Ash content: Furnace sizing, More number of mills, sizing of PAF, APH, ESP, CHP, AHP. For high ash coal, the furnace is higher by about 20%.
- Boilers supplied by BHEL are capable of giving rated output with coal quality variations of about 1000 kcal/kg.
- High abrasive content in ash: Low flue gas velocities and large spacing in pressure parts.
- High Moisture: derates mill capacity, needs high mill air temperature and accordingly sizing of economizer. Low moisture content will result in higher flue gas temperature.
- FC/VM Ratio: This indicates reactivity of coal. Ratio more than 1.5 indicates coal is difficult to burn.
- High VM: Easy burning with long flame. Needs careful handling. Affects mill outlet temperatures.
- HGI: Large variations results in difficulty in achieving desired fineness. More unburnt carbon loss.

Effect of coal quality parameters on boilers

- Ash Characteristics: Compatibility of ash characteristics is most important. These includes ash fusion temp., base/acid ratio, iron/calcium ratio, silica/Alumina ratio, iron contents etc. These decides slagging/fouling/erosion/corrosion potential may impose limitation in reaching rated capacity besides furnace cleaning and ash handling.
- Large proportion of blending of imported coal of low ash and high GCV with domestic coal of high ash content and low GCV may result in changed heat transfer profile in radiation, convection and conduction zone and difficulty in attaining steam parameters.
- Blending results in change in aggregate quality of coal to be fired.
- Ash, GCV, Fixed Carbon, GCV, and moisture content to some extent are additive in nature. Where as other parameters are not and needs to beevaluated thoroughly.
- Conduct combustion test of blended coal before hand conducting site trials is considered a good approach for deciding blending proportions.

Blending Methodology

Various methodologies of blending imported and indigenous coal are as follows:

- *Separate layering of imported and domestic coal in stockyard or blending in beds.*
- *Blending on conveyors by silo*
- *Blending by ground hoppers or emergency reclaim hoppers*
- *Blending of two streams of coal on conveyor belt.*
- *Dedicating one or two mills for firing imported coal and remaining mills on domestic coal.*

Development of infrastructure for use of blended coal is required inside thermal power plant as well as outside the plant.

In an existing plant, there may be space limitations in creating infrastructures. In a new plant, it is possible to keep best provisions for use of blended coal.

Experience with Blended Coal

- Large number of utilities are already using blended coal. Generally blending of 10-15% by weight of imported coal with domestic coal is possible.
- These utilities have experience of handling imported coal.
- It is reported that it is difficult to mix two different coals of varying heat values. This results in uncontrollable combustion parameters and high un burnt carbon losses.
- Handling of High VM coal requires special precautions. Mill temperatures needs to be kept low.
- At some station use of separate mill for imported coal has solved mill problems and un burnt carbon loss. Whereas at some stations this has resulted in clinkering in burner zone of mill firing imported coal.
- Some of the existing units are successfully firing blended coal with 30% of imported component.

Approach For Future

- Possible extent of blending depends on boiler design and characteristics of coal to be blended. Generally blending of 10-15% by weight of imported coal with domestic coal is possible in existing boilers.
- It is important to know the characteristics including organic and inorganic properties of both imported coal and domestic coal in advance to examine the compatibility. Mere averaging the coal quality parameters is not adequate and needs thorough analysis including testing in laboratory before field trials.
- It may not be possible to use blended coal for some stations eg. Stations already getting very good quality domestic coal, stations facing layout constraints etc.
- For new boilers it is possible to design the boiler for any blend of domestic and imported coal.
- In existing stations, the choice of blending methodologies depends on facilities available in CHP and additional space available for creation of facilities.
- Efforts should be made to supply coal to pithead stations in BOBR wagons.

General Indicators For Good Blending

Following observations need to be particularly made during firing of blended coal:

a) Deposits on heat transfer surfaces of water wall and convection pass - should be loose and easily removable.

b) It should be ensured that heat flux is fully regained after wall/soot blowing.,

c) Rise in furnace exit temperature - should not be high as this may increase the SH/RH spray levels.

d) Rated steam parameters must be achievable

e) Furnace temperatures shall be observed through view holes/peep holes by pyrometers

f) Mill outlet temperature should be monitored and achievable as per the quality of coal fired.

g) There should be no abnormal increase in the following

SH/RH spray

NOX and CO emissions

Unburnt carbon in bottom and fly ash

Acid dew point of flue gases at air heater outlet

Thanks