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POWER GENERATION FROM WASTE HEAT EXTRACTED THROUGH CLINKER PRODUCTION IN CEMENT INDUSTRY

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ABSTRACT

The purpose of this work is to utilize the waste heat in cement industries.Cement industry is one of the strongest industries in terms of waste heat recovery (WHR) because of the reason that about 38% of heat utilised in clinker production process is exhausted to atmosphere from exhausts of suspension pre heater without utilisation of such cases. So this much heat is enough to affect the production, efficiency and turnover of an industry at such a big level and that's why it emphasise the point of recovery of waste heat.

In this study to recovery of waste heat through clinker production in cement factory we installed an external de-super heater in a boiler consisting a super heater. By this the temp is decreasing with the increasing of power. In our case study we saw the differences and improvements in flue gas temperature, steam temperature, steam pressure, steam flow rate, and de-super heater old percentage feedback after and before installing the de-super heater.

KEYWORDS: Waste Heat Recovery, Temperature Control, Energy Conversion, Experimental Analysis

INTRODUCTION

Waste heat is generally the energy associated with the waste streams of air, gases and liquids that leaves the boundary of the system and enter into environment. Waste heat which is rejected from a process at a temperature enough high above the ambient temperature permits the recovery of energy for some useful purposes in an economic manner. The essential quality of heat is not the amount but its value. Waste heat recovery and utilization is the process of capturing and reusing waste heat for useful purposes. Not all waste heat is practically recoverable. The strategy of how to recover this heat depends on the temperature of the waste heat sources and on the economics involves behind the technology incorporated. The total world energy consumption was approximately 12730 mtoe (millions of tonnes oil equivalent). With the fast industrial growth of developing nations over the last decade, the industrial sector has consumed energy at approximately 2852 mtoe. About 33% of the total energy consumed in industry is rejected as waste heat. Together with the concern for global warming and oil depletion issues, there is a strong incentive to develop more efficient and clean technology for both heat recovery and energy conversion systems using waste heat. Most of the energy rejected by industry is identified as low-grade waste heat. This type of waste heat has a small work producing potential for temperatures below 230°C, and this implies a low energy density. These characteristics make it almost impossible to recover this waste heat for power generation using a conventional energy conversion system such as steam or gas turbine. There are other suitable low-grade heat to electricity conversion systems that can be chosen for using low-grade waste heat such as the Organic-Rankine Cycle (ORC) and the Kalina cycle. However, these systems are more complex as they require rotary parts which are subject to wear and tear and require a high investment cost, therefore these options are not considered economically viable. Because of the constraints associated with low-grade waste heat, it is desirable to have a passive method to convert this thermal energy into electrical energy.

CASE STUDY

About the Industry

Shree is a rapidly growing Company focused on its core business of Cement & Power. Currently its manufacturing operations are spread over North and Eastern India across six states. It is recognized as one of the most efficient and environment friendly Company in the global cement industry. The Company's high corporate governance and social performance together with consistent financial performance makes it a truly Sustainable Company. Shree Cement is primarily an Indian cement manufacturer. It was founded in Beawar in the Ajmer district of Rajasthan in the year 1979 and now headquartered in Kolkata, is one of the biggest cement makers in Northern India. It also produces and sells power under the name Shree Power (Captive Power Plant) and Shree Mega Power (Independent Power Plant).

Work Output

In our case study we have seen that a boiler mainly consists of a super heater (whose capacity is about 20tonn) and for controlling the temperature it has de-super heater in super heater of boiler. Super heater increase the temperature and produce steam or generate steam and de-super heater is used to control the excessive temperature rises by the super heater. And to control the temperature and increase the productivity we have applied an external de-super heater. And we have studied the values of following terms before the installation of external de-super heater:-

- Flue gas temperature
- Steam temperature
- Steam Pressure
- Steam flow rate
- De-super heater old percentage feedback

The number of pre heater stages in a cement plant has significant bearing on the overall thermal energy consumption and waste heat recovery potential. The higher the number of stages, the higher the overall thermal energy efficiency of the kiln and the lower the potential for waste heat recovery. Selection of the number of pre heater stages is based several factors such as cooler efficiency, restrictions on pre heater tower height, or heat requirements for the mill itself.

And we found the average value of the following terms related to the boiler:-

- Flue gas temperature: - 641.02 ºc
- Steam pressure: - 17.46 Kg/cm2
- Steam temperature: - 415.04 ºc
- Steam flow rate: - 26.78 TPH
- DSH old % feedback: - 67.945%

Overview of Work Place

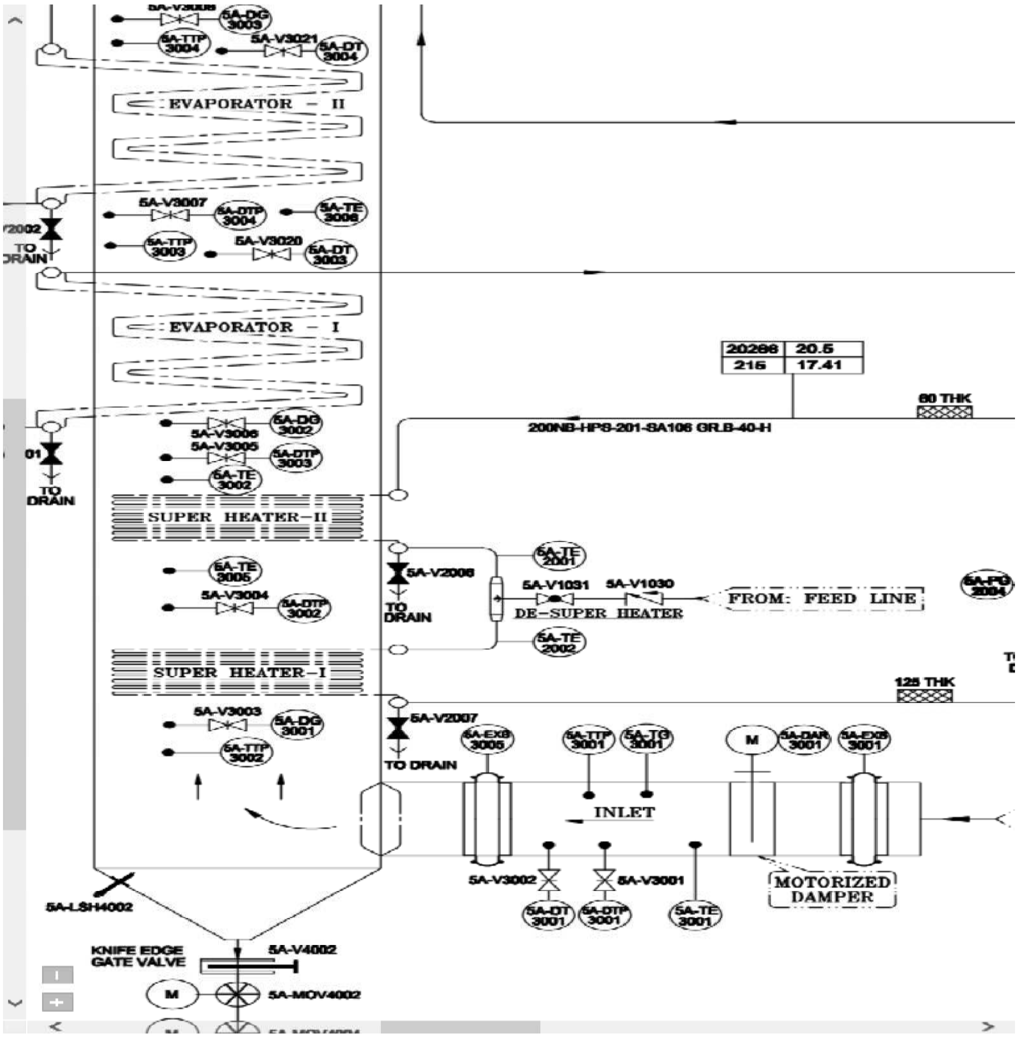

Figure 1: Power Generation from Waste Heat using External De Super Heater

Table 1: Before the Installation of De-Super Heater (DSH)

Sr. No.	1	2	3	4	5
Description	Flue Gas Temperature	Steam Temperature	Steam Pressure	Steam Flow	DSH Old % Feedback
Unit Of Measurement (UOM)	°C	°C	Kg/Cm2	TPH	%
1	632.00	416.43	17.32	25.65	45.16
2	640.52	414.18	17.22	26.02	53.49
3	622.00	402.22	17.39	26.73	63.66
4	654.00	412.33	17.57	27.28	91.38
5	630.99	415.46	17.48	26.90	78.18
6	650.23	422.28	17.52	27.35	72.34
7	660.15	415.77	17.49	27.21	37.18
8	632.78	416.00	17.54	28.51	54.43
9	646.48	420.65	17.61	25.40	79.60
Average Value	**641.02**	**415.04**	**17.46**	**26.78**	**67.94**

Table 2: After the Installation of De-Super Heater (DSH)

Sr. No.	1	2	3	4	5	6
Description	Flue Gas Temperature	Steam Temperature	Steam Pressure	Steam Flow	DSH Old % Feedback	DSH New%Feedback
Unit Of Measurement (UOM)	°C	°C	Kg/Cm2	TPH	%	%
1	652.99	401.70	17.92	33.59	84.99	87.34
2	635.00	401.00	17.22	33.86	99.19	98.87
3	653.85	400.88	17.09	32.96	99.12	99.06
4	625.00	402.64	17.21	32.64	99.12	99.17
5	650.57	400.35	17.89	32.72	95.47	95.51
6	640.88	399.98	17.92	33.50	84.99	87.34
7	650.85	398.55	17.65	33.45	99.19	98.87
8	634.97	399.36	17.76	31.10	67.92	73.63
9	632.27	400.81	17.41	31.11	89.33	91.09
Average Value	**641.82**	**400.58**	**17.56**	**32.77**	**91.03**	**92.32**

COMPARISON & CALCULATION

And we get to know the results after the installation of external de-super heater. According to the table in which we have get the average value of the following terms:-

- Flue gas temperature:- 641.82ºc
- Steam temperature:- 400.58ºc
- Steam Pressure:- 17.56Kg/cm2
- Steam flow rate:- 32.77tph
- De-super heater old percentage feedback:- 91.03%
- De-super heater new percentage feedback:- 92.32

Finally, we have seen the comparison between before and after the installation of de-super heater and get to know the improvement in following terms.

Gain In Steam Flow After Modification	TPH	7.93	7.84	6.22	5.35	5.83	6.15	6.24	2.59	5.72	**5.99**

Net stream temperature = after value – Before value

400.58 – 415.04 = **(-14.46ºc) decrease**

Steam capacity improvement=5.99TPH

The net steam temperature (-14.46ºc).Here –ve sign show the decrease in temperature.

So we have net stream temperature less than before installation of de-super heater that is 14.16ºc. And the Gain in steam flow after modification is 5.99TPH which is very beneficial for the industrial prospectus.

RESULTS & DISCUSSIONS

This report consist the results and discussions of the power generation from heat waste heat through clinker production in cement industry. It takes part to the improvement in steam generation and temperature controlling.Waste heat recovery power systems used for cement kilns operate on the Rankin Cycle

We have net stream temperature less than before installation of de-super heater that is 14.16ºc. And the Gain in steam flow after modification is 5.99TPH which is very beneficial for the industrial prospectus**.** Specific country market opportunities for WHR can be prioritized according to key parameters including size of WHR potential in MW capacity, electricity prices, or concerns over power reliability. Thus it provides a color-coded prioritization of the 11 target countries based on eight key market parameters. Green signifies a strong positive driver or factor for WHR development, yellow represents a weaker positive driver or marginal conditions for WHR development, and red represents very weak drivers or conditions that could hinder WHR market development.

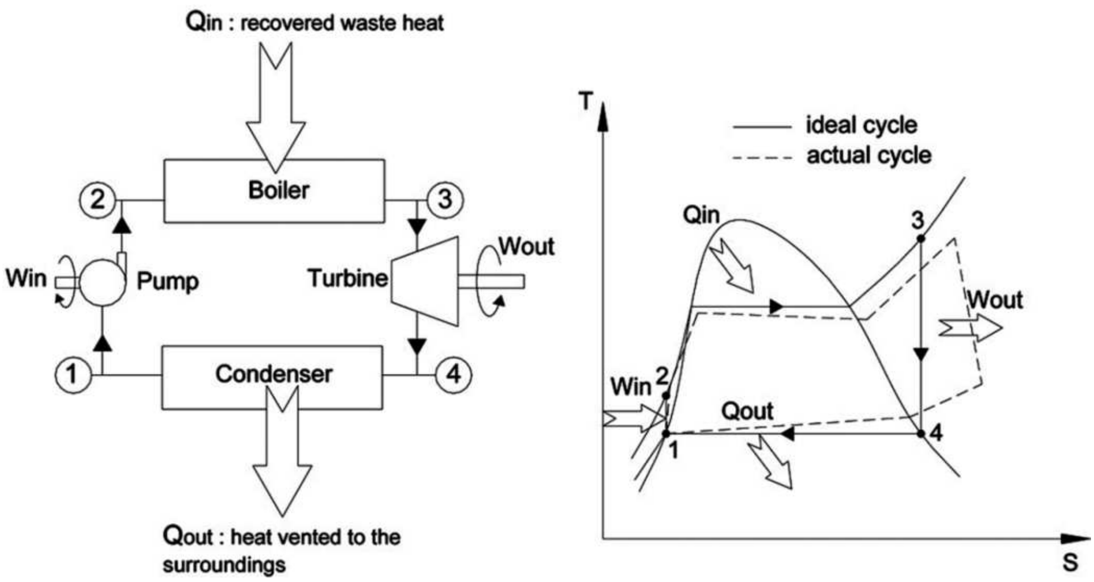

Figure 2: Recovered Waste Heat in Renkine Cycle

CONCLUSIONS

In the cement industry waste heat is utilized by the use of external de-super heater in boiler consisting of a super heater. This is very beneficial for a company to convert its waste heat to generate power. In this project our research shows that enough electrical supply is given by the power generated by the waste heat recovery which is extracted through clinker production.

Now a day this happens mostly in cement industries but after some years it will be used in all the industries due to its benefits. And further in the near future industries will fulfill their half of their electrical needs by their own power generation from waste heat recovery.

Cement Industry being a power intensive industry, one has to think in terms of energy optimisation and savings. Waste Heat Recovery Power Plants; contribute significantly, to the electrical energy saving (to the tune of 25%).

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