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MATHEMATICAL MODELLING FOR ELECTRICITY GENERATION FROM STEEL PLANT

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ABSTRACT :-

This research paper, the potential to use waste energies from the steel production at B.S.P. Bhilai C.G. investigated. B.S.P is a leading producer of high strength steel, such as slab, bloom, billets, wire, ingots, other steel products every year. The study is based on energy balances in the different production lines. The energy balance are investigated with applying three dimensional mathematical model at different energy flows.The work concludes that there is a great potential for increasing the use of waste energy at steel plant.

Keywords :- Steel Plant, Heat loss, Radiation, Electricity Production, Metal

1. INTRODUCTION

The economical situation due to ever increasing energy prices globally and problems associated with global warming with the methods of energy utilization especially in the melting processes. There is a clear need for the heat transfer industries to focus on energy, efficient methods and implementation of new resources. The proposed new technologies shall be capable of utilizing variety of fuel resources with optimum release of heat energy and low emission introduction of the paper should explain the nature of the problem, previous work, purpose, and the contribution of the paper. The contents of each section may be provided to understand easily about the paper.

2. Practical Arrangement

For the satisfactory result purpose arrival experimental investigation. Fabricate the actual steel melting continuous casting model and collect the reading. Here used lead-tin material by replacing steel material and co-relate this experimental process with steel melting by continuous casting method. In investigations it is found that lead tin (Pb-Sn) material cast as like to steel manufacturing which actually observed in Furrow Alloy Corporation Industry, & Bhilai Steel Plant, Bhilai & other industry. Collect the reading on date 03-04-2013 over this experimental set-up which given data as below table with considering respective plate size. The reserve paper published

3. ANALYSIS OF STEEL PLANT CASE (I): HEAT ABSORBED THROUGH FURNACE

Q1 = 1250 x 9.36 x 3.14 x 15 x 6.43.13

Q1 = 3,54, 413, 647.1 watt = 3,54, 413.647 kw

U = 1250 w/m2ok [pg no – 555 data book heat transits]

CASE (II): STEEL MEETING SHOP

Q=3,094,351.

CASE (III): HEAT COLLECTED FROM EXHAUST PIPE

ΔT1=t1-t3 =143-30

=1130c

ΔT2=t2-t4=90 – 83=70C

LMTD =ΔT1-ΔT2 = 113 – 7

---------- ----------

ln ΔT1 ln 113

------ -----

ΔT2 7

= 106 106

---------- = ----------

ln (16.14) 2.78

LMTD = 38.129

Q = UALMTD

= 1250x3.14x1x60x38.129

Q = 8,979.3795kw

CASE (IV):CALCULATION FOR ELECTRICITY

Total Q = Case A + Case B + Case C

= (3,54,413.647+5,19,014.126+5,53,163.333 +6,33,531.643+6,30,836.075)+(3,094,351.3 kw)

(8,979.3795)

Q = 2,690,958.821+3094,351.3

Q= 8,979,3795

Q = 5,794,289 kw

Q=5794.289 kw

Steady flow energy eqh.

h1 + V12 +gz1+ da

---- -----

2 dm

h2 + V22+gz2+ da

----- -----

2 Dm

Turbine is thermally insulated hence H. T. is negligible

ΔKE = 0, ΔPE = 0, Q = 5,926.611 mw

h1 + 5794289 = h2 +w

W= 5794289 + (h1-h2)

h1 = Entering the enthalpy in turbine

h2 = Existing enthalpy through the turbine

t1=300Centrytemp + t2=1000C turbine exert tamp

h1 = ? hg = 2,556.4 Kg/kg Cp = 1.005 Kg/kg 0C

P = 0.042 bar, ---------- = 233.8

h1 = hg + Cp (t sup- t sat)

h1 = 2,556.4 + 1.005 (233.8-30)

h1 = 2,759.195

h2= hg + Cp (t sup – t sat)

h2 = 2,676.0 + 1.005 (99.6-100)

h2 = 2,676-0.402

h2 = 2,675.598

W = 5794289+(2,759.195-2,675.598)

W = KJ /sec.

W = 5794373 kw. = 5794.373 mw

Generator efficiency = 90%

Work done by generator = 0.90 work done by turbine

= 0.90 x 5,794,373

= 5214.93 mw KJ /sce

To -------- the absorbed heat energy to electricity is

Electricity = 5214.93 Mw

Electricity= 521.46Mw

From steel plant total Electricity production 5214.93 Mw.

4. HEAT ENERGY LOSS:

(Heat gain) = Q metal melt + Q Countinious steel melt shop + Q exhaust gas

Flow rate = 2.5 Ton per min when dia 50 mm

Q in furnace metal melt = mass flow rate x sp. heat of steel x (temp at furnace –room temp)

=0.34167 kg/sec. x 0.475 kj/kg0k. x (950.6-30)

Q in furnace metal melt = 149.40 kw------------(1)

Q Contention steel melt shop = mass flow rate at metal x sp heat x (Tamp dingy)

= 500 kg/sec x 0.475 Kj/kg0k x (750-30)

= 500x0.475 x720

Q Contention steel melt shop = 171000kw-------(2)

Q exhort gas = mass flow rate of exhorts gas x sq heat of exhorts ------ x (Temp exhort - Temp of air)

air coat lean mixture furnace 1:10

Q exhort gas = 0.13878 x 11 x 1.083kj/kg0k (143-30)

Q exhort gas = 185.77 kj/kg0k ---------(3)

Heat Consume = Q 1 + Q 2 + Q 3

= 149.40 + 171000 + 185.77

Heat Consume = 171334 kw ----------(I)

Q Heat collected = Q Furnace+ Q Continuous+ Q exhoust gas

Q Furnace = 2,690,958.821 kw ---------(4)

Q Continuous carry = 3,094,351.3 kw -----------(5)

Q exhoust gas = 8979.3795 kw --------------------(6)

Heat Collected= Q4 + Q5+ Q6

= 2,690,958.821 + 3,094,351.3 + 8979.37

Q Collected = 5,794,288 kw------------(II)

Total coal Consumption :-

Q = 19566 + 182490 + 280316

Mg = 6,58,467 (Tonne)

Q = mt x CV

Q = 6,58,467 x 103

------------------- x 29,836.104 kj/lg

30 days

Q = 6,58,467 x 103

------------------ x 29,836.104

30 x24x3600

Q = 7579,483.56 kw

Q IP = Q collected + Q consumer+ Q---- possible to collect

7,579,48356 = 5,965,622 + Q exhaust not possible to collect

at P1= 1 ban, P2= 1.5 bar, V= 4m3/min. N= 200

V- is entropic constant

Total seven compressor are used for collecting heat energy

V-1

V

Compressor Power

= 14.30 kw

Velocity at overall furnace 950.60C

V =(T2 – T1)CP (950.6-30) 1.005 X 1000

----------------- =------------------------

Pw Ps 1.04 x 0.00

Qs = Slip factor = 0.9

Qw = Work I/P factor = 1.04

920.6 x 1.005 x 1000

= ----------------------------

1.04 x 0.9

Velocity of air = 994.2156 m/sec.

Cylindrical volume at N.E. = π/4 xD2L

Exhaust gas = Co2, Co3, N2, H2, 02

Parallels flow heat Exchanges

Heat collected = 5,965, 622 KW

Heat Energy less in compressor=14.30 KW

Original Heat Collected

= 5,965, 622 – 14.30 KW

= 5,965,6077 KW

= 5965.607 MW.

5. RESULT:

Heat collected = 5,965, 622 Kw

Heat Energy less in compressor = 14.30 Kw

Original Heat Collected

= 5,965, 622 – 14.30 Kw

= 5,965, 6077 Kw

= 5965.607 Mw.

1)A finite volume heat transfer and solidification model has been formulated to predict the temp field and liquid pool position in the C.C. process under different conditions. This has been verified with the temp measurement of slab surface.

2)Casting speed is the most effective parameters on mould heat transfer. Therefore, it is the most important factor in controlling solidified shell thickness & slab temp.

3)Since, the air gap size in narrow face of mould is higher than the wide face, the breakout of strand often occurs in the narrow face.

6. FUTURE SCOPE:

Heat Energy loss remain study, in lots of industries such as Textile industry, paper industry, chemical industry, workshop

Heat energy loss in cast iron plant.

Heat energy loss in copper plant.

7. CONCLUSION :

In NECO, Nagpur industry photo, indicate that how practically temp rise of electric furnace when metal melt. The person show on metal 1626^{0}C temp through sensor but again need to raise upto 1662^{0}C for complete melting purpose. But theoretically consider 1549^{0}C temp on near about. Sunflag Industry literature Survey show plant photo.

For the parametric determination purpose prototype model develop, that dimension also given. In Photo, indicate actually model. In FACOR, Nagpur industry, Photo indicates actually parametric determination & also collects video clips.

Hence all above results, discussions, photographs, graphs, simulation, mathematical, module also live survey, recording prototype model, it is clean that heat energy radiate in steel industry.

Over the parametric determination real data collect from B.S.P. Bhilai, C.G. Data book in the year of 2002-03, 2003-04 & 2004-05. For bloom, billet, slab, wire, ingot, channel, beam, rods dimension purposes. Same data in FACOR, Nagpur and other steel plant.

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