DESIGN AND OPERATING FEATURES OF NEW 27.6 MVA FURNACE AT NAVA BHARAT VENTURES LIMITED, PALONCHA

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ABSTRACT

NBV commissioned a 27.6 MVA furnace in the year 2005. This paper explains:

a) Furnace design features

b) Furnace process control, Direct slag granulation

c) Continuous casting, Waste heat recovery, Sintering

d) Gas cleaning plant, Protection of Environment.

Keywords: *Furnace Equipment, SiMn Production, Casting, Heat Recovery and Low hood*

1. INTRODUCTION

Nava Bharat Ventures Limited (Formerly Nava Bharat Ferro Alloys Limited) started operations with production of ferro silicon in a 16.5 MVA furnace of Russian design, at Paloncha in Andhra Pradesh in 1975. Two more furnaces of 16.5 MVA each were subsequently installed to increase the plant capacity. All the three furnaces were open type submerged arc furnaces of high hood design with the power supplying cables passing through the hood. The plant was originally producing ferro silicon and calcium silicide. To improve the contribution, the company switched over to manufacture of high carbon ferro chrome and later on to manganese alloys. In 1997, the company set up a green field plant with two furnaces of 22.5 MVA each in Orissa and started manufacture of high carbon ferro chrome.

To enhance the capacity and modernize production, the company installed a new 27.6 MVA furnace at its ferro alloy plant in Andhra Pradesh in 2005.

The company's ferro alloy plant in Andhra Pradesh today produces manganese alloys with a total installed capacity of 125,000 tonnes per annum while the ferro alloy plant in Orissa produces ferro chrome with an installed capacity of 75,000 tonnes per annum.

To control the cost of power which was increasing rapidly in India at that time, the company set up captive power plants in the premises of its ferro alloy plants in Andhra Pradesh as well as Orissa . The power plant in AP has a capacity of 114 MW. The power plant in Orissa has a present capacity of 30 MW, which is under expansion to 94 MW.

The Quality and Environmental Management Systems are certified as per ISO 9001: 2000 and ISO 14001:2004

The company has a divisional structure as delineated below:

FERRO ALLOY DIVISION	POWER DIVISION	SUGAR DIVISION
Ferro Alloy Plant (A.P.P Manganese Ferro Alloys Capacity 125,000 TPA	Power Plant (A.P.) Capacity 114 MW	Sugar Plant Capacity 3500TCD White Crystal Sugar Rectified Spirit, ENA Co-gen of Power
Ferro Alloy Plant (Orissa) Chromium Ferro Alloys Capscity 75,000 TPA	Power Plant (Orissa) Capacity 30MW (under expansion to 94MW)	New green field project Capacity 2500 TCD with co-gen of power & prodn of bio-fuel

This paper presents the design and operating features of the 27.6 MVA furnace at the company's ferro alloy plant in Andhra Pradesh and related systems.

2. DESIGN FEATURES

The 27.6 MVA furnace adopts low hood design, which protects mechanical and electrical fittings from flames and heat, facilitates easy maintenance and reduces fugitive emissions.

The furnace is equipped with a modern electrode position regulator, hydraulic holder and electrode column of PYROMET design. In this design, the bus tubes, water-cooling pipes from pressure ring and lower electrode are concealed in a water-cooled heat shield. The traditional nut-and-screw contact shoes/pressure rings are replaced by metallic bellows, which are more compact and concealed. This system enhances the life of pressure ring components and provides better slipping and position control.

The furnace transformers are arranged on three sides and placed on the top of the hood to reduce secondary losses in bus bars.

3. FURNACE OPERATION

3.1 Process Control:

Process control is mainly based on analysis of tapping samples in each shift and daily analysis of finished product stacks. The possible raw material corrections are also based on visual observations of tappings such as slag and metal temperatures and slag fluidity. The material burden sheet is prepared based on a computer optimized material balance.

Furnace eruptions are controlled through a set of safe operation procedures comprising:

a) Reducing amount of fines from 20% to 12% by using appropriate screens.
b) Decreasing the available oxygen through the usage of sinter
c) Early tapping so that accumulation of metal pool is avoided.
d) Maintaining higher basicity of slag.
e) Surface raking of charge material.
f) Avoiding moisture in rainy seasons by covering raw materials with tarpaulins.

The specific power consumption for 60-65grade of silico manganese is around 3600-3800 kWh/MT. The manganese recovery achieved from the charge is around 85%.

The company has installed a PYROMET furnace controller which uses one of the latest and advanced resistance based control systems. It operates the tap changer, lowers or raises the electrodes and maintains the furnace load within specified range at the given resistance set point.

Batching of raw materials with the help of bins and feeding hoppers and charging by means of skip hoist and rotary car distributor are done through a PLC based control system. The feeding system is robust, accurate, precise and flexible to charge different raw materials. The same PLC controls all the furnace blowers and motors.

The advantages of the above system are:

1. Reduction in manpower for operation and maintenance.
2. Lower specific power and indication of possible burden corrections

The design features of the furnace and the automation described above coupled with the rigorous maintenance practices followed, has helped the company achieve furnace availability above 98%.

3.2 Direct Slag Granulation

The method of collecting slag from cascaded slag pots and granulation in a pit is time consuming and requires multiple crane operations. The company has therefore adopted direct granulation for the new 27.6 MVA furnace, which produces more slag volume due to the higher capacity of the furnace. The liquid slag passes through a closed launder before impinging against a jet of pressurized water. The closed launder prevents spread of steam during granulation. The slag granules fall into a granulation pit from where they are collected with the help of a grab. This practice eliminates crane handling of slag pot and saves time. With MnO up to 12 per cent and basicity greater than 0.6, the slag has high fluidity which facilitates direct granulation.

3.3 Continuous Casting

Casting of alloy is automated with a continuous casting machine consisting of a synchronized automatic ladle tilter and continuously moving moulds. Different speeds are employed for casting different grades of alloys, as the solidification time is different for each alloy.

The advantages with the continuous casting adopted are:

1. No contamination with foreign material.
2. Faster solidification of alloy than in bed casting.
3. Less manpower for breaking the metal to the final size as the size of alloy cake is much smaller than bed cast cakes
4. Less generation of fines
5. Uniform distribution of size (20 - 70 mm)

3.4 Waste Heat Recovery System

The company (NBV) has installed a heat exchanger to utilize the heat available in the furnace flue gases, for heating the boiler feed water and main condensate of 32 MW Captive Power Plant located in the same premises. The heat exchanger is of cross flow type with two passes. The first pass is called as HPHX and the second pass is called as LPHX. The flue gases are passed vertically downwards over bundles of horizontal water tubes in HPHX and upwards in LPHX. Feed water and main condensate are heated in HPHX and LPHX respectively. The flue gas coming from the furnace passes over HPHX first, later over LPHX and finally enters Gas Cleaning Plant (GCP) through an ID fan.

The WHRS gives the following benefits:

1. Improved life of GCP bags.
2. Reduced maintenance cost of GCP
3. Reduced power consumption of Induced Draught Fan
4. Reduced specific steam consumption of Power Plant Turbine

3.5 Sintering of Fines

Sintering is a well-known and established method for use of Mn ore fines. The sintering process adopted in NBV is pan sintering with a plant capacity of 80 MT per day. Dolomite is added up to 1 percent for self-fluxing of sinter. The burn through velocity is low in this sintering process. The sinters are of good quality and the return sinter fines are around 25% to 30%, which is on par with international practice.

The suspended particulate matter collected in the Gas Cleaning Plants is added to the sintering pans in order to recycle Mn units, which go as a waste otherwise, and, for maintaining appropriate Mn/Fe ratio in the sintered material. The sintering technology so developed is environment friendly.

3.6 Gas Cleaning Plant:

Filter bag technology is used for cleaning the furnace gases after passing though the Waste Heat Recovery System. The filter bags are capable of collecting suspended particulate matter up to 20 microns size and handling volumetric flow rate of gases up to 300000 Nm3/hr. The stack emissions are kept well below 100-mg/Nm3 helping NBV comply with the stringent environment regulations and the related legal requirements on air quality.

3.7 Protection of Environment:

The company has taken several steps to protect the environment. The significant practices adopted are:

1. Supply of granulated slag for use in manufacture of Pozzolana cement, fly ash bricks and as partial substitute for sand for concrete rings and concrete roads.
2. Sintering of Mn fume collected from GCPs and reuse in furnaces.
3. Reduction in fugitive dust emission in material handling by:

   a) Using completely covered transfer chutes and conveyors
   b) Mist formation at ground hoppers

4. Sourcing water for granulation of slag from cooling tower blow down and treated water from effluent treatment plant, resulting in conservation of water.

5. Extensive plantation of trees for maintaining effective green belt in and around the manufacturing plants.