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ENERGY AUDIT OF THERMAL UTILITIES IN A CEMENT PLANT

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ABSTRACT

The energy audit has emerged as one of the most effective procedures for a successful energy management programme. This paper focuses on energy audit of thermal utilities in a cement plant, which has been using data measured from cement plant at Karnataka. A detailed analysis of kiln, grate cooler, Preheater, Precalciner, raw mill, coal mill, gas conditioning tower are done and the possible approaches of heat recovery from some major heat loss sources are discussed and also identify technological opportunities in order to decrease energy consumption of the plant, increase the productivity, and improve the production process

KEYWORDS: Coal Mill, Gas Conditioning Tower, Grate Cooler, Precalciner, Preheater, Raw Mill, Rotary Kiln

INTRODUCTION

The conservation, balance and management of energy are hot and emerging topic of today's discussion. The main aim of the energy audit is to provide an accurate account of energy consumption and energy use analysis of different components and to reveal the detailed information needed for determining the possible opportunities for energy conservation. In this regard, the attempts for energy balance in the industries of developing countries like India are having extreme significance. Cement industry is an energy intensive industry. The process of manufacturing of cement using dry process include the use of a rotary kiln, which consume large amount of energy to burn coal and the working of the blower which is used to suck the heated air to the other end of the rotary kiln. Theoretically, producing one tonne of clinker requires a minimum on 1.6 GJ heat (Liu et al., 1995). The specific thermal energy consumption in cement industries in India varies from 2.95 GJ to 4 GJ/tonne of clinker. The higher specific energy consumption is due to the harder raw material and poor quality of fuel. A significant quantum of studies can be witnessed in this field. Among them, there are many attempt aiming, not only energy approach to the cement industry, but also the potential means of improvement in energy consumption of cement industry.

Schuer et al. (1992) gave energy consumption values and described the energy saving methods and potentials for German Cement Industry. The research was based on electrical and thermal energy saving methods. The results were given in the form of energy flow diagram. Shaleen et al. (2002) conducted research on energy balance in a cement industry. They used the data from existing plant in India with a production capacity 1MT per annum. The author found that about 35% of the input energy was lost with the waste heat streams. A steam cycle was selected to recover heat from the streams using a waste heat recovery steam generator and it was estimated that about 4.4 MW of electricity could be generated.

Camdali et al. (2004) carried out energy and exergy analyses for a dry system rotary burner with pre-calcinations in a cement plant of an important cement producer in Turkey using actual operational data. They found that energy and exergy efficiency values for rotary burner were 85% and 64% respectively.

Engin and Ari (2005) performed an energy audit analysis of a dry type rotary kiln system with a capacity of 600 tonne clinker per day working in a cement plant in Turkey. They found that about 40% of the total input energy was being lost through hot flue gas (19.15%), cooler stack (5.61%) and kiln shell (15.11% convection plus radiation). For the heat loss through hot flue gas and cooler exhaust, a waste heat recovery steam generation system was proposed which recovered 1 MW energy.

Rasul et al. (2005) conducted a research base data from Indonesian Portland cement plant. They presented a simple model to evaluate the thermal performance of the cement industry.

The developed model was based on the mass, energy as well as exergy balance. The results obtained were that burning efficiency was 52.7%, cooler efficiency was 45%, and the heat recovery efficiency was 51.2%. There was high heat loss at the cooler of 19% and it is mostly due to convection and radiation.

Sogut et al. (2009) examined heat recovery from rotary kiln for a cement plant in Turkey. It was determined that 5% of the waste heat could be utilized with the heat recovery exchanger. The useful heat obtained is expected to partially satisfy the thermal loads of 678 dwellings in the vicinity through a new district heating system. This system is expected to decrease domestic-coal and natural gas consumption by 51.55% and 62.62% respectively].

This paper focuses on energy audit of thermal utilities in a cement plant, which has been using data measured from a typical cement plant in Karnataka, India. The detailed analysis of kiln, grate cooler, preheater, Precalciner, raw mill, coal mill and gas conditioning tower are done, and then, the possible approaches of heat recovery from some major heat loss sources are discussed.

PROCESS DISCRIPTION

MINES

Plant is having its own mining facility at about a distance of 17kms from plant. Mined limestone is crushed in to small sizes for convenient transportation with the help of primary and secondary crusher in the mines itself. The crushed limestone is then transported to plant through aerial ropeways where it is further crushed into small particles in tertiary crusher.

RAW MILL

The plant has one raw mill of capacity 60TPH. Raw milling involves mixing the extracted raw materials to obtain the correct chemical configuration, and grinding them to achieve the proper particle-size to ensure optimal fuel efficiency in the kiln and strength in the final concrete product.

Main raw material like, lime Stone, clay and sand is ground proportionately in the mill. The mill output product is stored in Blending & Storage silos as raw meal. To remove the moisture content from meal hot gas from PH section is used. Inlet raw material moisture is 4% whereas after mill the moisture content in raw meal is 0%.

COAL MILL

There are three coal mills of capacity varying from 3.3 TPH to 15 TPH at the plant. The coal that is to be burnt in the kiln and Precalciner section is dried and finely grounded. The fine coal is sent to the storage silos from where it is fed to Kiln burner and Precalciner section. The moisture content in the coal entering mill is around 10% whereas at outlet it is around 2%.

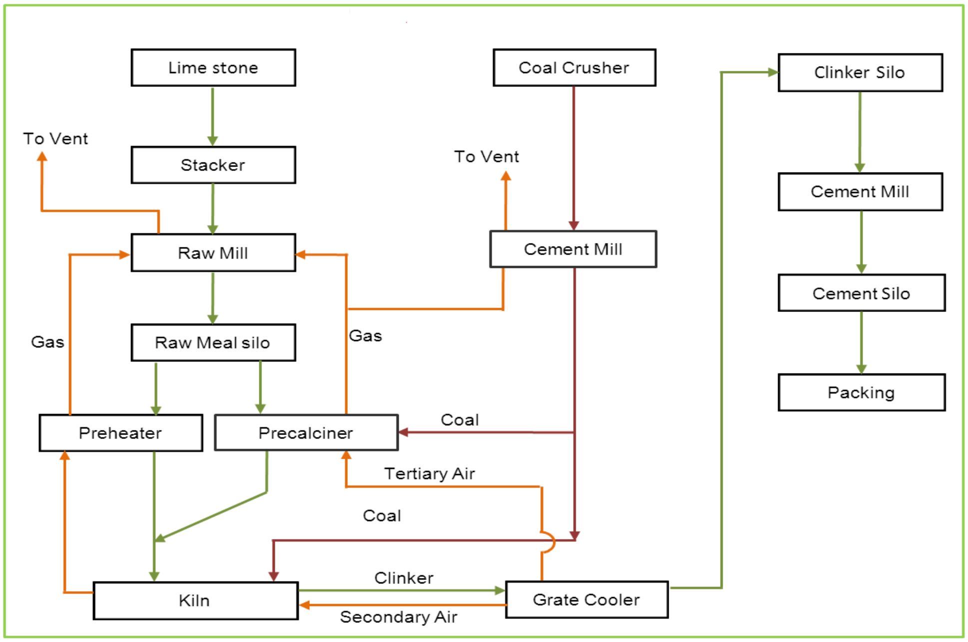

Figure 1: Process Flow Diagram of the Cement Plant

PYROPROCESS

There are two strings installed in the preheater section with four stages. In preheater the raw meal fed from top of the string will preheated by the hot exit gas coming from kiln, and in the precalciner combustion is taking place for calcining (a heating process in which calcium oxide is formed) the raw meal. After this the Calcined raw meal is fed into kiln for burning (sintering process) in the kiln, which is the final process in pyroprocessing. At the end of this process the raw meal fed into the kiln comes out as clinker. Clinker is hard, gray, spherical nodules which formed from the chemical reactions between the raw materials. Fine grounded coal from coal mill is used for combustion in kiln and precalciner.

GRATE COOLER

After clinker formation the clinker has to cooled to 70-100^{0}C to preserve the ideal quality and for maneuver by conveyors. In cooler, clinker cooling is taking place with the help of ambient air supplied by cooler fans to recover the heat from clinker, after taking heat from clinker one part of hot air is supplied into kiln as secondary air for complete combustion and one part is supplied to precalciner as tertiary air and remaining will be vent through ESP and ID fan.

The fairly coarse dust collected from clinker coolers is comprised of cement minerals and is restored to the operation. The flow rate of ambient air supplied into the cooler is based on the clinker production rate and the clinker bed thickness in cooler. The cooler section consists of six fans for clinker cooling of varying flow rates. After cooling the clinker to desired temperature it is conveyed and stored in yard for the next process.

CEMENT MILL

In cement process this is the final stage. There are two mills installed in the plant for cement grinding with capacity of 35 TPH and 65 TPH for OPC cement. In cement mill the clinker is ground with other materials like slag, gypsum etc (which impart special characteristics to the finished product) into a fine powder. Material that has not been completely ground is sent back into the mill after it gets separated in separator. The output of the mill is then sent to cement storage silos where it is stored and sent to the packing units which are consisting of manual as well as electronic packers.

PACKING SECTION

Cement stored in the silo is sent to packing unit where it is packed. Plant is having two packing units, one is loaded in wagon in bulk quantity and other one is packing where it is packed into bags. Figure 1 shows the detailed process flow diagram of the cement plant.

OBSERVATION AND ANALYSIS

RAW MILL

Average production rate of mill is varying from 73 – 76 TPH. Moisture content present in raw material IN and OUT of Raw mill is 4% and 0% respectively as per plant data. The total power consumption of the raw mill system is 1150kW and it is constant throughout the logging period. Average specific energy consumption is 26.9 kWh / Tonne of material. Pressure drop between cyclones, Separator, ESP are as follows119, 200, 68mmWC.

Air ingress across duct from PH fan to Mill separator is 15%. Air ingress across separator and cyclone is 18%. Air ingress across cyclone and ESP outlet is 10%. Air ingress at different locations as mentioned above is on the higher side, reducing the air ingress would reduce power of raw mill fan and raw mill ESP fan.

COAL MILL

Plant is installed with three mills, in which two mills (CM-1&5) are of ball mill type and other one is vertical roller mill (CM-3) type. The design capacity of the mill is 3TPH, 5 TPH and 15 TPH (with higher fineness) respectively. The typical coal mill circuit diagram with temperature, pressure, oxygen percentage and flow of fans at various locations is given below.

Average production rate of CM-1 is 1.4 TPH, CM-5 is 3.05 TPH and CM-3 is 4.7 TPH. Moisture content present in raw material IN and OUT of Coal mill is 7-12% and 2.2-3.5% respectively as per plant data.

The power consumption of coal CM-1 and CM-5 are almost constant and it consumes 69 kW and 116 kW respectively. Power consumption of CM-3 (VRM) is varying between 78 – 90 kW. Average specific energy consumption is 60.1 kWh per Tonne of material. Air ingress across duct from PH fan to coal mill booster fan is 20%.

Air ingress across Coal mill booster fan and VRM cyclone is 26.5%. Air ingress across VRM cyclone and bag house outlet is 6%. Air ingress at different locations as mentioned above is on the higher side, reducing the air ingression would reduce power of mill fans and Bag house fan.

PYROPROCESSING SECTION

Preheater System consists of dual streams (Preheater and Precalciner streams), 4 stage Preheater and Precalciner. The raw meal after gets ground in Raw mill stored in storage silo is fed into the preheater section through the first cyclone which gets heated up by the upcoming hot gas in both streams.

For firing in Kiln and Precalciner, fuel (coal) is conveyed through compressed air. The pyroprocessing section of the cement plant is shown in figure 2

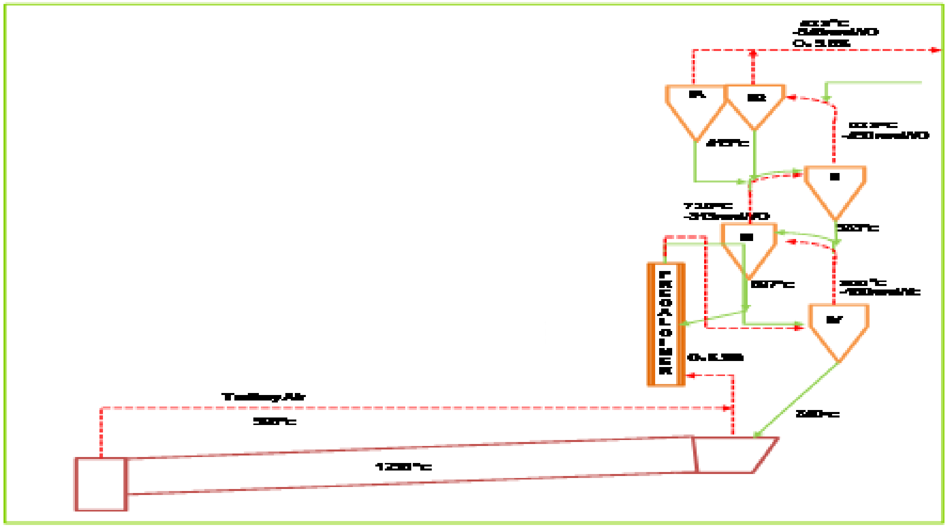

Figure 2: Pyroprocessing Section

PARAMETERS OBSERVED IN CYCLONES

The temperature of hot gas and material temperature, static pressure at cyclone IN & OUT, Oxygen content in flue gas at the exit are shown in table 1.

Table 1: Flue Gas Analysis of Pyroprocessing Section

	Kiln Exit	Precalciner Stream Exit	GCT Outlet	ESP Outlet
Oxygen %	3.2	9.5	10	11.7

Pressure drop across cyclone 2 & 3 are found high. Check for possible material clogging which needs to be cleaned so that the pressure drop is reduced and the resulting reduction in power consumption of Preheater fan. From the flue gas analysis it was found that there is ambient air infiltration into the Preheater and Precalciner Ducting system which will increase the work load of PH fan and Kiln ESP fan. Oxygen percentage in kiln discharge is satisfactory. At present air infiltration percentage is 15.5%, so the specific air flow in preheater section is 2.47 NM^3/kg of clinker which is on the higher side compare to the standard 1.6 NM^3/kg of clinker. So reduce air infiltration up to 8% to reduce specific air flow to 2.31 NM^3/kg of clinker. Still this is on higher side since only one string is in operation.

GRATE COOLER

Grate cooler is installed in the plant to cool the hot clinker which comes out from the kiln after the Calcination process. Design parameters of cooler are capacity - 1500 TPD of clinker, Grate Area - 52.92 m^2. During the study the plant is running on partial load with one string operation in preheater section. In one string operation the clinker coming in to the cooler is reduced by half, but during this time also grate speed is at its design 3.5 Strokes/min. The specific air flow of cooler is calculated from our measurements and it is found to be 5.22 NM^3/kg of clinker which is on higher side compared to its standard of 1.8 NM^3/kg of clinker. This is due to the following reasons such as the Kiln is running with 50% load so clinker coming in to the cooler is less than the rated and cooler fans are running at full speed. Grate speed is also at its rated/full load speed, so bed thickness would be thin and uneven. If the bed thickness is thin and uneven, air supplied by cooler fans will simply pass through the uneven material, for maintaining under grate pressure.

HEAT BALABCE

In order to analyze the heat balance of the Rotary Kiln and grate cooler, the following assumption are made

- Steady state working condition
- Change in ambient temperature is neglected
- Cold air leakage into the systems is negligible

ROTARY KILN

The plant has installed one Rotary Kiln with production capacity of 1500 TPD. The present Kiln speed is 1.3 rpm. The kiln is installed with one centrifugal fan for swirl air and one Roots blower for axial air to control the flame shape and the same air is acting as primary air for combustion.

Coal is conveyed through compressed air into the kiln. During study various operating parameters have been observed and measured and the important data collected is given below:

The average coal consumption of main kiln burner is 3 TPH coal. The average kiln feed is 52.5 TPH and clinker production is 31.8 TPH.

To reduce kiln surface heat losses its interior surface is covered with refractoriness of alumina bricks with 200mm thickness. The measured average surface temperature of kiln is 181^0C.

The kiln drive power consumption was taken during the audit. The average power consumption is 40 kW.

The heat balance is done based on coal firing quantity, measured air flow rates and temperature. The following parameters are considered as the basis for the analysis:

Ambient air temperature is 34^oC.

Clinker production at kiln discharge is 31.8 TPH.

Assumed clinker temperature at kiln discharge side is 1270 ^{0}C.

Proximate analysis of coal (Fixed carbon-39%, Ash-29%,Volatile matter-27.7%, Moisture-2.44%) and ultimate analysis of coal (Carbon-54.62%, Hydrogen-3.54%, Nitrogen-1.54%)

The Gross Calorific value of coal(GCV) can be calculated by using Dulong's formulae as

GCV = $([35.5\times C+114.8\times H+9.5\times S-14.5\times O]$ = 23422.212 kJ/kg.

Composition of clinker is SiO_2-20.90%, Al_2O_3-5.25%, Fe_2O_3-2.93%, CaO-62.11%, MgO-5.82%.

Heat of reaction of clinker (H_R) = $(4.11\times Al_2O_3) + (6.48\times MgO) + (7.646\times CaO) - (5.11\times SiO_2)-(0.59\times Fe_2O_3)$

= 1779.50 kJ/kg of clinker

The detailed heat balance of the kiln system is shown in table 2.

Table 2: Heat Balance of Kiln

Input Energy							
		Equation	Mass, m (kg/kg of clinker)	Temp °C	Cp(kJ/Kg)	Result (kJ/kg of Clinker))	%
1	Coal combustion in kiln (Q_1), GCV= 23422.212 kJ/kg	m×GCV	0.094			2201.68	41.14
2	Coal combustion in precalciner(Q_2), GCV = 23422.212 kJ/kg	m×GCV	0.1345			3150.28	58.86
Total Heat Input						**5351.96**	**100**
Output Energy							
1	Heat required for Clinker formation(Q_3), H_R =1779.50kJ/kg of clinker	m×H_R	1			1779.50	33.24
2	Quantity of heat used in Raw mill(Q_4)	(m×Cp (T_1-T_2))	1.1670	T_1=420 T_2=75.1	1.01574	408.83	7.63
3	Quantity of heat used in Coal mill(Q_5)	(m×Cp (T_1-T_2))	0.2891	T_1=420 T_2=73.1	1.01573	101.86	1.9
4	Heat Carried away by raw mill ESP fan vent(Q_6)	(m×Cp (T_1-T_2)	1.9699	T_1=75 T_2=34	1.0241	82.70	1.54
5	heat Carried away by coal mill Bag filter fan vent(Q_7)	(m×Cp (T_1-T_2)	1.58	T_1=73 T_2=34	1.0241	63.401	1.184
6	Heat carried away by clinker from grate cooler (Q_8)	(m×Cp (T_1-T_2)	1	T_1=110 T_2=34	0.7774	59.08	1.103
7	Heat carried away by cooler vent air(Q_9)	(m×Cp (T_1-T_2))	5.88	T_1=180 T_2=34	1.01574	871.95	16.29
8	Heat losses due to hot gas flowing out from Kiln ESP fan vent(Q_{10})	(m×Cp (T_1-T_2))	4.162	T_1=139 T_2=34	0.9990	436.56	8.15
9	Heat losses in GCT section(Q_{11})	(m×Cp (T_1-T_2))	2.55	T_1=420 T_2=34	1.0241	1008.02	18.83
10	Heat loss due to moisture in coal (Q_{12})	[L+(Cps+(T_1-T_2))×M]	m_{kiln}=0.0943 , m_{pc}= 0.1049	T_1=840 T_2=34	1.881	26.25	0.49
11	Radiation loss from kiln surface (Q_{13})	ε×σ×A× (Ts^4-$T\infty^4$),A_{kiln}=1272.34m^2		T_s=181 T_∞=34		89.53	1.67
12	Convection heat loss from kiln surface(Q_{14})	2.32×Akiln×(Ts-$T\infty)^{1.25}$×0.86, A_{kiln}=1272.34m^2		T_s=181 T_∞=34		89.82	1.68
13	Heat losses by surface convection and radiation from cooler (Q_{15})	{[0.548×$(T_1/55.55)^4$-$(T_2/55..55)^4$+ 1.957 $(T_1-T_2)^{1.25}$] ×0.86} ×A_{cooler}, A_{cooler}=310.2m^2		T_1 = 328K T_2=307K		8.51	0.16
Total Output Energy						**5026.011**	**94.29**
Unaccounted Heat Loss						**325.98**	**6.9**

GRATE COOLER

The heat balance of Grate cooler is done based on clinker quantity coming in to the cooler, measured air flow rates and temperature. The following parameters are considered as the basis for the analysis:

- Ambient air temperature is 34 ^{o}C.
- Clinker production at kiln discharge is 31.8 TPH.
- Assumed clinker temperature at kiln discharge side is 1270 ^{0}C.

The heat balance study of the grate cooler is shown in table 3.

Table 3: Heat Balance of Grate Cooler

Input Energy							
		Equation	Mass(kg/kg of clinker)	Temp ^{o}C	Cp(kJ/Kg)	Result (kJ/kg of Clinker))	%
1	Heat input to GC by clinker (Q_1)	$(m \times Cp \times (T_1 - T_2))$	1	T_1=1270 T_2=90	1.0868	1274.4	84.6
2	Heat supplied by GC fans (Q_2)	$(m \times Cp \times T_1)$	Flow rate=6.74	34	1.0032	228.71	15.4
Output Energy							
1	Heat carried away by clinker from cooler (Q_3)	$(m \times Cp \times (T_1 - T_2))$	1	T_1=90 T_2=34	0.7691	44.63	2.69
2	Heat carried by the cooler vent air (Q_4)	$(m \times Cp \times (T_1 - T_2))$	Flow rate=4.48	T_1=140 T_2=34	1.0069	478.52	28.57
3	Heat carried by the secondary air (Q_5)	$(m \times Cp \times (T_1 - T_2)$	Flow rate=0.7	T_1=720 T_2=34	1.0742	418.15	31.11
4	Heat carried by the Tertiary air to PC(Q_6)	$(m \times Cp \times (T_1 - T_2)$	Flow rate=0.9986	T_1=584 T_2=34	1.0470	553.80	34.72
5	Heat losses from cooler surface (Q_7)	$\{[0.548 \times (T_1/55.55)^4 - (T_2/55..55)^4 + 1.957(T_1 - T_2)^{1.25}] \times 0.86\} \times A_{cooler}$		T_1=55 T_2=34	1.0491	8.51	0.515

RESULTS AND DISCUSSIONS

INSTAL WASTE HEAT RECOVERY SYSTEM

The exit gas temperature from preheater section is supplied to raw mill and coal mill section to preheat the material (to remove moisture), remaining gases are sent through Gas conditioning tower(GCT) for cooling, since the ESP after gas conditioning tower will not withstand more than 200^{0}C. The gas temperature at inlet of GCT is varying from 380 – 400^{0}C. Plant is having a good scope in waste heat recovery.

Recovered waste heat is used for generate steam by boiler. Boiler is coupled with steam turbine to generate power. By installing this GCT can be avoided also water sprayed into the GCT will be saved, power consumed by GCT pump and LSQ pump also saved. So Install a Waste heat recovery boiler to utilize the heat from the gas coming to Gas Conditioning Tower. the proposed waste heat recovery system for the plant is shown in figure 3.

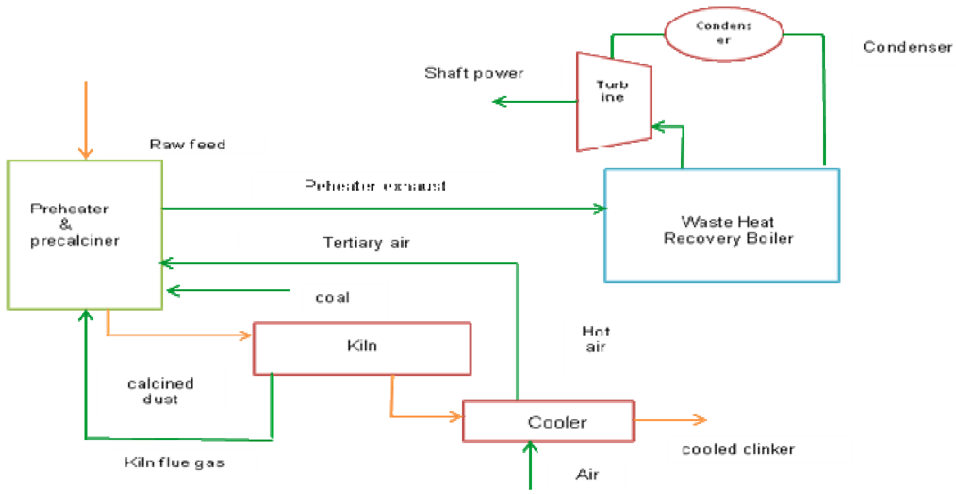

Figure 3: Waste Heat Recovery System

The total heat that could potentially be recovered can be calculated using this formula:

$Q = V\times\rho\times Cp\times\Delta T\times\eta$

Flow rate (V) of gas inlet to gas conditioning tower in m^3/hr

Density of gas(ρ) corresponding to the gas temperature in kg\m^3

Specific heat (Cp) of gas corresponding to the temperature in kcal/kg°C.

Combined(η) of waste heat recovery boiler and turbine

Change in temperature(ΔT) in °C

$Q = 2,32{,}962\times0.5576\times0.24\times(360-185)\times0.18=982041/860.4/1000$

$=1.14MW$

Investment- Rs 1500Lakhs

REDUCE PRESSURE DROP ACROSS PREHEATER CYCLONE III

Pyroprocessing systems installed in the plant to utilize the waste heat from the kiln exhaust gas to preheat &calcining the raw meal before entering into kiln. The pressure drop across cyclone III is 153 mmWC, which is higher than the recommended 100 mmWC. Check the cyclone for material clogging and clean it to reduce the pressure drop. After reducing pressure drop power consumption of the PH fan will come down. Expected reduction in power consumption after reducing the pressure drop in cyclones I and III is around 60kw.An annual energy saving of 431,829kwh which corresponds to an annual cost saving of Rs.24.3Lakhs. For producing a yearly energy saving of 431,829kwh we need to invest Rs.10 Lakhs which corresponds to a payback period of 5 months.

REPLACE METALLIC BLADES OF KILN SURFACE COOLING FANS AND COOLING FANS BY FRP BLADES

The kiln of capacity 1500 TPD is installed in the plant for calcination. The surface and tyre of the kiln has to be kept cool, for this purpose ten fans are installed in kiln section. All the above mentioned fans are having metallic blades. FRP blade fans are energy efficient than other fans and it is the better choice to replace metallic blades which will consume less power for the same flow. The FRP blades fan power consumption is less because it is light weight material, greater blade twist and superior surface finish etc. Replace metallic blades from all the fans by FRP blades to reduce the power consumption of fans by 20%. An annual energy saving of 87,581kwh.which corresponds to an annual cost saving of Rs. 4.9Lakhs. For producing a yearly energy saving of 87,581kwh we need to invest Rs.6 Lakhs which corresponds to a payback period of 15 months.

OPTIMIZE COOLER AIR FLOW TO SAVE POWER IN GRATE COOLER FANS AND COOLER VENT AIR FAN

During audit it is found that the specific air flow of Grate cooler is found to be 5.22 NM^3/kg of clinker which is on higher side compared to its standard of 1.8 NM^3/kg of clinker this is because under utilization of cooler. Due to this cooler vent air fan is also handling more flow and consuming more power. Reduce specific air flow of Grate cooler by modifying the grate cooler to save considerable amount of fans power consumption This will reduce the power consumption of Grate cooler fans and cooler vent air fan. An annual energy saving of 1,113,053kwh which corresponds to an annual cost saving of Rs.62.6Lakhs. Total investment and pay back is low.

REDUCE AIR INFILTRATION IN RAW MILL SECTION HOT GAS DUCT

There was air ingress in the raw mill section gas duct for about 39% in between PH fan and raw mill booster fan. Arrest/reduce air ingress in raw mill circuit up to 10%. Annual energy saving is 313,992kwh, Annual cost saving is Rs. 17.6Lakhs, Total investment is Rs.2Lakhs, simple pay back is 1 Months

INSTALL MECHANICAL CONVEYING SYSTEM FOR TRANSFERRING RAW MEAL TO PREHEATER SECTION INSTEAD OF PNEUMATIC SYSTEM

Since the blower was located in more dusty area. Filters are choked and it was delivering very less flow. Moreover pneumatic conveying system was not an efficient method. A pneumatic conveying system typically requires far more horsepower to operate than an equivalently sized mechanical conveying system. The reason is that changing the air pressure to achieve pneumatic conveying consumes a large amount of power and is inherently less efficient than a mechanical conveying system's mechanical transfer.

In fact, in applications with the same transfer rate over the same conveying distance, a pneumatic conveying system can require 10 times the horsepower of a mechanical conveying system. A pneumatic conveying system also requires a larger dust collection system than a mechanical conveying system. This is because the pneumatic system has to separate the conveyed material from the conveying air at the system's end. Install mechanical conveying system (bucket conveyor) instead of pneumatic conveying,

so the power consumption for raw meal conveying will comes down. An annual energy saving of 158,400kwh.which corresponds to an annual cost saving of Rs. 8.9Lakhs. For producing a yearly energy saving of 158,400kwh we need to invest Rs.300Lakhs which corresponds to a payback period of 404 months.

REDUCE AIR INFILTRATION IN COAL MILL SECTION

There was air ingress of 17% in between coal mill booster fan and Preheater fan and 26.5% in between booster fan and Vertical roller mill fan. Reduce air ingress in coal mill circuit up to 10%. So the flow handled by the booster fan and VRM fan will be reduced and so the power consumption also. Annual energy saving is 93,892kwh, Annual cost saving is Rs. 5.3Lakhs, Total investment is Rs.3Lakhs, simple pay back is 7 Months

SUMMARY AND CONCLUDING REMARKS

The aim of this study was to determine energy situation in cement plant and the possible energy conservation measures and financial saving potentials. The energy efficiency value for the kiln system was found to be 41.83%. The major heat losses for the system were identified as the preheater exhaust gases (GCT) and heat carried away by cooler vent air(grate cooler). The preheater exhaust gas carries about 232962 m^3/hr, which indicate the total energy recovery from these waste gases of (16.48%). A waste heat recovery steam generation system was selected showing the energy saving potential of 1.14 MW from the waste heat streams with simple pay back of 48 months.

The energy cost plays a major role in production cost of the cement, so thermal energy conservation study is carried out in a cement industry. The conservation is concluded depends on the payback. From the energy study 7 numbers of Energy Conservation measures are find out. On successful implementation of the suggestions given for each energy conservation measures there will be net saving of 91,59,000 kWh. Out of the net saving 6960000 kWh (75.9%) from the heat recovery from preheater and water consumption from the removal of gas conditioning tower. The total investment required to implement all proposals will be Rs 1534 Lakhs, which gives an overall payback period of 37 months.

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