ANALYSIS WASTE THERMAL ENERGY UTILIZATION BY USE OF WASTE HEAT RECOVERY SYSTEM IN CEMENT PLANT

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ABSTRACT

The work focused on waste heat or thermal energy recovery from cement industry. In the cement industry lime stone processing done which is called pyro processing in a pre-heater there are no of cyclone and final material processed in kiln at 1450-1500 degree Celsius. The final product is in the form of granules which is called clinker and this clinker contained up to 800 degree Celsius heat so this heat is recovered in waste heat recovery system (WHRS) by generation of steam in boiler's and the steam goes for turbine and the final temperature of product is reduced from 800 degree Celsius to 100 degree Celsius. In the cement industry WHRS is play a key role for lowering the specific heat consumption in processing of lime stone and also reduced the specific power consumption by the recovery of power in the system.

Keyword: - *Power plant1, Boiler2, Heat recovery system3, Cement Industry4.*

1. INTRODUTION

Many studies reported about the utilization of waste heat from industrial processes and its reuse or transformation in other forms of energy. The results usually show a considerable reduction of the primary energy consumption, and have a contribution to the improvement of energy efficiency and pollution prevention targets.
The main objective of this article is that to find out difference in fuel consumption, water consumption, and overall production cost with or without WHRS in modern cement industry and find out total saving by using WHRS. Also find out some new things which will be new innovation in future study.

2. OBJECTIVES OF RESEARCH

In the cement industry the limestone is received from mines and this limestone is properly mixed in stacking and reclaiming process than this mixed material is grind in vertical roller mill till fine powder than this fine powder is feed in cyclone pre heater there is calcination of limestone takes places because of heat transfer between material and hot air, that hot air is coming from kiln by burning of coal, now this calcined material is gone to kiln which is a 60 meter rotating cylinder and in the kiln the entire reactions takes places and the fine material liquefy and become nodules and known as clinker and this clinker is grind with some amount of gypsum in a ball mill is called cement.
After the processing of limestone in cyclone pre heater the hot air is vented in environment at 320 degree Celsius and by using WHRS this heat is recovered in terms of electricity by using boilers and turbine. Although researchers are

trying to reduce the consumption of heat through the various mode and recover the heat from the industries but it still requires lot of research to minimize the consumption of heat which leads to reduction in non-renewable sources.
Hence, in the present work the heat is recovered from the cement manufacturing process and showed by mathematical calculation. Moreover, it's also represents the benefits of WHRS in cement industries and find out difference in fuel and power consumption by using WHRS and contained some approaches for future purpose.

Therefore the objectives the present works are:

- To find out the difference of specific fuel consumption, with or without WHRS. This point should be started by availing some technical data's of modern cement plant and waste heat recovery system.
- Difference in power consumption with or without WHRS
- Difference in water consumption with or without WHRS
- To find out total electricity generation through WHRS and annually saving through WHRS.
- To find out the way for optimize WHRS and future scope by reducing the AQC boiler outlet temperature.

3. METHODOLOGY

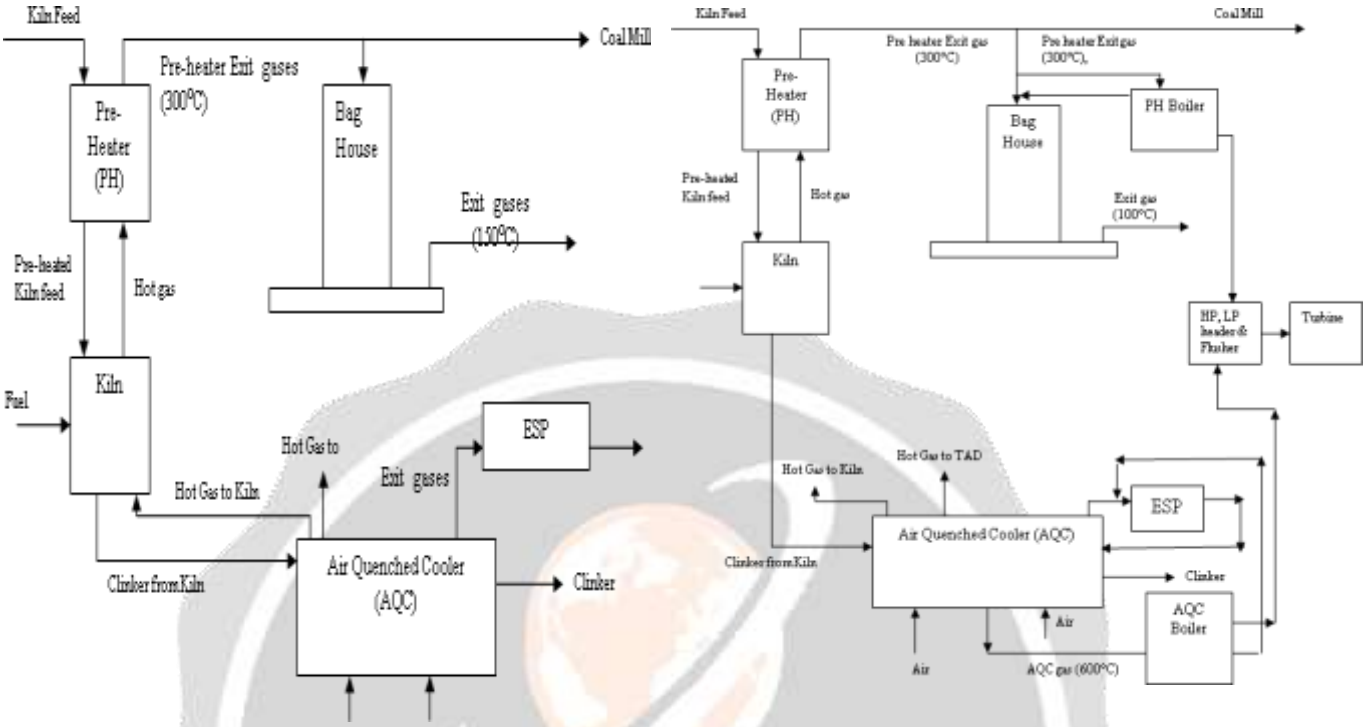
The method used in this article is combination of old research and some new things and scope's in the cement industry. the main focus of this article to aware and idealized to professional for benefits of WHRS in current days because in Indian cement industry after the wet process klin's the dry process are also waste a huge amount of thermal energy and fossil fuel or natural resources.
The article combined some reference the chemical data's of modern cement industry which gives us to how a little change in fuel consumption, change and save the large amount of money & natural resources.
This research work carried out on Indian cement manufacturing industry there are the wastage of thermal energy is very high in the 19 th century and now a days there are few cement organization's like "**Shree Cement Ltd**, **Ultratech Cement Ltd, India Cement Ltd**, **JK Cement Ltd** are available in India these are adopted WHRS in their premise and recovered lot of thermal energy in the form of electricity and saved lot of cost and reduced the specific heat consumption and specific power consumption on overall production, they also reduced water consumption and carbon di oxide emission by using waste heat recovery system in the organization.

3.1 -The following steps are used in the study.

Step 1 - collection of a cement plant running reference data with & without WHRS.
Step 2 - Collection of operational data of a WHRS system of cement plant with or without WHRS.
Step 3 - Mathematical calculation of fuel consumption and power consumption with or without WHRS.
Step 4 - Calculate the difference in results with or without WHRS.

The hot air flow of cement plant without WHRS and with WHRS is shown in fig. A and B respectively

A **B**



4. ANALYSYS

In a leading cement industry of India further try a waste heat recovery technique from product, say after the final processing of clinker the lot of heat clinker taken and stored in storage yard and this hot clinker taken lot of days to cool from 400 degree to 30 degree Celsius. Now this heat is also recovered in Shree cement by the using of AQC boiler and heat is taken from clinker cooler from 400-500 degree Celsius and rejected up to 100 degree Celsius and approx. 300 degree heat recovered from clinker, which is used in huge amount of power generation.

Some observation data collected from a cement plant and on the basis of these data some calculation or energy balance made by reducing AQC boiler outlet temperature from 164 degree to 100 degree.

For evaluation of cost and savings through WHRS in cement plant, we need some reference operational data. Like temperature, pressure, steam generation, coal consumption, clinker production on per hour or day basis

With the some operational data's of cement plant and WHRS plant we made some calculation for with or without WHRS and found some difference in cost by using WHRS.

4.1 Annually saving of fossil fuel or coal.

By using WHRS we found following difference in coal consumption in cement plant.

Total coal consumption per day with (WHRS) = 594 Ton's

Total coal consumption per day without (WHRS) = 600 TON'S

Total saving of coal with the use of (WHRS) = (600)- (594) per day

= 6×300 TON'S per year

= 1800 Ton's per year

Annual saving of coal = 1800 Tons per year

4.2Annually saving the cost of fossil fuel or coal.

By calculation of coal consumption with or without WHRS we found different saving in cost of coal.

Annual cost of coal with (WHRS) = 1069200000 Rupees per year

Annual cost of coal without (WHRS)= 1080000000 Rupees per year
Total cost saving of coal by using(WHRS) = (1080000000) – (1069200000) Rupees per year

Total cost saving of coal by (WHRS) = 10800000 Rupees per year

4.3 Total heat recovered by WHRS in terms of electricity.

By calculation of electricity generation through WHRS we found following out come.
Total steam generation by boilers = 52 TPH or 52×24 = 1248 TPD (ton's per day)
Total power generation by WHRS= (1248)/(4.45) MW per day
Total power generation by WHRS = 280.449 MW or 280449.4 KW per day
Total specific power generation per ton of clinker = (280449.4)/(190×24) KWH/TON
Total specific power generation = 61.50 KWH/Ton of clinker
Total annually power generation through (WHRS)
= 280449.4×300 KW/YEAR
= 84134820 KW/YEAR

Total Heat recovered from waste hot gases & product by using WHRS = 84134820 KW/YEAR

4.4Total annually cost saving by using WHRS

By calculation of the cost with or without WHRS we found following savings by using WHRS.
Total saving or generation of electricity per year by (WHRS)
= 84134820×3.30 rupees per year
Total saving through generation of electricity per year by using whrs =277644906 rupees per year

Total saving through generation of electricity per year by using (WHRS) = = 277644906 rupees per year

4.5Total annually saving of water consumption by using WHRS.

By collecting the datas of modern cement plant we found amount of water consumption with or without WHRS.
Annually saving of water consumption by using WHRS :-
Before using ACC the amount of water used in steam cooling is..
= 906.5277 Ltr/hour
Before using ACC the amount of water used in steam cooling is..
= 21756.666Ltr/day
Before using ACC the amount of water used in steam cooling is = 652700 Ltr/month
Before using ACC the amount of water used in steam cooling is = 6527 KL/YEAR
= 6527×1000 liter per ye
= 6527000 Ltr/year

Annually saving of water is = 6527000 Liter per year

4.6: Total cost saving by WHRS after reduction of AQC boiler outlet temperature.

The author make a approach and find a way for optimization or new things in modern WHRS system that is reduction of AQC boiler outlet temperature which is save more cost.
Total steam generation = 567.12/(530 degree Celsius) Ton per degree Celsius.
= 1.07 tons per degree Celsius
Now temperature reduced from 164 to 100 degree Celsius = 164-100) = 64 degree Celsius
Total steam generation after temperature reduction = 1.07 ×64 = 68.48 tons per day
Total power generation after temperature reduction = 68.48 ÷ 4.45 MW per day

Total power generation after temperature reduction = 15.39 MW per day
Total power generation after temperature reduction = 15.39 ×1000 = 15390 KW per day
Total specific power generation per ton of clinker =15390 ÷ (190×24) kw/ ton of clinker
Total specific power generation per ton of clinker = 3.37 KW per ton of clinker
Total annually power generation through (WHRS) after temperature reduction =
= 15390× 300 per year
Total annually power generation through (WHRS) after temperature reduction =
= 4617000 KW per year
Total cost saving after temperature reduction = 4617000 × 3.30 Rupees per year.
Total cost saving after temperature reduction = 15236100 Rupees per year

Total cost saving through WHRS after temp. Reduction = 15236100 rupees per year

5. CONCLUSION

The above study shows that WHRS reduced around 0.81 lac ton's of CO2 or greenhouse gases annual and by the reduction of coal or fossil fuel consumption WHRS also reduced the generation of NOX (oxides of nitrogen) as well as SOX (oxides of sulphur) which is responsible for acid rain and other degradation problems, so the waste heat recovery system is environment friendly and play a vital in industries in cost saving and heat recovery.

6. REFERENCES

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