Cogeneration Through Zero Dust Hot Waste Gas

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Abstract- *Energy conservation has become very important aspect in past few years. Conservation of energy is not only beneficial for industry with respect to reduction in energy bill but also help in carbon footprint reduction and make industry more environmental friendly. Waste heat management is one of the notable energy conservation techniques. Mostly in process or manufacturing industry hot waste gases are been released. So it is prior responsibility of industry to utilize hot waste gas and reduce the overall energy consumption of industry. This paper explains the cogeneration system designed to utilize zero dust hot waste gas. The zero dust hot waste gas is supplied to waste heat boiler so as to obtain high pressure steam and utilize further for power generation.*

Keywords-Zero dust hot waste gas, cogeneration, waste heat boiler, steam turbine, induction generator.

I.INTRODUCTION

During the project study over, "Energy Conservation Practices in Industry" in company Höganäs India Pvt. Ltd. it has been observed that 'Zero Dust Hot Waste Gas' is released at rate of 5000m^3/hr. from furnace(annealing furnace). Out of which 3500m^3/hr. is utilized and 1500m^3/hr. is released from safety point of view. The waste gas at rate of 3500m^3/hr. is utilized in rotary dryer system which is solely developed by company and it is 'Kaizen' of those employees who developed it. But before utilizing the waste gas, its temperature has to be reduced to 200°C to 300°C from 750°C to 850°C. Hence there is significant loss of heat energy in system. Considering future expansion of company, if there is significant increase in turnover of company then there will be also increase in waste gas. So it is been suggested that the total volume of useable waste gas can be can be utilized for cogeneration rather than utilizing it in rotary dryer system or else cogeneration can be implemented parallel with simultaneous utilization of waste gas in rotary dryer system.

II.WORKING PRINCIPLE

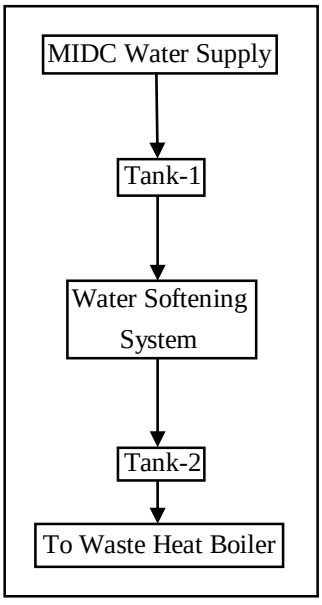
1) Transfer of energy through combination of conduction and convection.
2) Conversion of mechanical energy into electrical energy.

III.CONDITIONS ASSUMED

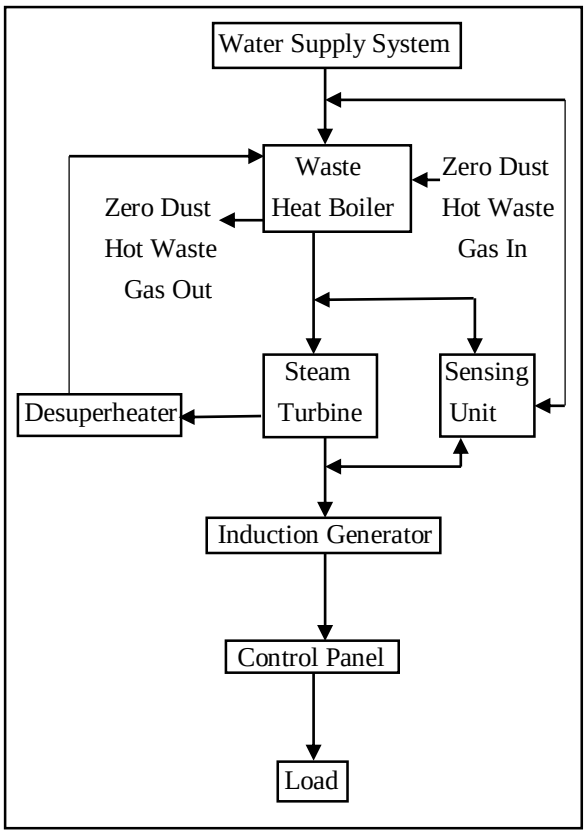
1) Minimum temperature of waste gas must be 750°C to 850°C and above.
2) Zero dust content in waste gas.
3) Minimum release rate of waste gas must be 6500m^3/hr.

IV.DIAGRAM

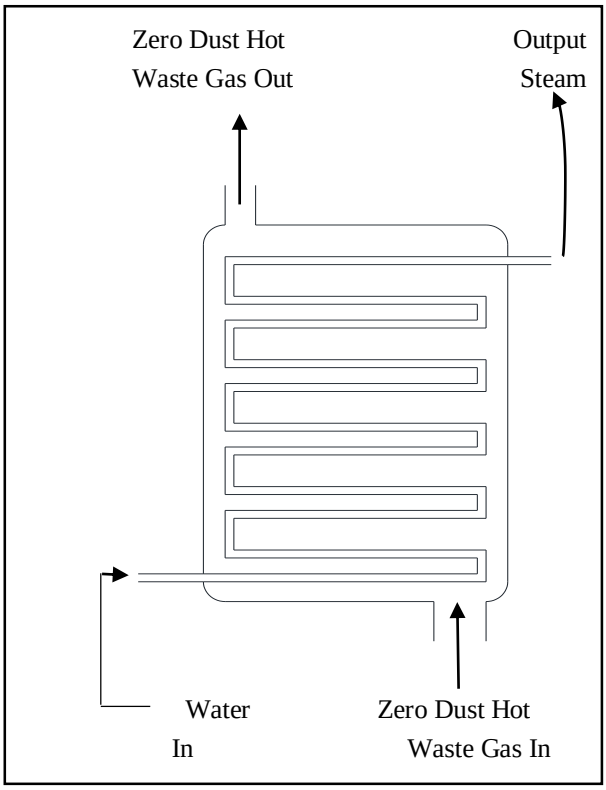
1) Water Supply System:



2) Cogeneration System:



3) Waste Heat Boiler:



V.EXPLANATION

1) The waste heat boiler is supplied with water from water supply system [Diag.1)].
2) The water supply system consists of two tanks, each having capacity of 40,000 litres. Each of the tank is made from aluminium-zinc, so as to avoid corrosion.
3) Initially water is stored in Tank-1 and transferred through water softening system to Tank-2.
4) The water softening system is used to avoid scaling and clogging of waste heat boiler due to presence of salts in water.
5) The waste heat boiler used is the modified version of economiser [Diag.3)].
6) The waste heat boiler is feeded with zero dust hot waste gas through which water is heated and converted into steam [Diag.2)].
7) The temperature of zero dust hot waste gas is about 750°C to 850°C. Its contents are CO (15ppm), CO_2 (15%), O_2 (3% to 4%), Water Vapour (present but not measureable) and N_2 (rest balance amount).
8) The generated steam is supplied to steam turbine through which shaft of induction generator is rotated and electricity is generated.
9) The generated electricity is given to load through control panel. The sensing unit maintains coordination between water supply system, waste heat boiler and steam turbine.
10) The left over steam is feeded back to waste heat boiler through desuperheater.

VI.PRACTICAL ASPECTS

a) The concept is more advantageous for industries releasing zero dust hot waste gas.
b) No need of traditional expensive boiler.
c) The concept is profitable if generation is between 300kW to 400kW and above.
d) The concept is moderately profitable if generation is between 150kW to 300kW. Whereas concept is not profitable for generation below 150kW.

VII.EXAMPLE

Consider a waste heat boiler with output steam pressure of 32kg/cm^2 and temperature of 400°C is supplied to steam turbine with steam flow 7TPH and back pressure of 3.5kg/cm^2. The turbine is coupled to induction generator of 500kW. If generator generates 400kW per hour and plant is operated for 10hrs./day×6days/week×4weeks/month. Then units of electricity generated and savings in electricity bill are calculated as further:

∴ Maximum output of induction generator = 500kW

∴ Expected output of induction generator = 400kW
(Per hour)

∴ Total hours for which cogeneration = 10×6×4 = 240hrs.
system is operated
(Per month)

∴ Monthly generated output = 400kW × 240hrs.
= 96,000 units

Now,

∴ The electricity bill savings are calculated as follows,

(Rates and charges are as per M.S.E.B., M.I.D.C., Maharashtra)

a) Energy Charges:- [Rate = Rs. 7.07/unit]

∴ 96,000 units × Rs. 7.07 = **Rs. 6,78,720/-**
---------- (1)

b) Wheeling Charge:- [Rate = Rs. 0.15/unit]

∴ 96,000 units × Rs. 0.15 = **Rs. 14,400/-**
---------- (2)

c) Tax on Sales:- [Rate = Rs. 0.019/unit]

∴ 96,000 units × Rs. 0.019 = **Rs. 1,824/-**
---------- (3)

∴ By adding (1), (2) and (3) we get,

∴ Total Amount Including Charges = **Rs. 6,94,944/-**
---------- (4)

d) Electricity Duty Saving:- [Rate = 9%]

6,94,944 × (9/100) = **Rs. 62,545/-**
---------- (5)

∴ By adding (4) and (5) we get,

∴ Final Actual Saving = **Rs. 7,57,489/-**
(Monthly)

∴ Final Actual Saving = 7,57,489 × 12 = **Rs. 90,89,868/-**
(Yearly)

VIII.CONCLUSION

It can be concluded that cogeneration through zero dust hot waste gas is not only energy conserving, but also profitable with respect to energy saving. During the research work it has been found that, this technique is practically feasible in waste heat management. It is also been found that the technique is not only energy saving but also helps in carbon footprint reduction. So overall it can be concluded that the technique is environment friendly.

ACKNOWLEDGMENT

Every orientation work has imprint of many people and this work is no different. This work gives us an opportunity to express deep gratitude for the same. While preparing this paper we received endless help from number of people. This report would be incomplete if we do not convey our sincere thanks to all those who were involved.

First and foremost we would like to thank our respected **Mr.Sharadkumar.D.Magar**, **Mr.Sirish Doere, Prof. Sanjay Joshi, Mr. Roshan Bhangale, Mr. Harshal Tamboli** for giving us valuable support while preparing this paper and also their priceless suggestions and valuable time. Finally, we would humbly thank our friends and family for being supportive with us, without them this paper would not have seen the light of day. Every work is an outcome of full-proof planning, continuous hard work and organized effort. This work is a combination of all the five of us put together sincerely.

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