

RESEARCH PAPER ON STUDY OF VARIOUS CIRCULATION SYSTEMS IN PTPS

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COAL CIRCULATION

Coal is transported from the coal mine with the help of train. Train wagons are emptied with the help of tippler and stored in coal yard. From here it goes to the coal crusher, where the big size coal is crushed and made into the required size. From coal crusher it goes to the coal bunker through conveyor belt and from coal bunker it move to R.C. feeder. R.C. feeder feeds coal to the coal mill, where the coal is ground into powder form.

Air from primary air fan is introduced into the coal mill and coal powder mixed with it and goes to the classifier. The work of classifier is just to separate the un pulverized coal and feed it again to the coal mill. The pulverized coal mixed with air enters in the furnace at the corner through and forms a circle due to tangential fired. Here coal burns completely and releases heat and becomes in ash form. Ash in the furnace is taken away by ID fan through the Electrostatic precipitator. The purpose E.S.P. is to collect the ash. From the E.S.P. ash goes to the ash handling plant. The particles of ash which are not collected in the E.S.P. are goes to atmosphere through the chimney.

DRAFT SYSTEM:

The force needed to draw air is called as draft. This force may be due to small pressure difference in the stream of flue gases or in the air which cause the flow to take place. In boiler it is necessary to supply sufficient quantity of air for proper combustion of the fuel and it is essential to force the fuel gases out of air for proper combustion of fuel and it is essential to force the fuel gases out of boiler. This is accomplished by suitable fans and this system is termed as mechanical draft as against natural draft.

In mechanical draft system, there are two type of application namely force draft & balance drafting. At P.T.P.S. balance draft system is used. Two fans are employed; one termed force draft other termed as induced draft fan. The F.D. fan is

utilized to force atmospheric air into the furnace and then it is function of ID fan to such out the boiler flue gases through the economizer, air pre heater etc. & discharging it out through the stack. There two working together maintain a balance draft which is normally slightly negative pressure in the furnace.

WATER CIRCULATION SYSTEM

In this system the water is delivered to a system generation from heaters at a temperature well below the saturation value corresponding to that pressure. Entering the economizer, first it is heated, to much near the saturation temp. From economizer the water enters the drum and flows down through the drum comer and enters bottom of the riser tubes. In the riser tube, a part of water is converted to steam and the mixture flows back to the drum. In the drum, the steam is separated from water particles and fed to water value and, saturated steam is fed to radiant roof. From here saturated steam is sent to steam cooled water

From steam cooled water valve, steam is given to LTSH. From LTSH steam is fed to platinum super heater and then goes to final super heater. In final super heater, temp. is up to 540°C and pressure is of 155 kg/cm². At this temp. and pressure, steam enter in the H.P. turbine. After doing work steam goes to boiler re-heater at 38 kg/cm² pressure and 380°C temp. In re-heater temp. rises 540°C and pressure falls to 36 kg/cm². At this temp. and pressure steam enters into the I.P. turbine, here pressure falls to 11 kg/cm² and 450°C and in this condition it enters in the L.P. turbine.

Turbine rotates at 3000 rpm and it is coupled to 6.6 KV generator which produces electricity. From L.P. turbine, steam passes to condenser where it is condensed to water that is collected in the hot well and it is extracted with the help of C.E.P. (condensate extraction pump) and fed to deaerator through L.P. heater.

The circulation in this case takes place on the thermo-siphon principle. The drum comes contain relatively cold water. Whereas the riser contain a steam water mixture whose density is comparatively less. The density diff. is the force for the mixture. Circulation takes place at such a rate that the driving force and frictional resistance are balanced. As the pressure increase the diff in density between water and steam reduces.

Thus the hydrostatic head available will not be able to overcome the frictional resistance for a flow corresponding to the minimum requirement of cooling of water wall tubes. Therefore natural circulation to boiler is limited to pressure of 175 g/cm² and in our case this pressure is about 138 kg/cm² and hence natural circulation system is sufficient.

Mineral salts such as carbonate, bicarbonate, chloride and sulphates of calcium, magnesium and sodium and also having suspended solids, clay, silt, silica, organic and inorganic matter and other microscopic organism.

The modern boiler, which generates steam at high temp. and in pressure demands high standards of purity for the make up of boiler.

The process describes the effect produced by addition of a alum to the colloidal suspended dispersion resulting in particle destabilization by a reduction force which lend to keep particle apart. Rapid mixing which is done in flash mixer in the clarifloculator is done to obtain uniform dispersion. Second stage of formation of particle from destabilized colloidal fixed particle is termed as 'flocculation'. Here coagulated particles grow in six by attaching to each other. At this stage particles are large enough to settle rapidly under the influence of gravity and may be removed.

After this the water is passed through the anthracites pressure filter to remove the suspended impurities and there after sent to the activated carbon filter to dechlorinate the filter water as the chlorine is harmful for the resins through which the water is to pass next. The D.M. water is obtained by ion exchange process. The filtered water is first passed through cation exchanger process where the cations of

dissolved impurities are removed. Then it is passed to the degassifier tower where most of CO₂ is removed.

The degassifier water is then pumped to the anion resins, where the chlorides, sulphates, carbonates and other anions are removed. The water coming out of the anion exchanger is finally passed through mixed beds containing both anion & cation resins to remove any traces of salts which might not have been removed earlier.

Thus the pure D.M. water is obtained which is stored in the storage tanks for make up. During the process of D.M. cation and anions resins get discharge and have to be reactivated with the help of HCL and caustic soda D.M. of water is done to prevent the scale sludge formation problem in the boiler drum which restricts the transfer of head of water.

ASH HANDLING SYSTEM

The ASH produced in the boiler is transported to ASH dump area by means of sluicing type hydraulic ASH handling system. This consists of bottom ash system, Ash water system, fly ash system, ash slurry system which are explained as follows:

1. BOTTOM ASH SYSTEM:

In the bottom ash system, the ash slag discharge from furnace bottom is collected into water impounded scraper through installed bellows water ash system. The ash is continuously transported by means of scrapper chain conveyor on the respective clinker grinders which reduce the lump sizes to the required fineness. The crushed ash from the clinker grinders falls in to the ash slurry further transported to ash slurry sump added by ash sluice channel. If the clinker grinder is not in operation, bottom ash can be discharged directly into the sluice channel through the bifurcating chute by passing the grinder. The position of the top gate in the bifurcating chute is to be manually changed.

2. FLY ASH SYSTEM:

The flushing hoppers are provided under EP hopper (40nos), Economizer hoppers (4nos), air pre heater (4nos) & stack hoppers (2nos). The fly ash collected in these hoppers drop continuously to flushing apparatus where fly ash get mixed with flushing water & the resultant slurry drops

into the ash sluice channel. Low-pressure water is applied through the nozzle directing tangentially to the section of pipe, to create turbulence & proper mixing of ash, with water.

3. ASH WATER SYSTEM:

High pressure water required for B.A. hoppers quenching nozzles, window spraying, clicking grinder sealing bars, cleaning nozzles, B.A. hoppers seal through flushing, economizer hoppers, flushing nozzles is tapped from the high pressure water ring main provided in the plant area.

4. ASH SLURRY SYSTEM:

Bottom Ash and Fly Ash slurry of the stream is sluiced up to ash slurry along the channel with the aid of high-pressure water get located at suitable interval along the channel. Slurry pump suction line consisting of reducing elbow with drain valve, reducer and butterfly valve and portion of slurry pump, delivery line consisting of butterfly valve, pipe & fittings as also been provide.

Now the oil is first atomized in the oil guns under the pressure of steam through nozzles and after atomization, the oil is sprayed at every corner of the furnace for initial ignition. After this coal received from the mill in pulverized form is burnt in the furnace. Combustion air is supplied through the forced air fans and primary air fans. The coal after the combustion gives out the energy, which is used to heat up water in tubes and convert this water into steam. The flue gases formed are taken through chimneys with the help of induced fans.

The coal after combustion gets converted to ash flue gasses gets exhausted from the chimney and the bottom of the furnace ash and clinkers are crushed and mixed with water and slurry finally, disposed of in ash disposal area with the help of slurry pumps. Some of the ash particles go in the atmosphere with gasses. The water used in the boiler is the dematerialized water. This water is produced in the water treatment plant by chemically and pneumatically treating the water in the plant. The steam generated in the boiler drum is taken to the turbine through pipes and long conduits. The turbine used has three stages i.e. H.P., L.P. turbine with their respective casings. The turbine speed is being

governed by hydrodynamic governing system. The turbine is coupled with the generator and DC excitation system.

The steam after giving work in the turbine goes to the condenser where it is converted I to the water with the help of cooling tower. The condensate from the condenser is re-fed to the boiler tubes with the help of boiler feed pumps. Turbine is fitted with five low pressure re-heaters to reheat the condensate for feeding into the boiler for economic point of view. The condenser works under vacuum, which is the steam ejectors.