Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 7 Issue 07, July-2018

Energy Audit of Coal Handling Power Plant

Abhishek Kumar
Department of Mechanical Engineering
Thapar Institute of Engineering and Technology
Patiala, India

Sumeet Sharma
Department of Mechanical Engineering
Thapar Institute of Engineering and Technology
Patiala, India

Dr. D. Gangacharyulu
Department of Chemical Engineering
Thapar Institute of Engineering and Technology
Patiala, India

***Abstract*—An energy audit of coal handling plant is feasibility study to establish and quantify the cost of various energy inputs to and flows within a coal fired thermal power plant or an organization in a given period. Energy Audit coal handling plant of Coal Fired Thermal Power Plant has been considered out. The aim is to calculate all the losses and give measures to rectify them and calculate the economic benefits after taking measures of rectification of losses. The Energy Audit coal handling plant of NTPC Dadri is done. The study is based method used and validated by NTPC Dadri, BUREUEU OF ENERGY EFFICIANCY and GUDELINES FOR THERMAL POWER PLANT (INDO GERMAN ENERGY PROGRAM). From the calculation we find out that coal is black gold these days, so its use should be optimized. The belt loading factor should be taken maximum so that motors does not run ideal.**

I. INTRODUCTION

The main objective of coal handing plant is to supply the appropriate amount of coal to the boiler bunker and store some amount of coal to the stack for the future purpose so that power plant can work all the time and no scarcity of coal is there. Coal is hard black or dark brown sedimentary rock formed by the decomposition of the plant material widely used as a fuel.

The coal particles are called coal lumps. They use E & F grade coals in India.

A. Coal is transported in different ways

1) Railways
2) Ropeways
3) Roadways
4) Waterways
5) Airway

The coal is transported to first crusher and the coal size is reduced to 300 mm.

The coal is then transported to second crusher and the coal size is reduced to 80 mm

Now the coal is feed to the 3rd crusher and the coal is 20 mm size.

After this process the coal is the coal is then transported to the pulveriser and then the coal is pulverised.

When the coal is full in bunker then the coal is transported to the stock pile and then the coal is stored in the stock pile. Coal handling plant is a plant in which the coal is handled from the receipt to the boiler bunker.

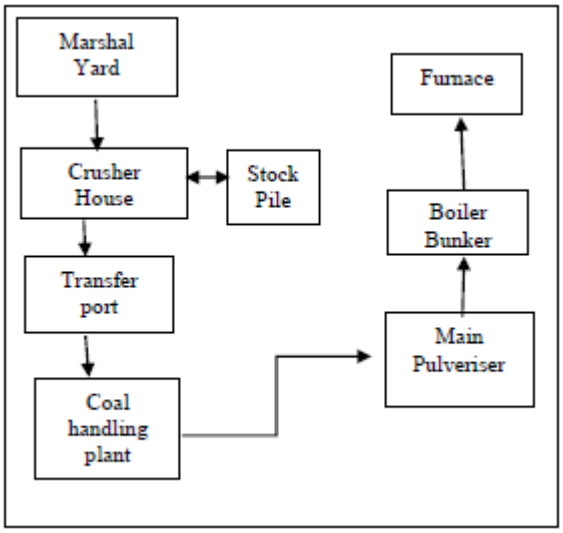


Figure 1: - Coal flow in thermal power plant

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 7 Issue 07, July-2018

B. Flow of coal in thermal power plant

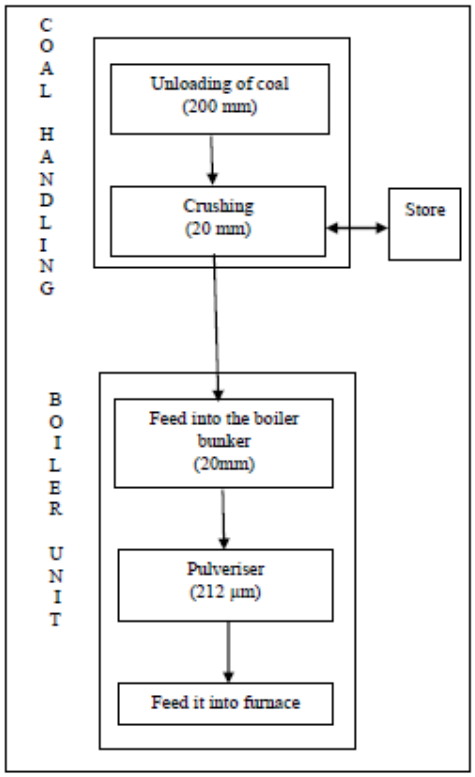


Figure 2: - Flow of coal from CHP to boiler unit

C. Methods of taking coal out of the wagons

1) Track hopper system

Figure 3 :- Pictorial representation of Track hopper system

The train when comes to the marshal yard of the power plant the driver simply opens the gates from a switch which in pneumatic operated valves. Then the gates are open, and the coal gets into the hopper. For plant 500 MW the only track hopper system is convenient.

Merits of track hopper system
Fast evacuation of coal from wagons

Demerits of track hopper system
Gates are opened by pneumatic operated valves thus due to excessive dust sometimes the valves are not opened, and the train wagon moves back without evacuation.

For this we have to make big under ground hoppers along the complete line. Thus, cost of making them is very high because underground construction costs 1.5 times more than the over ground construction

2) Wagon tippler method

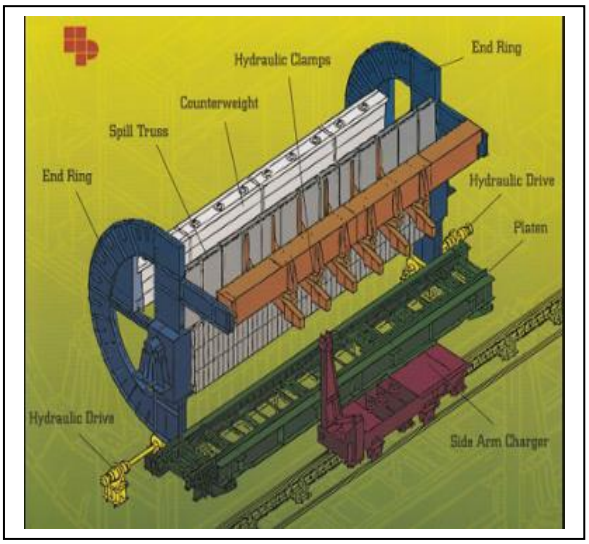


Figure 4 :- Wagon tippler system

Coal is fetched for 24 hours in the boiler furnace. Coal handling cannot be done more then 12 hours due to excessive dust which is very harmful for workers

.

Wagon tipper method there is very less wastage of coal. the coal is only wasted in form of dust.

Two types of hopper are there: -
180-degree side hopper
360 degrees under side hopper

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 7 Issue 07, July-2018

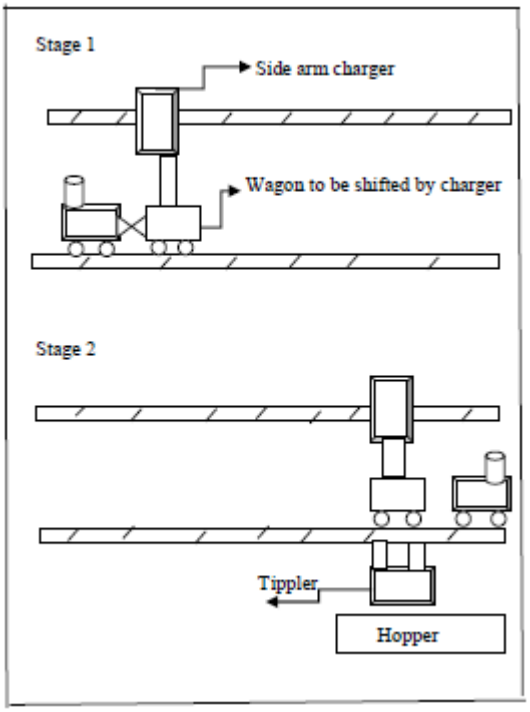
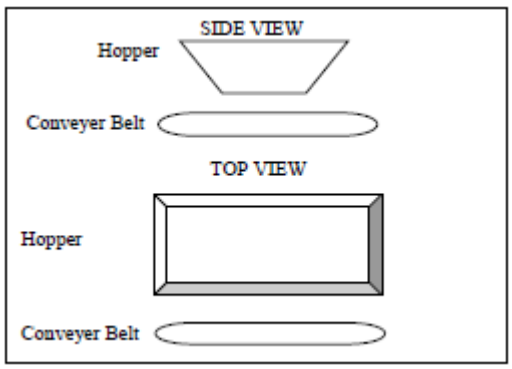


Figure 5: - Wagon tippler method explanation

The train comes, and the engine is detached and moved to other side of the track after the hopper assembly. The side arm charger which is on the track which is parallel to the track having wagon. Take one wagon and detach it from the train. Then it takes it near the tippler the tippler hold the wagon and tippler is either 180 deg or 360 deg depending upon the hopper position. At the same time the side arm charger goes back and takes the older wagon which is full of coal and thus when the previous wagon is empty it takes new wagon from the train and hits the empty one thus due to higher movement of inertia of the new wagon the old wagon moves away and join the engine which is now at the other side of the tippler.



Reason why hopper size is 2.5 times the wagon

If the hopper is of 1 wagon capacity, then at the time the 1st wagon is empty in the hopper and the 2nd wagon coming then at that time the belt is moving empty.

An hopper is of 1 wagon capacity whole coal will be falling in the belt string nature as belt will fall due to excessive impact loading on the belt.

Peddle feeder

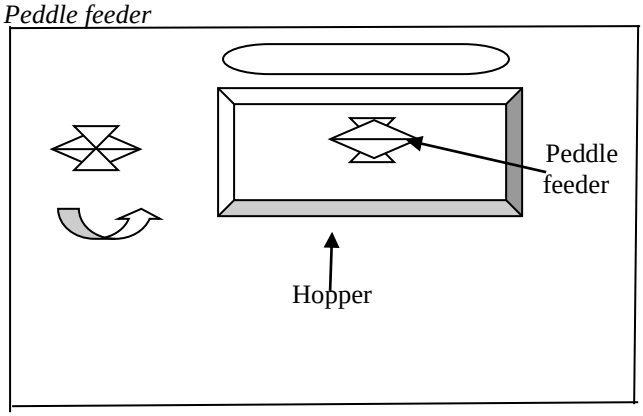


Figure 7 :- Peddle feeder

Peddle feeder is used when the conveyor belt is offset.

We can change the feed rate by changing the speed of the peddle feeder.

If the best is not working, we will first stop the peddle feeder and the coal will not be supplied to the conveyor belt.

Figure 8:- Picture of Coal handling plant of NTPC Dadri

II. METHODOLOGY AND CALCULATION

The Energy Audit coal handling plant of NTPC Dadri is done. The study is based method used and validated by NTPC Dadri, BUREUEU OF ENERGY EFFICIANCY and GUDELINES FOR THERMAL POWER PLANT (INDO GERMAN ENERGY PROGRAM)

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 7 Issue 07, July-2018

A. Readings of Coal Handling Plant

Item description	Readings
Input Size of coal in crusher	250 mm
Output size of coal in crusher	20mm
Belt Loading Factor	60 ton
Amount of Coal in wagon	70 ton
Coal stuck in clamps of tippler	10 kg
Total CHP motor consumption	1500 kW
Marshal yard CV	3500 to 4000 kJ/kg
Pulverised Coal CV	3300 To 3800 kJ/ kg

B. Formula used in ENERGY AUDIT OF CHP (method used here is method of NTPC)

$$\text{Efficiency of crusher} = \frac{Input\ size - Output\ size}{input\ size} \times 100$$

$$\text{. Air Losses} = \frac{Weight\ of\ coal\ at\ starting - Actual\ coal\ Feed}{Weight\ of\ coal\ at\ starting\ of\ conveyour} \times 100$$

$$\text{Tippler Efficiency} = \frac{Total\ coal - (coal\ held\ in\ clamps + Dust\ coal)}{Tolat\ amount\ of\ coal}$$

$$\text{Theft losses} = \frac{Amount\ of\ coal\ initially - Amount\ of\ coal\ reached}{Amount\ of\ coal\ initally} \times 100$$

C. Results of coal handling plant

Item description	Efficiency%
Efficiency of crusher	92%
Air Losses	36%
Theft losses	30%
CHP motor consumption	1500 kW
Oxygen losses in coal from marshal yard to pulverised coal	3.5 % to 4.5%

III. ENERGY EXPLORATION POSIBILITIES

As we all know that coal is black gold these days, so we must use of this coal is in the most appropriate manner so that no wastage of coal takes place in the plant. So, we first checked all the components which there in coal handling plant are and then calculates the amount of coal which is wasted and then weighed.

1. The clamps to hold the wagon should be of different material so that reduction in size of clamps can be done and same strength can be obtained and as size is less thus less coal will be stuck at that part according to this loss in coal will be less.
2. To avoid air loss, we should cover the conveyer belt and don't let air to blow over it.
3. Water should be sprinkled time to time over the coal so that to avoid dust from the tippler and dust losses can be minimised.
4. The wagon containing the coal should be covered from the top to avoid theft losses.
5. The pneumatic valves to open the gates of the wagon to let coal to fall in the hopper in track hopper system should be perfect so that the wagons can be cleared in less time to avoid demerge cost given to Indian Railway by plant.
6. The CV of the coal from marshal yard to pulveriser is reduced by 200CV it can be avoided by keeping coal in less moist area.
7. CHP motor consumption is 1500 KW of total all motors, but this depends on full load, partial load or no-load condition. To avoid losses in MOTORS all motors should be always in full load condition so that the losses which are in no load condition can be compensated. We should also reduce idling time so that no-load condition can be avoided.
8. The coal used in power plat should always be washed coal so that minimum CV losses are there.
9. The circuit the use is very bulky and large because the stakes are at a distance from the furnace. They can be brought nearer thus very less no. of conveyor belts are there and subsequently less n. of motors to rum them and directly decreasing the auxiliary power consumption.
10. In CHP they are having closed rooms with less no. of windows and having concrete sealing at their top which are opaque. Thus, they can also use maxim no. of windows and can also give green sheet which is translucent in nature thus some amount of light can entre and reduces in electricity consumption. 11. Power factor of maximum motors in CHP was 0.6 to .07 thus can be improved up to 0.9 as BFP is working at .09 PF.
11. The possibility of using chemicals for reducing water spray should be there. Mixing of chemical compounds in water for suppression of dust provides much better atomisation of water spray by reducing surface tension which is not practised here.
12. Principle of 'FIRST IN FIRST OUT' in case of coal transportation SILO to HOPPER is used here which is very much efficient.

IV. COST ANALYSIS

A. Coal handling plant

1) Cost estimation of losses due to air

To avoid air loss, we should cover the conveyer belt and don't let air to blow over it.

Maximum capacity of coal can be in inlet = 1400 ton/hour

Actual feed to bunker = 900 ton/hour

500 ton/h coal is lost due to air losses

Present cost of 1 ton of coal = Rs 3210

Cost of 500 ton of coal = 3210 x 500

= 1605000 /-

2) Cost estimation of losses due to transportation of coal

The clamps to hold the wagon should be of different material so that reduction in size of clamps can be done and same

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 7 Issue 07, July-2018

strength can be obtained and as size is less thus less coal will be stuck at that part according to this loss in coal will be less.
Tippler losses = 10 Kg loss in clamps = 10 x 3.21
= 32.1 /-
In form of dust = 5 Kg = 5x 3.21
= 16.05 /-
Theft loss in wagon = Amount of coal feed in wagon = 100 ton
Amount of coal lest at last when it reaches the power plant = 70 ton
30 ton of coal is theft which cost = 30 x 3210
= 96300 /-

3) Cost estimation of losses due to non-opening of gates in track hoppers system The pneumatic valves to open the gates of the wagon to let coal to fall in the hopper in track hopper system should be perfect so that the wagons can be cleared in less time to avoid demerge cost given to Indian Railway by plant.
Where the gate of wagon is not opened due to dust of coal complete wagon goes back to loss of coal in cost = 100 x 3210
= 321000 /-

4) Cost estimation of losses due to idling time of the motor
Motor at no load condition = 1 Kw
Motor at full load condition = 15 Kw
Thus, if no coal is being fetched then also 1 Kw power is being consumed by motor.
Motor consumes 1 unit of electricity in 1 hour
As if idling time is 1 hour daily then 1 unit of electricity is wasted daily
Per year 365 units is wasted
Which will cost = 365 x 8
= 2920 /-

5) Cost estimation of losses due to opaque walls and excessive use of electricity In CHP they are having closed rooms with less no. of windows and having concrete sealing at their top which are opaque. Thus, they can also use maxim no. of windows and can also give green sheet which is translucent in nature thus some amount of light can entre and reduces in electricity consumption. 11. Power factor of maximum motors in CHP was 0.6 to .07 thus can be improved up to 0.9 as BFP is working at .09 PF. In CHP where the officers sit there is very less number of windows and there are maximum opaque walls

1 tube light consumes 60/- in one month
30 tube lights are there in office = 30 x 60
= 1800/-

IV. CONCLUSION

From the investigation of this paper, we came to know that there are lots of losses in the coal handling that are crusher losses, losses in coal due to air flown in the conveyor belt, transportation losses are losses in tippler i.e. dust losses theft losses i.e. the coal which is stolen in between the transportation from the coal mines and the thermal power plant, losses in calorific value of the coal from marshal yard to the boiler bunker. In this paper we have not only checked the losses and find out the methods to remove them. The total cost of coal which is wasted due to these losses and can be easily rectified is ₹ 2027020. Thus, by using this method of energy audit of coal handling plant we can find out the actual losses, method to rectify them and actual cost of the coal lost.

REFRENCES

[1] Kaya D., EyidoganM. and Kilic F.C. (2014).Energy saving and emission reduction opportunities in mixed fuelled industrial boilers. Environmental progress and sustainable energy 0(0) 17.
[2] Saidur R., Ahamed J.U. and Masjuki H.H. (2010).Energy, exergy and economic analysis of industrial boilers. Energy Policy. 38 21882197.
[3] Li F., Zheng G. and Tian Z. (2013).Optimal operation strategy of the hybrid heating system composed of centrifugal heat pumps and gas boilers. Energy and buildings. 58 2736.
[4] Liao Z. and Dexter A.L. (2004).The potential for energy saving in heating systems through improving boiler controls. Energy and buildings. 36 261271.
[5] Kumar A. T, Chandramouli R. and Jothikumar K. (2014). Exergy analysis of a coal based 63 MW circulating fluidised bed boiler. Applied Sciences. 14(14) 15141521.
[6] Bakhshesh M. and Vosough A. (2012).Boiler parametric study to decrease irreversibility. Indian Journal of science and technology. 5(4) 25342539.
[7] Nielsen H.P., Frandsen F.J., Johansen K.D. and Baxter L.L. (2004).
[8] The implications of chlorineassociated corrosion on the operation of biomassfired boilers. Progress in energy and combustion science. 26 283–298.
[9] Demirbas A. (2008).Sustainable cofiring of biomass with coal. Energy conversion and management 44 1465–1479.
[10] Sami M., Annamalai K. and Wooldridge M. (2004).Cofiring of coal and biomass fuel blends. Progress in energy and combustion science 27 171–214.
[11] Saidur R., Abdelaziz E.A., Demirbas A., Hossain M.S. and Mekhilef S. (2009).A review on biomass as a fuel for boilers. Renewable and sustainable energy reviews 15 2262–2289.
[12] Skrifvars B.J., Ohman M., Nordin A. and Hupa M. (2008). Predicting bed agglomeration tendencies for biomass fuels fired in FBC boilers A comparison of three different prediction methods. Energy & fuels 13 359363.
[13] Skrifvars B.J., Backman R. and Hupa M. (2003).Bed agglomeration characteristics during fluidized bed combustion of biomass fuels. Energy & fuels 14 169178.
[14] Faaij A. (2005). Modern biomass conversion technologies. Mitigation and adaptation strategies for global change 11 343375.
[15] Vohra S.M. and Bhatt B.I. (2009). Stoichiometry. Publ. Tata McGrawHill. 3rdEd.
[16] Nag P.K. (1999).Power plant engineering. Publ. Tata McGrawHill. 2ndEd.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 7 Issue 07, July-2018

[17] Guidelines for Energy Auditing of Pulverised Coal Fired Thermal Power Plant (INDO GERMAN ENERGY PROGRAM)
[18] ASME PTC4 2008 Fired Steam Generators
[19] Energy Performance Assements of boilers (Bureau of Energy Efficiency).
[20] Fundamentals of Engineering Thermodynamics, Michael J. Moran, Howard

.