CHAPTER - 20
Fuel & Ash Handling

Liquid Fuel Handling

Introduction:

Fuel Handling covers receiving, unloading, storage and forwarding of Fuel to the Boilers.

In case of Liquid fuels, Fire Protection attains primary importance and the Fuel Handling Systems are designed and constructed to approval of the Department of Explosives, Govt. of India, Nagpur.

Important factors to be taken care of in Liquid Fuel Handling:

Generally there are two types of liquid fuels that are handled. Some Fuels are Highly Explosive like Naphtha, Petrol, Diesel Oil and Kerosene while others are not so explosive such as Furnace Oil and LSHS.

Further, some liquid fuels are highly viscous and require to be preheated for making them flow. LSHS is a fuel of this type. At normal ambient temperature LSHS does not flow. It remains almost in a solid state and has got to be heated to a temperature of 70^0 C for making it possible to flow and be pumped.

Some fuels are highly volatile such as Petrol and Naphtha. Such fuels emit explosive vapours while being handled and are prone to fire hazards. Naphtha vapour is heavier than air and therefore tends to get collected in low-lying areas surrounding the fuel handling facility and when concentration of Naphtha Vapour becomes high it can cause explosion and fire.

Safety Aspects of Liquid Fuel Handling:

Because of the above-described factors, the following safety precautions are taken in Liquid Fuel Handling:

- Earthen dykes individually surround storage Tanks such that entire volume of fuel stored in the tank can be easily contained within the dyke. The dyke is not provided with any direct drain since such drain would also cause the fuel to flow out in case the storage tank is damaged. For taking out rainwater, a sump for collection of rainwater within the dyke and a pair of pumps for pumping the same out of the dyke are provided. This ensures that fuel shall not flow out of the dyke if the storage tank gets damaged.
- Storage tanks are spaced sufficient distance apart from each other so that in case of fire in one of the storage tanks, it does not spread to others.
- For Highly Explosive fuels, fire-fighting systems comprising Foaming Systems and Water Deluging Systems are installed around the storage tanks. Design of such systems is to be got approved from T.A.C. (Tariff Advisory Committee of Insurance Companies) and the Department of Explosives.
- For fuels which are highly volatile and whose vapour are heavier than air, portable handheld ‘Hydrocarbon Detectors’ are kept available at the Fuel handling installations and a practice of regular checking of presence of Hydrocarbon, within the dykes and other areas identified to be dangerous, is established.
- All switches, illumination fittings and motors installed in Liquid Fuel Handling Area are always of ‘Explosion Proof’ construction.

- Care is taken that no spark is generated while handling the Liquid Fuel due to Static Electricity. For this purpose the entire installation is designed to be an Equipotential Surface and the Transporting Tankers are 'grounded' with Equipotential surface in order to ensure that Static Electricity is discharged.
- Precautions are taken for ensuring that the entire Liquid Handling Area is declared as 'No Smoking' Zone.
- Entire installation is constructed and maintained to be free from leakages.
- Since Liquids are generally incompressible, a Non-return Valve is provided between the forwarding piping and the storage tank such that when the forwarding piping is isolated at its both ends with the help of valves, the liquid in pipe can pass on to the storage tank if it expands in volume due to temperature.
- In case of Highly Explosive and Volatile Fuels such as Naphtha, Storage Tanks are of 'Floating Roof' type of construction so that there is no need of providing vent in the storage tank.
- All maintenance work is carried out with the help of 'Non-sparking Tools' so that there is no chance of occurrence of any spark that may cause ignition of fugitive vapour, if any.
- Torches used for emergency lighting are all of Explosion Proof construction.
- In case of Low Flammability Liquid Fuels which have to be heated for being less viscous and easy to handle, such precautions are not necessary. In case of such fuels steam tracing lines are provided for keeping the fuel hot as it flows in the pipes and steam heating coils are provided in storage tanks for the same purpose. The transport tankers for such fuels are also equipped with steam heating coils.

Important aspects of layout of Liquid Fuel Handling Systems:
Following are important aspects of layout of Liquid Fuel Handling:
- Pumps are so installed that required NPSH is always available.
- Pipe Lines are laid preferable with a gently rising slope of 1 in 200 so that air pockets are not formed. At the end, or at locations where the pipe must come down, suitable vent is provided such that controlled venting can be carried out for priming. After priming of the piping the vent is locked in closed position.
- Liquid Fuel Pipes for Highly Explosive Fuels are not laid on same racks on which pipes carrying hot materials are laid, such as hot water and steam pipes.

Solid Fuel Handling
Solid fuels commonly used are Coal, Lignite, Wood, Bagasse, Rice Husk, Coconut hell, Ground Nut Shell etc.
Method of handling them differs depending upon quantity to be handled. Conventional material handling systems such as Wagon Tipplers, Conveyor belts, Conveyor Feeders, Vibrating Feeders, Vibrating Grizzle, Stacker-reclaimers, Ring Granulators, Hammer Crushers, Bucket Elevators are used.
Coals being the primary fuel in India, salient features of Coal Handling are given in the following.

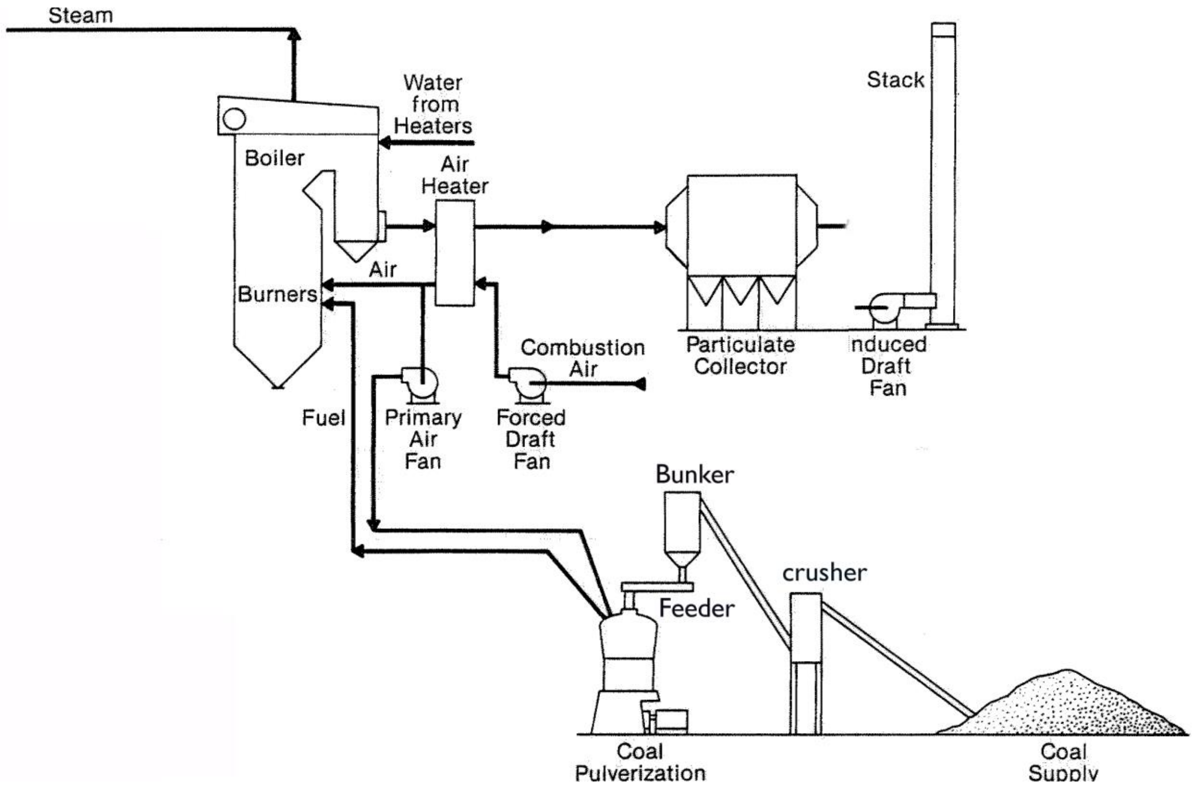
Coal Receiving:
Coal is received in the following alternative manners:

- By means of dedicated railway merry-go-round system,
- By means of conventional railway systems,
- By aerial ropeways and
- By trucks.

When dedicated railway merry-go-round system is used, the railway wagons employed are of 'bottom opening box wagon' type. For unloading coal from such wagons the loaded train is made to pass over receiving hoppers and bottom discharge gates of wagons are opened one by one through a suitable automatic control system. The train does not have to stop at all for discharging the coal load from wagons. Weighment of loaded and tare wagons is also automatic. Such systems are employed in very large thermal power stations of 1000 MW and higher capacity if these are located with 10 to 20 kilometres of coal mines.
Receipt of coal by means of conventional railway system utilizes special box wagons with open roof. Coal is unloaded by means of wagon tippler. Wagon tippler over turns wagons one by one into receiving hopper.
When coalmines are very close to power plant (5 to 10 km) and power plant capacity is lesser than 1000 MW, aerial ropeway is considered to be most economical and convenient means of coal transport.
Coal transport by truck is quite common for use in industrial boilers and small power plants of up to 200 MW capacities. Depending upon the number of trucks to be unloaded, methods used for unloading coal from the trucks differ. Methods such as manual unloading with help of shovels, rear dump trucks, truck tipplers are used.

Coal Storage:
Coal generally contains volatile matter, which tends to escape during storage. The escaping volatile matter causes spontaneous combustion of coal. Such combustion is not only a fire hazard and wasteful of coal but also causes damage to handling equipment such as conveyor belts. Therefore, coal storage is to be so arranged that incidence of spontaneous combustion of coal is minimum. Long-term storage of coal in R.O.M. (Run of Mines) form (in shape of boulders) is not advisable from this point of view and is generally avoided.
For this purpose coal is stored in crushed form (size about 30 mm) and the stack of the crushed coal is well compacted so that exposure to atmospheric air is minimum. For this Ring Granulators are used for crushing and Bull Dozers are used of formation of storage stacks.
If coal is to be stored for substantially long period, its stack should be covered suitably for ensuring seclusion from atmosphere.
Coal storage yards are provided with slope and drain channels so as to allow rainwater to drain out. Stacks are covered with low cost PVC or polyethylene sheets.
In cold countries coal is also stored in large silos. In India, however, this has not yet been tried.

Lignite Storage:
Lignites are prone to spontaneous disintegration in storage and become powdery and loose their volatile content. Therefore, Lignite is generally not stored in bulk. It is stored in small quantities in the form of as large boulders as possible, which are crushed in real time as they are fed to coal bunkers of the boiler.



Typical Coal Handling Plant for PF

Precautions in Solid Fuel Handling:
Solid fuels cause dust nuisance during handling. Such dust apart from being harmful to health also forms explosive mixture with atmospheric oxygen. Dust also causes of valuable fuel in the long run. Therefore, dust suppression equipments are installed in Solid Fuel Handling Plants. Such systems comprise of dust suction and collection arrangements and the collected dust is directly fired in boiler.
In order to ensure safety from fire due to explosive nature of dust, all motors, switchgear, switches and light fittings installed in fuel handling area are of explosion proof type of construction.
Personnel working in fuel handling areas are provided with dust masks so that they do not inhale dust. Other industrial safety precautions are also taken.
Conveyor belts are provided with 'Pull Cord Switches' for enabling manual stoppage of the conveyor in case of any emergency.
In order to prevent iron and steel pieces belonging to fuel handling machinery from finding their way in coal preparation plant large electromagnets are installed over conveyor belts. Such magnets lift the iron and steel pieces.
Certain components of fuel handling machinery such as Hammers of hammer Mills and Rings of Ring Granulators and shovels used in mining are made of non-magnetic

Manganese Steel. Such non-magnetic pieces cannot be lifted by electromagnets installed on conveyor belts. Therefore, Metal Detectors are installed n conveyors leading to boiler bunkers. The Metal Detector System is so designed that upon detection of metal on the conveyor belt it not only gives Alarm (Audio Visual) but also drops powdered lime over the conveyor close to the locations where metal was detected. This helps in identifying the location of non-magnetic metal pieces and their removal.

Blending of Solid Fuels and Feeding of Additives:
Often it is desired to blend several grades of solid fuels before feeding them to boiler. This can be achieved by two means as follows:
(i) By forming fuel stacks in layers of various types of fuels and
(ii) By controlled reclaiming of various fuels from different stacks.
Generally the first system is adopted, as it does not require installation of any costly equipment.
However, in some cases it becomes necessary to ensure controlled blending for the purpose of feeding fuel additives. One commonly used additive is Limestone. Limestone is fed along with coal into the boiler furnace for limiting emission of SO_x from boiler along with flue gases.
This is generally achieved by direct feed of properly sized limestone into furnace through regulated feeders, rather than by blending with the coal being fed to boiler bunkers.

Ash Handling
Ash is a waste product of coal and solid fuel combustion. It contains many harmful elements which can contaminate sub-soil water of water is allowed to seep through ash into soil. Further, percentage of ash present in Indian coals is large. As a result, disposal of ash also uses up considerable area of land, which could otherwise be put to better use.
Therefore, it is desirable to put ash to use so that the problem of providing land area for its disposal is solved. All out efforts are being made for finding uses of ash. Presently, only negligible amount of total ash produced in the country is put to use. However, ash being a good landfill material can be used in bulk in projects like highway construction. This is being done to as large an extent as possible.
Pollution Control Regulations have made it mandatory to dispose ash in dry form only so that harmful elements do not find ingress in the sub-soil water.

Ash Handling Systems:
In modern boilers ash is collected in two locations namely (i) Bottom of the furnace and (ii) in Electrostatic Precipitators (or Dust Collection Systems). Out of these two fractions generally the quantity of ash collected in Electrostatic Precipitators (or Dust Collection Systems) is larger. Ash collected in the Bottom of Furnace is generally small in quantity and is handled wet, whereas that collected in Electrostatic Precipitators (or Dust Collection Systems) is now collected by means of dry handling systems.

In the following is given brief description of Wet and Dry Ash Handling Systems:

Wet Ash Handling:
In wet handling ash is made to fall in a trough or hopper impounded with water. Ash collected in such trough or hopper is in the form of clinker and is collected by one of the following methods:
Scraper Conveyor,
Water jet assisted hydro-ejectors (in such systems the clinker is ground to fine grit size before being passed through hydro-ejector).
The water-ash slurry collected is disposed by means of pipes into the storage area or into temporary storage bins from where it is carried to the disposal site by means of trucks.

Dry Ash Handling:
Ash collected in the form of fine powder in the hoppers of ESP or Bag Filters is collected dry. Dry collection systems utilise the drag between fine ash particles and air and make powdery ash fly with air in the form of a thick dust storm inside the handling pipes. Upon reaching the collection bins this ash laden air is passed through cyclone separators and finally through bag filters.
Dry powdery ash from collection bins is either disposed by means of trucks or belt conveyors or other mechanical conveying systems to the ash disposal area.
In order to prevent harmful elements finding their way into subsoil water of the ash disposal area, the entire ash disposal area is lined with an impervious membrane. After disposal too, such impermeable membranes are put in place between successive layers of ash.
Finally when high enough heap of dry ash is formed it is covered with a sufficiently thick layer of soil and suitable plants are grown on it for maintaining ecology to the extent possible.