VISAKHAPATNAM STEEL PLANT – RASHTRIYA ISPAT NIGAM LIMITED

Electricity Conservation at Feed Air Compressors of Air Separation Plant

SUMMARY OF THE OPTION

Rashtriya Ispat Nigam Limited (RINL) is the corporate entity of the Visakhapatnam Steel Plant. The steel plant is located 26 km south of Visakhapatnam city. The plant has capacity to produce 2.656 MT (million tones) annually of saleable steel of which 2.410 MT is finished steel.

Pure oxygen used in converters for manufacture of steel from liquid iron is supplied from the air separation plant which consists of three air separation units (ASU's) each of 500 TPD capacity. The process mainly consists of compression of atmospheric air to 6.0 $kg/cm^2_{g,,}$ by feed air compressors followed by liquefaction of compressed air and separation of liquefied air into oxygen, nitrogen and argon by the process of distillation. The products, oxygen and nitrogen, at low pressure from the distillation column, are compressed in centrifugal compressors and supplied to the different concerned sections (departments). Nitrogen is compressed to 9.0 kg/cm^2_g

The main input of the air separation plant is electric power. Any reduction of power consumption directly reduces the cost of input. The prevalent specific power consumption of ASP registered a value of 722.28 kWh/ton of total oxygen. Specific power consumption was monitored continuously for improving the overall efficiency of the plant. Towards this, the distillation column operating efficiency was improved by optimizing the reflux flow quantity, in addition to chemical cleaning of intercoolers and regular cleaning and replacement of air filters. This measure resulted in an annual electrical energy savings at end use of the order of 7.6 million kWh worth Rs. 152.4 lakhs annually (US$ 353,488). The associated reduction in GHG emissions amounted to 6787 tons CO2 per year.

KEY WORDS

India, Iron and Steel, Compressors and compresed air, Electricity, Air separation unit

OBSERVATIONS

The following observations were made:

- The air being processed was at the rate of 2,11,760 Nm^3/hr.
- Gas outlet temperature after compression of Feed Air Compressor, Oxygen Compressor (OC) and Nitrogen compressor (NC) was more than 45 ^0C.
- Sometimes, differential pressure across air filter of the feed air compressors (FAC) were more than 1 kPa (0.0102 kg/cm^2) due to clogged suction filters.
- The major consumption of oxygen from ASP was in the LD converter in the steel melting shop (SMS) which is a batch process. Being a batch process, there was a wide variation of demand of oxygen in the LD converter depending on the availability of the hot metal.
- Oxygen demand fluctuations ranged from peak flow of 48,000 Nm^3/hr to minimum flow of 25,000 Nm^3/hr during blowing and non-blowing periods respectively.
- When 2 LD converters were in line, the 3rd LD converter was under relining and the peak oxygen demand reduced to 30,000 Nm^3/hr.
- Variation of oxygen demand results in variation of plant load in ASU's.
- Of the total power consumption in Air Separation Plant, FAC's consume 57.18 per cent, OC's consume 19.30 per cent and NC's consume 15.42 per cent.

OPTIONS

Specific power consumption reduction in ASP from 722.28 kWh / ton of total oxygen to 689.1 kWh/ton of total oxygen by:

- Adjustments of reflux flow for optimum utilization of distillation column in order to meet the varied demand of oxygen.
- Chemical cleaning of intercoolers of all the compressors, whenever gas outlet temperature goes beyond 45 ^{0}C.
- Cleaning or replacement of suction air filters, whenever differential pressure across air filters of the compressors crosses 0.5 kpa.

A figure indicating the various operating parameters before and after the implementation of the options in the ASU is given below:

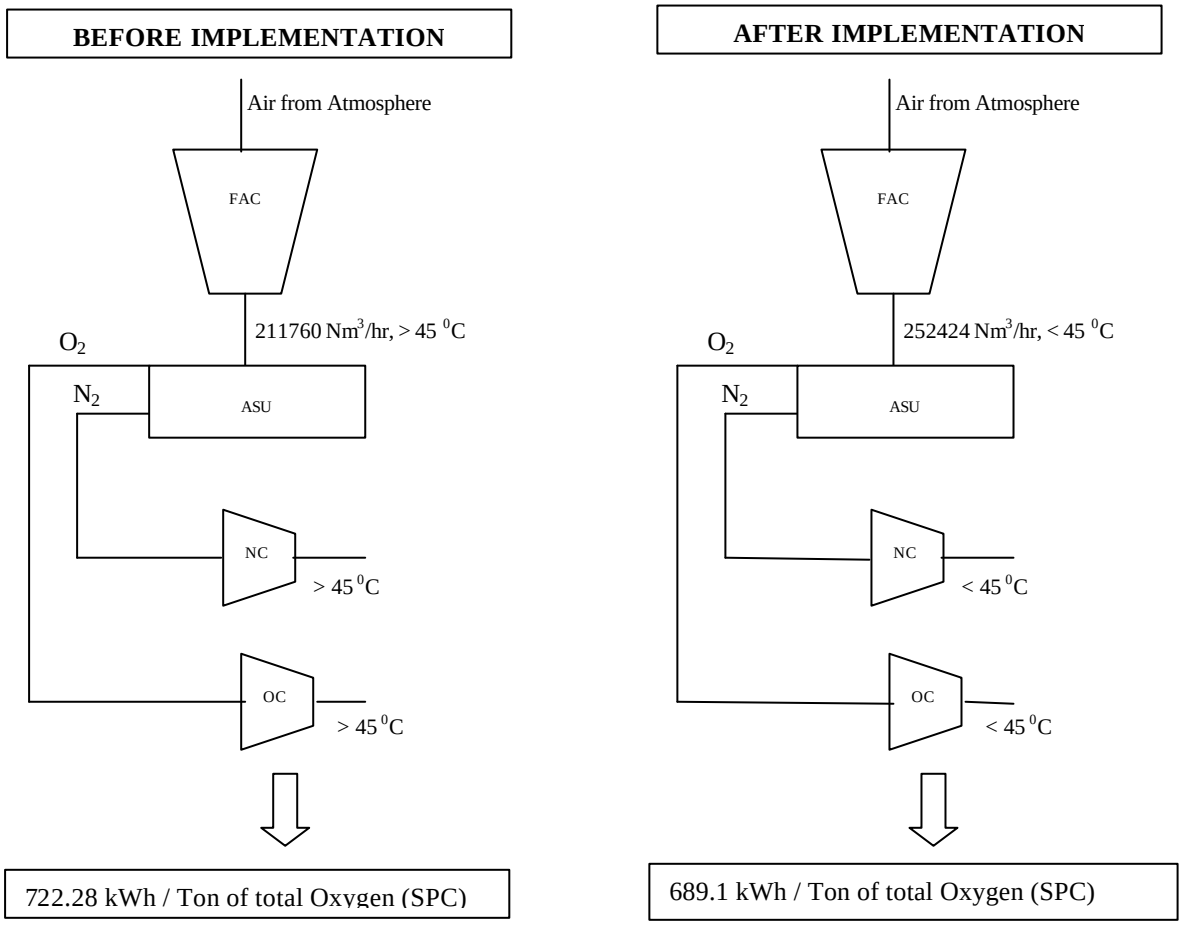

Figure 1: Operating parameters before and after implementation of energy conservation options

RESULTS

Assumptions and calculations behind the results are:

- Total air processed (After implementation):252424 Nm^3/hr
- Total Oxygen Compressed (After implementation):
- Volume flow rate: 37502 Nm^3/hr (Density of Oxygen: 0.698 kg/Nm^3)
- Mass flow rate: 26176 kg's/hr
- Specific power consumption before modifications/improvements: 722.28 kWh/ton of total oxygen
- Hourly oxygen compressor power consumption (Before implementation): 0.01891 million kWh
- Specific power consumption after modifications/improvements: 689.1 kWh/ton of total oxygen
- Hourly oxygen compressor power consumption (after implementation): 0.01804 million kWh
- Reduction in specific energy consumption: 33.18 kWh/ ton of total oxygen (722.28 – 689.1)
- Annual hours of operation: 8760 Hrs

PARAMETER	BEFORE IMPLEMENTATION	AFTER IMPLEMENTATION
Total Air processed	21760 Nm3/hr	252424 Nm3/hr
No. of operating hours	8760 hrs	8760 hrs
Amount of Oxygen as output in compressed form	26.176 T/hr	26.176 T/hr
Oxygen compressor power consumption	18910 kW	18040 kW
Specific energy consumption	722.28 kWh/Ton of Oxygen	689.10 kWh/ton of Oxygen

Financial benefits

- Investment: none
- Annual operating cost: no change
- Annual cost savings: Rs.152.4 lakhs or US$ 353488 (= 7.6 million kWh X 2 Rs.kWh @ Rs43 / US$)
- Payback period: immediate

Environmental benefits

- Annual electricity savings (direct at end use): 7.6 million kWh (= 26.176 X 33.18 X 8760)
- Annual GHG emission reduction: 6787 tons CO_2, (= 7.6 million kWh X 0.000893 tons CO_2 /kWh) [1]

FOR MORE INFORMATION

GERIAP National Focal Point in India
Mr. A. K. Asthana
Group Head Energy Management
Mr. P. K. Gupta, Director, NCPC-India
National Productivity Council,
5-6, Institutional Area, Lodi Road, New Delhi - 110003
Tel: +91 – 11 – 24697446
Fax: +91 – 11 - 24698138
E-mail: ak.asthana@npcindia.org / ncpc@del2.vsnl.net.in

GERIAP Company in India
Mr. Y. S. S. Rao, Company Chairman and Managing Director
E-mail: cmd@vizagsteel.com
Mr. K.K. Rao, Director – Operations,
Mr. C.S. Gupta, Addl. GM (Energy and Environment and Designated Energy Manager)
E-mail: gupta.cs@rediffmail.com
Rashtriya Ispat Nigam Ltd., Visakhapatnam Steel Plant
Visakhapatnam, Andhra Pradesh, India
Tel: +91-0891- 2518444/2518301
Fax: +91-0891- 2518237/2518631