Indian Experience in Construction of Kalugin Top Combustion Stoves

Kazbek Agaev, JSC “Kalugin” Representative in India & Vice President (Projects),
Evo Tech Pvt. Ltd.
Email : nartbek@gmail.com

Abstract

Introduction of high temperature Kalugin Top Combustion Hot Blast Stoves in India has been jointly initiated by JSC “KALUGIN”, Russia and EVO TECH PVT. LTD., India in 2005.

The first greenfield Kalugin Stove Unit was commissioned at Sun Flag Iron & Steel Co. Ltd., Bhandara Works in 2007. It should be stressed that the Kalugin Top Combustion technology for this very first stove unit in India was studied and cleared by MECON LTD. as the main blast furnace technology supplier.

On the eve of 10th anniversary of introduction of the Kalugin Top Combustion Stove technology, we are proud to state that the success of the SUN FLAG unit ensured completion of 8 stove units in India, both greenfield and brownfield projects where the blast furnace capacity ranged from 215 m^3 to 2,300 m^3 with operating hot blast temperatures of 1200^{0}C. The recent Kalugin stove projects are aimed at maintaining 1,250 - 1,300^{0}C operating hot blast temperature.

Therefore, the present trend of hot blast temperature enhancement aimed at reduction in operating cost is one of the best means of optimizing the return on investment and better management of natural resources in iron making.

Key words : Blast Furnace, Kalugin Top Combustion Stoves

Introduction

A sustainable 10-year cooperation of JSC “KALUGIN”, Russia and Evo Tech Pvt. Ltd., India has resulted in successful construction and commissioning of a number of Kalugin Top Combustion Systems, that ensured significant technological and commercial benefits to our

clients. Various stove projects, jointly implemented by us in India have been both green field and brown field type and are based on turnkey as well as on divisible scope of supply.

The blast furnaces, which have been equipped by us with the Kalugin Top Combustion Stoves in India, were of various design origins including indigenous and imported whereas the BF capacities ranged from 215 m^3 to 2,300 m^3.

The implemented projects have been also characterized by various technological and constructional challenges that have been successfully resolved in the course of technical and commercial negotiations and also during construction stage.

The following is a brief description of a few joint project cases.

Study case 1

A joint Agreement between Sunflag Iron & Steel Company, JSC “Kalugin” & Evo Tech Pvt. Ltd. on construction of the Kalugin Top Combustion Stoves & Waste Heat Recovery System (WHRS) for a green field blast furnace of 350 m^3 capacity based on divisible scope of work and supplies was concluded in 2005 and subsequently, the first ever Kalugin stove unit in India was successfully commissioned in 2007 where the blast furnace technology was provided by MECON Ltd., India.

Numerous technical meetings were initially held between Sunflag, MECON, Kalugin & Evo Tech where the Kalugin top combustion stove technology was scrutinized before the final go-ahead decision was made by the Client after having been convinced of the technical and commercial advantages of the Kalugin Hot Blast System.

Despite the fact that the blast furnace unit design was provided by MECON and the stoves were supplied by Kalugin, both the blast furnace and stoves have been successfully matched showing the strength of a perfect marriage of the state-of-the-art indigenous and imported technologies.

Salient features of the Sunflag Kalugin Top Combustion Stoves

- BF capacity - 350 m^3
- Design hot blast temperature - 1,200^{0}C
- Blast period - 60 minutes
- Blast volume - 52,000 Nm^3/hour
- Checker brick flue diameter - 20 mm
- Preheated air & BF gas - up to 160^{0}C

Performance guarantee tests jointly carried out after the unit commissioning by Sunflag, Kalugin & Evo Tech in March 2007 have confirmed the exact projected design operating parameters including hot blast temperature of 1,200^{0}C, blast period of 60 minutes, blast flow rate of 52,000 Nm^3/hour, design BF gas & combustion air consumption as well as temperature of preheating of gas and air in WHRS up to 160^{0}C. Accordingly, joint acceptance certificate was signed to the full satisfaction of the Client and Technology Supplier.

The stove unit is presently performing successfully with operating hot blast temperatures of 1,130 - 1,150^{0}C due to inferior quality of charge materials as per the reports of the company's blast furnace operators. Otherwise, there is no doubt that the Kalugin stoves can deliver the design hot blast temperature of 1,200^{0}C using only lean BF gas.

Study case 2

A similar divisible scope tripartite agreement was concluded between Kirloskar Ferrous Industries Ltd., JSC "Kalugin" & Evo Tech Pvt. Ltd. for construction of the Kalugin Top Combustion Unit & Waste Heat Recovery System for BF-1 & BF-2 of identical 254 m^3 capacities. Both blast furnaces of Tata Korf design initially had metallic blast preheaters with hot blast temperatures up to 800^{0}C while the proposed Kalugin stoves design allowed increasing the hot blast temperatures up to 1,200^{0}C. BF-1 Stove Unit was commissioned in 2007 while BF-2 stoves were put into operation in 2011. Both blast furnaces were originally

producing pig iron for the captive automotive products casting unit with purchased coke & 100 % lump ore charge.

The new Kalugin hot blast system including hot blast header, bustle pipe, stack, back draft chimney, expansion joints, tie rod system, tuyere stock assembly, etc. were designed to replace the existing facilities in order to sustain elevated hot blast temperatures. Finally, the existing metallic blast pre-heaters were phased out and the area was vacated for the plant use.

Despite the fact that initially after commissioning of the Stove Unit in BF-1, it had 100% lump ore charge and there was neither sinter nor coal dust injection, hot blast temperatures could be maintained as high as 1150-1160^{0}C. Such a significant enhancement in hot blast temperature allowed reduction of the specific coke rate by 12% while the specific productivity was increased also by 12 %. The above dramatic improvements in the operating parameters ensured the fastest return on investment within 7 months from commissioning.

It is also worth mentioning that both KFIL stove units were brown field projects and the construction technology was worked out in such a manner that it did not affect hot metal production. Only 14-day blast furnace shutdown was taken for replacement of the bustle pipe and new tuyere stock assembly in order to sustain 1,200^{0}C hot blast temperature.

It is also noteworthy that the above obvious improvements in the techno-economics of both blast furnace units as well as much less hazardous impact on the environment due to introduction of state of the art Kalugin stove technology allowed the KFIL Management to apply for Clean Development Mechanism.

Salient features of the KFIL Kalugin Top Combustion Stoves

- BF capacity - 254m^3
- Design HBT - 1200^{0}C
- Blast period - 60 minutes
- Blast volume - 42,000Nm^3/hour
- Checker flue diameter - 20 mm
- Preheated air & BF gas - 180^{0}C

Although the performance guarantee tests confirmed that both KFIL stove units were capable of maintaining the design hot blast temperature, they are performing satisfactorily with operating hot blast temperatures up to1150^{0}C due to the prevailing blast furnace technology.

Study case 3

BF-1 of Jayaswals Neco, Siltara was of Chinese design with the initial capacity of 630 m^3. It was also equipped with the Chinese design conventional internal combustion chamber stoves designed for 1,100^{0}C hot blast temperature although maximum operating temperatures were in the range of 1,050^{0}C. However, upon furnace capacity enhancement to 680 m^3, hot blast temperatures ultimately dropped to 950 - 970^{0}C, which were limiting the coal dust injection rates, overall fuel rate and specific productivity.

Finally, after a number of technical discussions held between Neco, Kalugin & Evo Tech, the Management of NECO took a decision to convert the existing stove unit into Kalugin Top Combustion design.

The original concept of the stove unit modernization was based on construction of stove No.4 and WHRS and a subsequent one-by-one conversion and connection of stove No.3 & Stove No. 2 followed by phasing out stove No. 1.

Due to the limited available space for construction of stove No.4 and impossibility to use soil excavation and exposure of the existing raft of the stoves and chimney foundations, piling method was adopted for construction of the new stove foundation and supporting structures.

However, during the course of construction of Kalugin stove No. 4, the management of NECO raised a point whether the overall stove unit modernization period could be reduced keeping in mind production losses due to the new stove connection as well as bank loan interest.

Subsequently, Kalugin and Evo Tech came up with the idea of simultaneous construction of stove No. 5 & stove No. 6, while connection of the stoves and a new extension piece of the hot blast header would be sequenced with the planned BF maintenance shutdown. The management of NECO readily accepted the proposal since the modernization duration and

bank loan period would reduce by 12 months whereas reduction in construction overheads have also been of a significant value.

Salient features of the NECO Kalugin Top Combustion Stoves

- Blast furnace capacity - 680 m^3
- Design hot blast temperature - 1,200^{0}C
- Blast period - 45 minutes
- Blast volume - 114,000 Nm^3/hour
- Checker brick flue diameter - 20 mm
- Preheated air & BF gas - 160^{0}C

All of the construction challenges and commercial benefit targets have been successfully achieved and the unit is presently running with the specific productivity of 3.1 t/d/m^3, total fuel rate about 515 - 520 kg/thm and hot blast temperatures of 1,170 - 1,180^{0}C.

Study case 4

The original BF-1 of JSW, Vijayanagar of 1250 m^3 capacity was designed by MECON and equipped with conventional internal combustion chamber hot blast stoves with operating hot blast temperatures up to 1050^{0}C.

Recently, JSW decided to increase the capacity of BF to 2,300 m^3 and the thermal capacity of the stoves to cater to larger blast volume and higher HBT.

JSC Kalugin and Evo Tech submitted the best technical proposal for the stove unit modernization and the order for the supply of Kalugin Top Combustion Stoves & WHRS for the modernized BF-1 was accordingly placed on Kalugin & Evo Tech while the work order for the Basic Engineering of the blast furnace modification was awarded to M/s Paul Wurth and the Detail Engineering job was awarded to MECON Ltd. In order to amalgamate both imported and indigenous technologies, once again it was proven that splitting of the blast furnace modernization project into separate packages is not in any way harming the project cost, or its duration. On the contrary, the split package concept ensures adoption of the best available fuel-efficient technologies for the BF proper and hot blast stoves.

Salient features of the JSWKalugin Top Combustion Stoves

- Blast furnace capacity - 2,307 m^3
- Design HBT - 1200^0C
- Blast period - 45 minutes
- Blast volume - 230,000 Nm^3/hour
- Checker flue diameter - 20 mm
- Preheated air & BF gas - 190^0C

The initial plan of the management of JSW was to first construct Kalugin Stove No. 4 and WHRS at a new location and, subsequent to its commissioning,to convert two of the existing stoves into Kalugin design, which was almost similar to the NECO stove modernization concept.

However, the above philosophy of modernization had its own negative points like extended period of implementation, interference in the on-going hot metal production, increased bank loan interest and construction overheads.

Kalugin & Evo Tech made a reference of the NECO stove modernization case for the consideration of the JSW Management and, quite logically, the advice to construct a completely new stove unit without interfering into the day-to-day blast furnace operation was positively accepted.

Although the available area for construction of the new stove unit and its auxiliaries within the existing plant infrastructure was quite limited, the compact arrangement and spatial flexibility of the Kalugin Hot Blast System allowed fitting of the completely new stove unit & WHRS next to the existing stoves also taking care of proper access of construction materials, construction cranes and machinery to the site and, most importantly, ensuring non-interference in day-to-day hot metal production.

It is also noteworthy, that upon commissioning of the new Kalugin Hot Blast System the entire area, presently occupied with the existing stove unit, will be cleared and vacated for better and free access to the blast furnace, which will also make future BF maintenance activities easier and faster.

At present, construction of the Kalugin Stoves & WHRS as well as initial drying and heating have been completed and the stoves are kept in heated and ready condition while modernization of BF-1 proper and its auxiliaries is still going on. However, we do not have any second thought that the JSW BF-1 Stove project would also be a sure success as all our previous ones had been in India and abroad.