VISAKHAPATNAM STEEL PLANT – RASHTRIYA ISPAT NIGAM LIMITED

Rubber Shots Cleaning Technology to Improve Vacuum in Turbo Generator Condenser

SUMMARY OF THE OPTION

Rashtriya Ispat Nigam Limited (RINL) is the corporate entity of Visakhapatnam Steel Plant. The steel plant is located 26 km south of Visakhapatnam city. The plant has a capacity to produce 2.656 MT (million tones) annually of saleable steel of which 2.410 MT is finished steel. The product profile of the plant comprises of wire rods, reinforcement bars (rebars), angles, channels, beams, squares, billets and blooms. The product profile also includes basic grade pig iron, granulated slag, coal chemicals and other by products. The plant also exports power to AP Transmission company from its captive power plant. The monetary value of the total energy consumption of main inputs averages Rs. 13,913 million (US$ 323 million) which accounts for 40 % of the manufacturing cost. The specific energy consumption during this period was 6.26 Gcal/ ton of Crude Steel. The commitment to energy conservation is reflected in the energy policy of RINL where in it is committed to reduce specific energy consumption by 1% per year up to 2010 AD.

The company has a thermal power plant for captive power generation. The thermal power plant has five boilers, each with foreign materials like broken fill, debris largely due to heat transfer area fouling because of turbid water. This problem was tackled by a new and innovative method involving bullet shot cleaning of the condenser tubes of TG-1 and TG-3 to facilitate vacuum improvement. This option on implementation resulted in the annual energy savings of around 19.55 million kWh worth Rs. 3,265 lakhs (US$ 759,302). An investment of Rs. 10 lakhs (US$ 23,256) towards rubber shot blast cleaning was paid back in less than a month and this measure resulted in annual GHG reduction of 17,460 tons of CO_2/year.

KEY WORDS

India, Iron and steel, Fuels and Combustion, Power generation, Condenser

OBSERVATIONS

Turbo generator -3 - Design parameters

- Steam consumption: 270 TPH (101kg/cm^2, 540^{O}C)
- Generation Capacity: 60 MW
- Turbine type: Extraction cum Condensing turbine
- Steam dumped to Condenser (after extraction): 170 TPH
- Cooling water flow (through condenser): 11000 m^3/hr
- Cooling water Temperature difference (across condenser): 8.1^{o}C
- Condenser vacuum: 0.8962kg/cm^2 $_{(abs)}$ (eqvt. Back pressure -0.1038 kg/cm^{2}abs)

Turbo generator -3 – Actual operating parameters

- Steam consumption: 270 TPH (@101kg/cm^2, 540^{O}C)
- Generation Capacity: 60 MW
- Turbine type: Extraction cum Condensing turbine
- Steam dumped to Condenser(after extraction): 170 TPH

- Cooling water flow (thru condenser): 11000 m^3/hr
- Cooling water temperature difference (across condenser):14^oC
- Condenser vacuum: (eqvt. Back pressure - 0.27 kg/cm^2 $_{(abs)}$): 0.73 kg/cm^2
- The Cooling water being used in the condenser was very turbid and as a result the fouling effect increased with time.
- Condenser tubes were fouled and the normal method of tube cleaning was by wire brush cleaning.
- Cooling water temperature range of 14^0C (low flow due to blockage of tubes) and lower condenser vacuum were indications of condenser fouling.

OPTIONS

Improvement in condenser vacuum of TG–3 and consequent increase in generation by maintaining cleanliness of tubes and avoiding tube choking through rubber bullet shot blast cleaning technique.

The rubber bullet shot blast technique is analogous to shot/sand blasting technique, which is quite prominent in foundries. In this process small iron balls or sand is blown at a high pressure targeted on to the casted metal object and due to friction between shot/sand and the metal surface it is cleaned and the rough edges are smoothened.

RESULTS

Assumptions and calculations behind the results are:

- TG 3 Generation: 60 MW
- Steam flow to the turbine: 270 tph
- Heat rate: 2600 kCal/kWh
- Coal Calorific Value: 2980 kCal/kg
- Condenser Vacuum: 0.89kg/cm^2 (Eqvt. Back pressure - 0.11 kg/cm^2 $_{abs}$)
- Difference as additional work available through the turbine for the same input: 7.9 kCal/kg steam (Enthalpy at 0.27 kg/cm^2 $_{(abs)}$ less Enthalpy at 0.11kg/cm^2 $_{(abs))}$
- Additional power generation: 2232 kW (= 270 X 1000 X 7.9 / 860 X 0.9 Turb. Eff.)

PARAMETER	DESIGN VALUES	BEFORE IMPLEMENTATION	AFTER IMPLEMENTATION
Steam Consumption	270 TPH	270 TPH	270 TPH
Cooling water flow thru condenser	11000 m3/hr	11000 m3/hr	11000 m3/hr
Cooling water temperature differential	8.1 C	14 C	8 C
Condenser vacuum	0.8962 kg/cm2	0.73 kg/cm2	0.89 kg/cm2

Financial benefits

- Investment: Rs. 10 lakhs (US$ 23,256)
- Annual operating cost: Same as it used to be earlier
- Annual cost savings: Rs. 326.5 lakhs/yr or US$ 759,302 (= Rs 1.67/kWh X 19552320 @ Rs 43 / US$). (Purchased power Rs.3.67/kWh; generated power Rs. 2.00/kWh)
- Payback period: Less than a month

Environmental benefits

- Annual electricity savings: 19,552,320 kWh or 19552 MWh (= 2232 kW X 8760 hrs/yr)
- Annual GHG emissions reduction: 17,460 tons of CO_2 (Increased generation for same steam input and avoided purchased electricity) (= 19,552,320 kWh X 0.000893 tons of Co_2/ kWh) [1]

Other benefits

- Time saving and reduction in the use of chemicals and solvents used for cleaning operations

[1] – UNEP GHG Calculator. Value specific to India

FOR MORE INFORMATION

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