

IS THE WHRB POWER GENERATION BENEFICIAL TO SPONGE IRON PLANTS?

**- A.N. Jha (B.E. Metallurgy)
382, Sunder Nagar, Raipur (C.G.)**

In this article an effort has been made to briefly highlight the difficulties and technical issues related to implementing the WHRB Power Plant with Sponge Iron Plants which are as follows:

- 1) Sponge Iron Reduction Kiln is one of the very critical reaction vessel which perform the following functions simultaneously.
 - a. Combustion of Coal
 - b. Gasification of Coal
 - c. Preheating of Iron Ore.
 - d. Preheating of Coal
 - e. Reduction of Coal (in to Gases).
 - f. Reduction of Iron Ore
 - g. Conveyor of the Solid
- 2) In view of the above the following conditions are very-very critical in the Kiln.
 - a. Slight positive pressure inside the kiln has to be maintained.
 - b. Temperature inside the Kiln at various zone has to be maintained at desired levels.
 - c. Air Coal Ratio i.e. Air feed rate to be maintained according to the coal quality and quantity.
 - d. Reducing atmosphere inside the Kiln i.e. CO:CO₂ ratio.
 - e. Charge Mix that is Fe:C ratio in the Kiln
 - f. Mechanical health of the Kiln.
 - g. Uninterrupted operation of the Kiln.

Contd...2

- 3) To achieve the above the raw material i.e. Iron Ore and Coal, Physical and Chemical composition parameters are really very critical such as:
- a. Feed size of the Iron Ore and Coal.
 - b. Thermal stability of ore.
 - c. Reducibility of ore.
 - d. Fe content of the ore.
 - e. Sulphur and Phosphorous content in the ore.
 - f. Shattering index of ore.
 - g. Tumbling index of the ore.
 - h. Fixed carbon of coal.
 - i. VM in coal.
 - j. Swelling index of the coal.
 - k. Reactivity of the coal.
 - l. Ash fusion temperature of the coal.
 - m. Ash percentage of the coal.
 - n. Moisture in coal.
 - o. Proper mix of Iron Ore and Coal.
 - p. Feed rate of Iron & Coal.
 - q. Retention time of mix in the Kiln.
 - r. Proper composition of limestone or dolomite.
 - s. C/Fe Ratio of Mix

Contd...3

In addition to the all the above parameters the following also influence greatly the performance of the Kiln.

- i. Humidity in air
- ii. Ambient Air temperature.
- iii. Uninterrupted operation

Influence of changes due to any of the above parameters has the following adverse impact in operation of the process.

- a) Change in the reduced thermal stability poor shattering index, poor tumbling index of Iron Ore may lead to generation of higher fines which may have adverse impact on the downstream WHRB operations due to higher dust load in flue gases containing higher % of Iron particles.
- b) Increase in the sulphur content in Coal or in Iron Ore may emit higher SO_2 which may cause Acid deposition in Boiler and Air-pre-heater system.
- c) Higher VM in coal can reduce the Fe:C ratio and cause changes in the reducing atmosphere inside the kiln and reduction of ore may be hampered or metallization level will get decreased. This will influence the Gas volume from Kiln. Hence affect WHRB operations. more over higher V.M. will lead to higher kiln temperature approaching to Ash fusion temperature & will enhance accretion deposition.
- d) Similarly any disturbance in the Kiln activity and reaction may cause either tremendous decrease in temperature or increase in temperature; of flue gas at the same time affect the metallization and production of Sponge Iron.
- e) Any change in feed rate will also have the same impact which will influence the WHRB Boiler steam generation performance.
- f) The WHRB tubes are more prone to Nitrous Stress and also prone to thermal shocks and impact of SO_x which may result in to frequent break down.

Contd...4

In view of the above the design of WHRB for Sponge Iron Kiln is very critical and subject to frequent fluctuation in power generation. No efforts can be permitted to sacrifice the production of Sponge Iron hence the WHRB has to be operated according to the availability and behavior of the Kiln. Therefore the resultant PLF will be much less than the normal Thermal power plant at the same time higher operation and maintenance will be required. Also the raw material quality variation which is normally possible to accommodate with the independent sponge Iron Kilns having no WHRB, will not be permissible with the Kilns with WHRB. Hence very strict quality control on the input side of Raw material also has to be maintained.

Moreover one of the very important aspect must also be noted that once the WHRB is under breakdown then the Sponge Iron Kiln also has to be stopped, it can not then be run without WHRB, therefore this freedom of operating Sponge Iron Plant will be clubbed with WHRB. Therefore impact of all these on economics must be worked out together before any decision is made to set up WHRB power plant with Sponge Iron Kilns. There are several other issues which one should keep in mind such as availability of highly experienced WHR boiler operators, and TG operators which have comprehensive under standing and knowledge of dealing with fluctuations & their causes, remedies etc. and must have online and correct co-ordination with the Sponge Iron Kiln operation team.

The WHR system operation is not as independent and easy to control as a coal based Boiler.

Therefore the inexperience team may cause not only the production loss in the WHR based power plant but it may also totally destroy the quality of Sponge Iron production, as well as quantity of Sponge Iron production, and which may also lead to faster ring formation in Kiln and Rapid Tube failures in Boilers.

The back up grid support or DG based power support is another essential requirement, to avoid any mishaps. If the generated power is to be used for Captive purpose then it is most essential to have a Grid backup or stand by DG sets etc.

Contd...5


In case of WHRB power is being planned to export the surplus to the grid then very good grid availability and evacuation system must be there, along with an automatic synchronization system. The synchronization panel must be able to take care of all the power fluctuation.

It may be noted that the stoppage of WHRB power plant may result in to stoppage of Sponge Iron Plant; which must always be avoided. Because every stoppage of Sponge Iron Kiln will result in to several days of production loss and financial loss as well as also the campaign life of kiln will be affected.

The availability and variation in raw material quality for Sponge Iron like Iron Ore and Coal must also be kept in mind.

Any decision to invest on WHRB should be done keeping the above in mind and keeping that at best 60 to 70% PLF can be achieved.

Place: Raipur (C.G.)
Dated: 21/October/2003


(A.N. Jha)