Mechanised Coal Handling and Processing Systems for Paper and Pulp Industry

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The vast industrialisation taking place in India during the last ten to fifteen years called for advance technology in the field of power and steam generation to meet the increasing demand of power and steam. This requirement is basically from continuous process industries of medium and small scale/size. Today's Paper and Pulp industries require power and steam which is obtained from Oil and Coal fired boilers. As the economy of the coal fired boiler over the oil fired one is already proven due to higher prices of oil, most of the units have coal fired boilers. The boiler capacity depends upon the capacity of unit and process. Few Boiler Manufacturers have put in serious efforts to implement advance technology to fulfill the steam and power requirements, which is giving satisfactory results and number of plants are utilising the same. The superior design of boilers while fulfilling the requirement of power and steam at reasonable cost calls for change in use of allied equipments, accessories and operating method to certain extent. Boilor Manufacturers are making extensive efforts to advise, educate the Users, Customers and helping them in selecting allied equipments and operating methods to achieve expected goals.

The mechanised/semi-mechanised coal handling, crushing, storage system/equipment pay an important role in functioning of the boiler. The economical viability of semi-mechanised/mechanised coal handling system is already proven. The mechanised stoker, fluidised bed boilers is the advancement in the boiler technology for small and medium capacity boilers. The width, speed and the design of the stoker varies from manufacturer to manufacturer. The mechanised stoker and fluidised bed boilers call for the sized/graded coal. The coal sizing requirement is decided by boiler manufacturer depending upon stoker design.

The larger paper plants of 200 TPD to 250 TPD capacity require coal to the tune of 400 to 1000 MT. per day and hence they tend to install completely mechanised handling right from the unloading of wagon by Wagon Tippler upto feeding the crushed coal to storage bins This paper describes the semi-mechanisied systems which are essentially installed in medium/small paper units.

While selecting the proper type of coal handling system, crushing, screening equipments various aspects are required to be taken into consideration such as (i) Grade of coal available for continuous use (normally C & D grade coal is made available to most of the paper plants), (ii) Percentage of fines (average) in the incoming coal, and (iii) percentage of fines acceptable for boiler feeding, (iv) Foreign material in the incoming coal, (v) reliability of over-all system, (vi) Space-available for installation, (vii) Man-power saving achieved due to implementation of scheme (viii) Power-consumption.

To minimise the manual handling and limiting the operation to particular hours crushed coal handling storage systems are essential. Advantages of using mechanised crushing and hand ing system are much more and will have to be viewed separately on case to case basis. Few common advantages can be described as under :

1. Uniformity in product size of crushed coal.
2. Less generation of fines as compared with manual crushing.
3. No wastage of coal during handling.

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4. No. control or supervision required during operation.

5. Continuous and naterogenous feed available to boiler which avoids fluctuation in its performance.

The selection of equipments required for system such as belt conveyors, bucket elevators, chain conveyors, feeders, etc. depends on various factors such as site lay-out, space availability and other requirements. The belt conveyor installation is preferred over bucket elevator from dust near boiler house and operation and maintenance point of view and to minimise manual handling distance from coal yard to boiler.

REQUIREMENT OF VIBRATING SCREEN IN THE SYSTEM

Vibrating screens are installed in the system to have reject separation. Screen size selection is important for efficient screening and depends on expertise and experience of system designer/Manufacturer. Since coal sizing requirement of boiler varies as per make, location of vibrating screen, i.e. before crusher or after crusher is important from system functioning point of view, e.g.

(i) Some boilers require average 25 MM. size coal with 20% to 25% fines (—3 mm). In this case screen installation is not required. Refer Fig. (1)

(ii) Some boilers require 100% -25 mm. size coal with 30% to 40% fines (-2 mm). In this case screen should be installed after crusher to remove over size. (Refer Fig (2))

(iii) Some boilers require average 25 mm. size coal with max. 10% fines (-3 mm.). In this case screen should be installed before crusher to remove fines. (Refer Fig. (3)).

(iv) Fluidised bed boilers require 100% -8/6 mm. and +1 mm. In this case screen should be installed after crusher with over-size recirculation system. (Refer Fig. (4).

The screen location should be selected keeping in view the basic coal size requirement.

SELECTION OF COAL CRUSHERS

Various types of crushers are available in the market, manufactured by concerns of repute. Selection of proper type of crusher has become difficult as there is no control on the incoming coal from the quality aspects are required to be taken into consideration such as (i) Input size coal characteristics, (ii) desired reduction in size of coal, (iii) crushed coal size analysis required (iv) crushing action in the crusher, (v) Ruggedness of equipment, (vi) durability, (vii) protection device, (viii) Maintenance and operation cost, (ix) Initial cost, etc.

MECHANICAL REDUCTION METHODS :

The coal crushers available crush the coal using one or more of the crushing action mentioned below :

(i) Impact
(ii) Attrition.
(iii) Shear.
(iv) Compression.

Every reduction method has specific advantages and should be preferred for following conditions.

(i) IMPACT

1. When a more cubical particle shape is needed or desired.

2 Where the finished product should be well graded from the top size to the bottom. In other words, where intermediate sizing specifications must be met as well as top and bottom specifications.

3. In many cases, ores contain 'Foreign' or unwanted material such as mica in some feldspars, etc. Impact crushing will cause such ores to break along their natural cleavages, thus freeing the wanted material from the foreign, and preparing it for successful separating.

(ii) ATTRITION

Attrition grinding should be specified.

1. When material is fairly friable and not too abrasive (low silica content is usually required).

2. When 'closed-circuit' grinding is not feasible or desirable.

3. When a maximum of 'fines' are wanted in the finished product.

FIG. 1

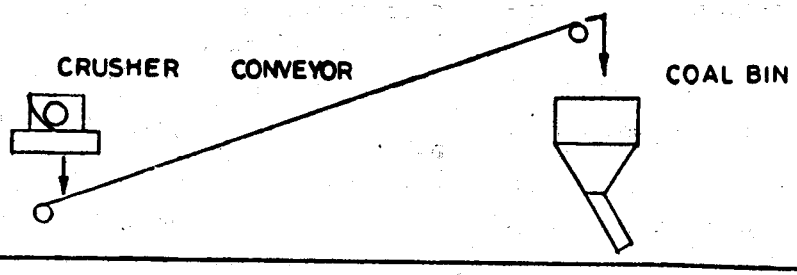


FIG. 2

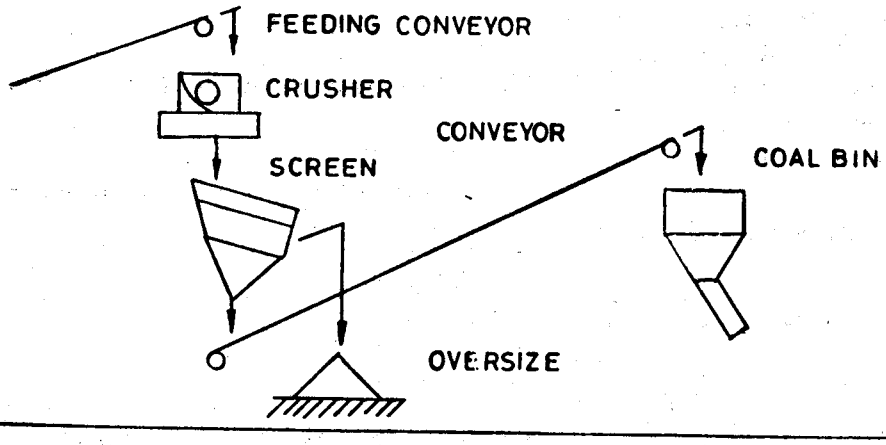


FIG. 3

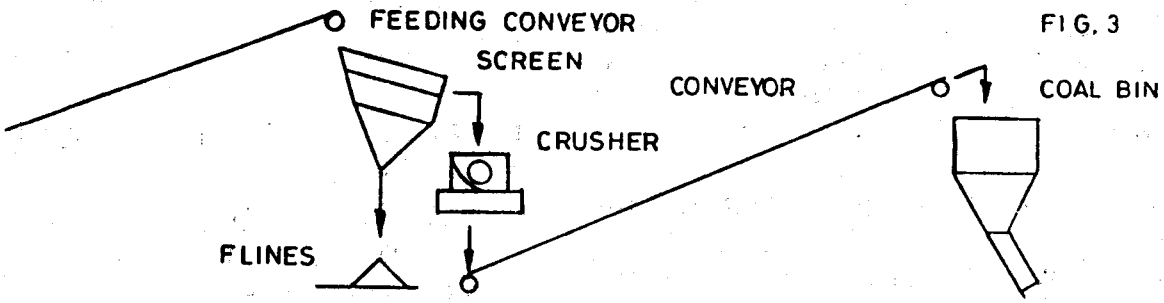
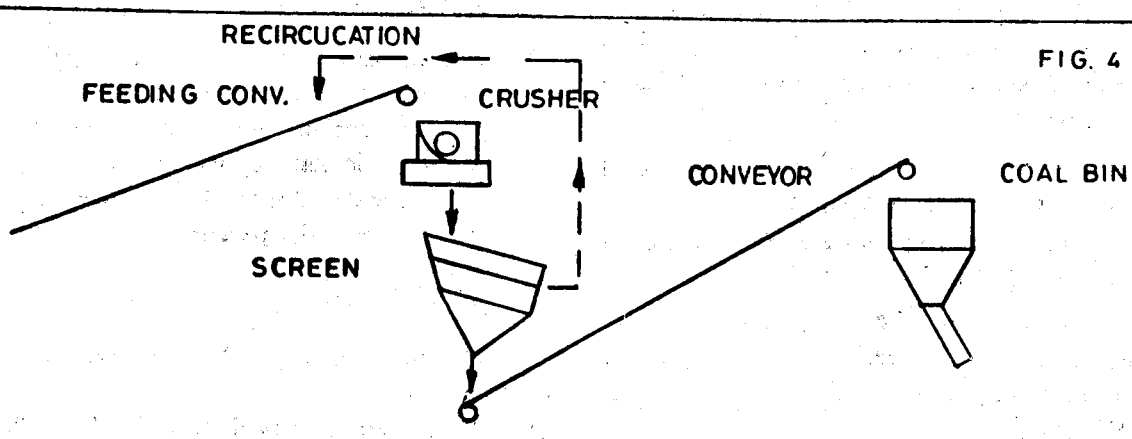


FIG. 4



(iii) SHEAR

1. When material is fairly friable (compressive strength usually under 15,000 to 20,000 Psi) and containing a relatively low silica content.
2. When large reduction ratio is needed. It is not unusual for a single roll crusher to handle 40" cubes (or large) and reduce them to 5" and under cubes.
3. When a minimum of fines is desired.
4. When a relatively coarse product is wanted - usually no finer than $1\frac{1}{2}$" top size.

(iv) COMPRESSION

1. When the material is hard and tough.
2. If the material to be crushed is abrasive.
3. If the material is not sticky.
4. When a uniform and cubical product with a minimum of fines is desired.
5. When the finished product is to be relatively coarse-usually approximately $\frac{3}{4}$" or larger top size.

Following crushing actions are involved in the crushing by popularly used crushers.

1.	Hammer Mill	:	Impact & attrition.
2.	Impactor	:	Free air impact.
3.	Ring-Granulator	:	Impact, compression and Attrition.
4.	Single roll crusher	:	Impact, shear & compression.
5.	Jaw Crusher	:	Impact & Compression.

Different charts/graphs are available giving crushed product analysis for crushers. A typical case of crusher selection will be as under :

Conditions :

(i) Incoming coal size - 200 mm to 250 mm.

(ii) Boiler feed size - Average .25 mm. with 30% fines acceptable.

(iii) Feeding to crusher - Manually.

Normally the incoming coal already contains 15% to 20% fines. Hence if the high speed crusher which generates @ 20% fines is selected, the total build up of fines percentage will be 40% which is not desirable for boiler feeding. As the crusher is to be manually fed it should be a slow speed from safety point of view. The above conditions can be fulfilled by a single roll crusher as it operates on a slow speed crusher and will generate very less percentage of fines, gives average .25 mm. size crushed coal and hence it should be selected.

CONCLUSION :

1. At least a partially mechanised system to handle and process the coal will directly result into higher performance from boiler resulting into better efficiency from steam generation section.
2. Selection of equipment like screen, crusher, etc. must be given great deal of attention for desired quality of processed coal.
3. Due to unsure quality of incoming coal, it is all the more necessary that component selections given due attention.
4. For sophisticated boilers like fluidized bed type, a thought should be given to use the powder in pellet from thereby climinating coal wastage.