INCREASING FURNACE EFFICIENCY AND POLYMER QUENCHING PROCESS

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***Abstract*— We are working on this project in Hindustan Forging and Steel Industry, Wagle Estate, Thane (West), were heat treatment process are carried out on various steel shafts, gear blanks and square blocks which are used by various companies. There are various furnace of different size are on shop floor of company for heating purpose in heat treatment process.**

We are study on a furnace to increase their efficiency for better utilization of fuel (gas as fuel). There are some methods we were going to focus to increasing efficiency of furnace are as follows:

i. **Selection of Blower,**
ii. **Selection of Refractory,**
iii. **Insulation ,**
iv. **Recuperator for utilization of exhaust gas leaving from furnace (Heat Exchanger).**

Also to increase efficient process of polymer quenching by suggesting best polymer for better quenching and better maintaining physical properties of material.

Keywords—Insulation,Refractory,Recuperater(Heat Exchanger),Polymer Quenching.

1. INTRODUCTION

We are working on this project in Hindustan Forging and Steel Industries, Wagle Estate, Thane (w), where some heat treatment processes are carried out on various shaft, gear blank and square block. There are various furnace of different size are on shop floor for heating purpose in heat treatment process.

In this company following are the work procedure

i] Ingot selection
ii] Forging
iii] Ultrasonic Testing
iv] Normalizing
v] Rough Turning
vi] Tempering
vii] Ultrasonic Testing
viii] Proof Machining

Fig 1: Gas furnace

In heat treatment process there are basically forging, normalizing and tempering processes are carried out for which various furnaces are used in heating purpose. After the heat treatment processes quenching is done. For quenching water based polymer are used.

The need for efficient thermal insulation has become more important with higher operating temperatures and increasing energy costs. Prevention of heat leakage by judicious application of thermal insulation is the simplest method of achieving substantial economy in energy consumption.

Glass wool is an insulating material made from fibers of glass arranged using a binder into a texture similar to wool. The process traps many small pockets of air between the glass, and these small air pockets result in high thermal insulation properties.

Glass wool is produced in rolls or in slabs, with different thermal and mechanical properties.

Fig 2: Glass wool material

2. LITERATURE REVIEW

Xiaochuan Luo, Zhi Tang[1]

The estimation of the total heat exchanger factor plays an important role while obtaining the reference trajectories on steady-state furnace operation for the reheating furnace control system.

Increasing efficiency by reheating method.

Beata Hadala, Marcin Rywotycki[2]

The boundary condition models at thinner outer surface of furnace wall have been developed taking into account heat transfer due radiation and convection.

The temperature of pipe by finite element method and transient heat conduction equation.

3. SELECTION OF PROJECT

In this project report we are going to focus on the two major factors which effects the overall efficiency of the company.

We are studying on furnaces to increase their efficiency for better utilization of fuel

(Gas as fuel) There are some methods we were going to focus to increase efficiency of furnace are as follows

i] Selection of Blower.

ii] Selection of Refractory.

iii] Insulation.

iv] Recuperater for utilization of exhaust (Heat Exchanger) heat from furnace.

4. PROBLEM DEFINITION

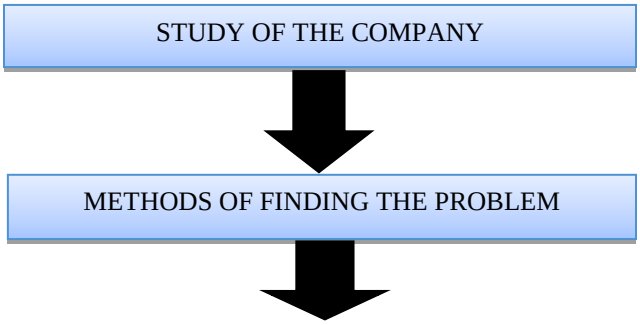
We were search for problem on shop floor in company likewise we found that

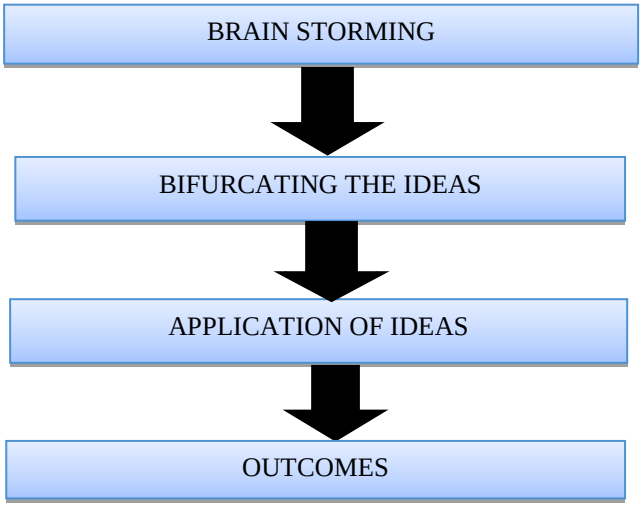
1) During the working of furnace there is loss of heat energy from exhaust of furnace. To overcome this problem we came across concept of heat exchanger or recuperator for utilization of exhaust waste heat.

2) The pipes through which atmospheric air is send to the furnace inlet having non-insulated. Because of this drawback we came across for provision of insulation to the pipes through which air is passing to the furnace.

3) The refractory which were used currently is not quality brick. To give them the suggestion regarding refractory which is currently used in market for furnace design?

5. METHODOLOGY



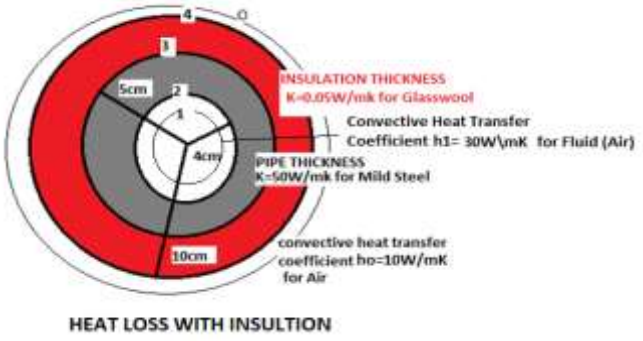


A) LOSSES ALONG CROSS SECTION OF PIPE

A.1] HEAT LOSS WITH INSULATION CALCULATION

$$Q_{withinsulation} = \frac{T1 - To}{\frac{1}{h_1 A_1} + \frac{\ln(\frac{R2}{R1})}{2\pi K(pipe)L} + \frac{\ln(\frac{R3}{R2})}{2\pi K(insultion)L} + \frac{1}{ho \times Ao}}$$

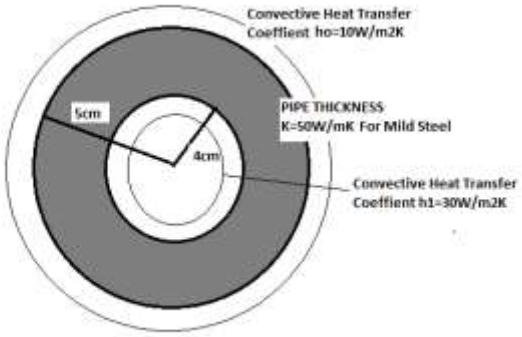
…FROM CENGEL, HEAT TRANSFER BOOK



HEAT LOSS WITH INSULTION

A.2] HEAT LOSS WITHOUT INSULATION CALCULATION

Let 'R' be the radius.



HEAT LOSS WITHOUGHT INSULATION

$$Q_{withought\ insulation} = \frac{T1 - To}{\frac{1}{h1A1} + \frac{\ln(\frac{R2}{R1})}{2\pi K(pipe)L} + \frac{1}{ho \times Ao}}$$

… FROM CENGEL, HEAT TRANSFER BOOK

B] TOTAL HEAT LOSSES ALONG PIPE

$Q_{total} = Q_{without\ insulation} - Q_{with\ insulation}$

C] QUANTITY OF GAS SAVING

Percentage increase in scm is =

scm use before insulation / scm use after insulation

D] COST SAVING IN GAS CONSUMPTION

Cost of 1 unit of scm : Rs 24
Total length of pipe : 7m
No of furnace : 4
Working cycle : 12hr

SR NO.	PARAMETER	QUANTITY
1	HEAT TRANSFER	$Q_{with\ insulation}$ = 145.611W $Q_{without\ insulation}$ = 903.166W
2	TOTAL HEAT LOSSES ALONG PIPE	Q = 757.555W
3	QUANTITY OF GAS SAVING	35.5%
4	COST SAVING IN GAS CONSUMPTION	RS.1,20,000 per month

6. CONCLUSION

We finally reach on our objective is that to decrease the heat transfer from the furnace and gas carrying pipes which results in increasing the efficiency of the furnace by providing suitable insulation materials. Also the exhaust gasses leaving the furnace throne through chimney is reused by means of using recuperative device (heat exchanger). Though there is a refractory brick re used in furnace walls we suggest them to manage some best quality refractories for construction of furnace and also to reduce small gaps in sliding parts like door opening, bed carrying the job through which heat is loss.

Also providing suggestion regarding the polymer used in polymer type-c currently for quenching purpose.

7. FUTURE SCOPE

1) By the installation and providing better insulating material inside the furnace.
2) On installing the more temperature Gauges to get an exact temperature readings so that we got accurate results of temperature reading.
3) Also the furnace are not closely pack due to small gap in furnace walls of sliding members of furnace such as door, tracer unit are having gaps through which lot heat is get wastage.

8. RESULT & DISCUSSION

1) Amount saving in heat loss through the pipes with the effect of insulation i.e increase in tempereture inside the furnace 71^0C
2) Amount of saving in gas (in scm) 241.4scm.
3) Cost saving in gas consumption is Rs.1,20,000/-per month

By applying the glass wool insulation we reduce the heat loss in pipe so that amount of gas use in furnace its get reduce and the saving in gas bill takes place.

9. REFERENCES

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