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Issue # 1: June 2008

IGEN – Thermal Power Plant Corner

Estimation of savings due to control of de-super heater water spray

Background:

A 140 MW thermal power generating unit, operating at 110 MW, was found to having main steam flow of 390 Ton/hr (TPH) at 120 kg/cm^2(g) pressure and 536^{o}C temperature (enthalpy = 822.9 kCal/kg). To control the super heat temperature, 30 TPH of water spray at 128 kg/cm^2(g) and 170^{o}C (enthalpy = 173.4 kCal/kg) was used in the de-super heater. The other operating parameters/ assumptions of the generating unit are as under:

Parameters/ Assumptions:

a) Main steam required at the above main steam pressure & temperature to generate 1 MW = 3.5 TPH.

b) Specific coal consumption = 0.65 kg/kWh

c) Coal GCV = 4,600 kCal/kg

d) Landed coal cost = Rs. 1,800 per ton

e) Expected steam consumption in the soot blowers after repair = 110 ton per day

f) Average revenue realised = Rs. 2 per kWh generated

g) Investment towards repairing of soot blowers = Rs. 4 crores

h) Boiler efficiency = 80%

i) Annual plant operating hours = 7000

Proposal:

The power plant plans to repair the existing steam soot blowers in order to improve the heat transfer within the boiler and to reduce the de-super heater water spray from 30 TPH to 7 TPH.

Issue:

What will be the energy and money saving potential if the above proposal is implemented by the power plant management?

Please send your solutions latest by 10th July 2008 to Mr. K. K. Chakarvarti,

Manager – Power Plant Component at ppc@energymanagertraining.com

All the best solutions received will be posted on the website latest by 17th July 2008 alongwith the names of the contributors.

Solution:

Part – 1:

Steam required for power generation

= 3.5 TPH x 110 kW

= 385 TPH

Main steam flow = 390 TPH

Steam used for soot blowing = 390 – 385 TPH

= 5 TPH

= 120 TPD

Steam consumption after repairing soot blower

= 110 TPD

Steam savings = 120 – 110 TPD

= 10 TPD

= 0.416 TPH

Option – 1:

Steam cost = $\frac{(822.9 - 173.4) \text{ kcal/kg} \times \text{Rs. } 1800/\text{T}}{0.8 \times 4600 \text{ kcal/kg}}$

= Rs. 317.7 / Ton

Annual Savings = Rs. 317.7 / T x 7000 hrs x 0.416 TPH

= **Rs. 9.25 Lakhs**

Option – 2:

The saved steam can be passed through turbine and can generate additional power

3.5 TPH steam generates 1 MW, therefore 0.416 TPH steam generates

= 0.119 MW power

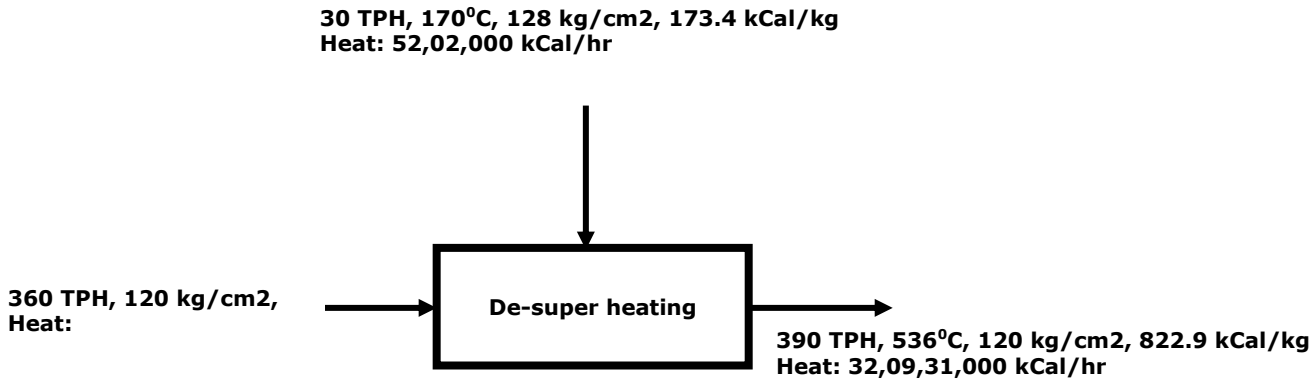
Annual savings = 119 kW x 7000 hrs x Rs. 2/unit

= **Rs. 16.16 Lakhs ----------→ 1**

Part – 2:

Enthalpy balance before and after the repairing of soot blowers

Before implementation of project:



Heat available after de-super heating

= 390000 kg/hr x 822.9 kCal/kg

= 32,09,31,000 kCal/hr

Heat added through water spray = 30000 kg/hr x 173.4 kCal/kg

= 52,02,000 kcal/hr

Therefore, heat available before de-super heating

= (32,09,31,000 – 52,02,000) Kcal/hr

= 31,57,29,000 kCal/hr

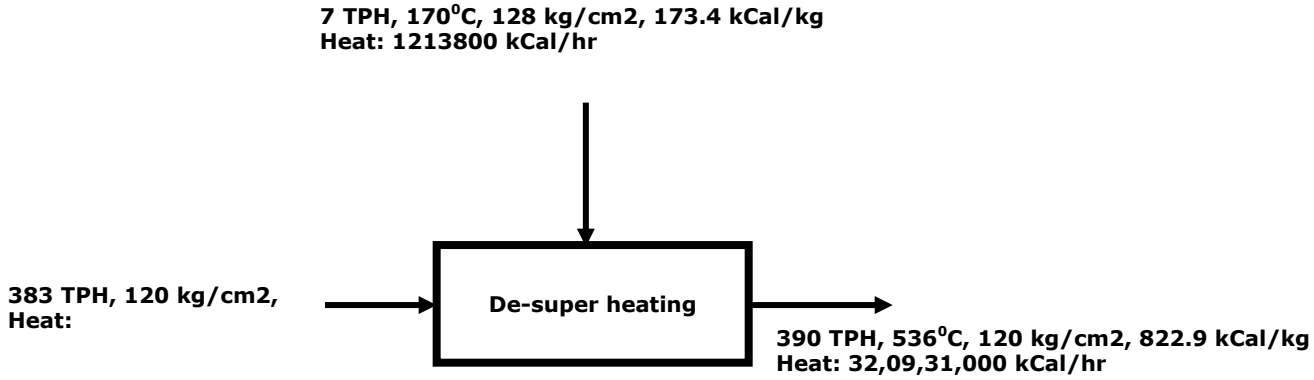
Enthalpy of steam = $\frac{31,57,29,000 \text{ kCal/hr}}{360,000 \text{ kg/hr}}$

= 877 kCal/kg

Based on the steam tables, steam temperature before de-super heating

= 625^{0}C

After implementation of project:



After implementing the project, the de-super heating flow reduced from 30 TPH to 7 TPH. To meet the power demand, the main steam flow should be 385 TPH for power generation and 4.584 TPH for soot blowing and 0.416 TPH for extra power generation, total 390 TPH.

However, 7 TPH is adding from water spray, therefore boiler generation is

= (390 – 7) TPH

= 383 TPH.

Heat available after de-super heating

= 390000 kg/hr x 822.9 kCal/kg

= 32,09,31,000 kCal/hr

Heat added through water spray = 7000 kg/hr x 173.4 kCal/kg

= 12,13,800 kcal/hr

Therefore, heat available before de-super heating

= (32,09,31,000 – 12,13,800) Kcal/hr

= 31,97,17,200 kCal/hr

Enthalpy of steam = $\frac{31,97,17,200 \text{ kCal/hr}}{383,000 \text{ kg/hr}}$

= 834.77 kCal/kg

Based on the steam tables, steam temperature before de-super heating

= 555^{0}C

Heat savings = (31,97,17,200 – 31,57,29,000) kCal/hr

	=	39,88,200 kCal/hr
Coal equivalent	=	39,88,200 kCal/hr 4600 kCal/kg
	=	867 kg/hr
Annual savings	=	867 kg/hr x Rs. 1.8 / kg x 7000 hrs
	=	**Rs. 109.24 Lakhs ------→ 2**
Total savings	=	1 + 2
	=	Rs. 109.24 Lakhs + Rs. 16.66 Lakhs
	=	**Rs. 125.9 Lakhs**
Investment	=	**Rs. 400 Lakhs**
Simple Payback period	=	Rs. 400 Lakhs x 12 months Rs. 125.9 Lakhs
	=	**38 Months**

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