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Proportioning of Raw Mix in Sinter Plant-2 by using PLC Based Automation System with Inticont Plus under Modernization of Bhilai Steel Plant

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Abstract: Sintering is the process of utilization of undersized valuable raw materials which seemed to be useless for the purpose of Iron making through Blast furnace route. The goal of the sinter process is to convert iron into steel. In Blast Furnace sintering process is adopted for agglomeration. Sinter is the main input of BF. The main objective of this paper is proportioning of raw material in Sinter Plant-2 (SP-2) to achieve required quality of sinter at blast furnace. The proposed work deals with proportioning and mixing of the raw material by a particular chemical analysis, which is required for sinter making. This is achieved through utilization of belt weighing system using load cells and controllers. In this paper it is envisaged how modernization techniques are used for sinter making. By implementation of the improved PLC based raw material feeding or proportioning system, Sinter Plant II is able to produce Sinter of consistent quality.

Index Terms: Agglomeration, Modernization, Production, PLC, Proportion, Blast Furnace, Sinter.

I. INTRODUCTION

Bhilai Steel Plant is one of the flagships of SAIL and Sinter Plant-2 is one of the major production shops producing sinter which is the main input of major blast furnaces. The output yield as well as sinter quality and its consistency are measured with respect to CaO-SiO2. CaO-Sio2 plays a vital role on the blast furnace performance i.e. production, productivity, cock rate and quality output of the hot metal.Total capacity of Sintering Plant-2 as 3.137 MT/Y. As the sinter being prime material in Blast Furnace burden, its chemical & physical properties play a vital role in hot metal production. In the Metallurgical Technology, the property of sinter is determined by various factors & components present in it. Those are mainly responsible for movement of burden into the furnace as well as physical & chemical properties of hot metal being produced by the blast furnaces. The desired properties of sinter are mainly CaO-SiO2, MgO, Fe, FeO, strength & Physical size. Out of these the CaO-SiO2 is the most important component of sinter which is mainly monitored by the blast furnace operators. It is a chemical component which is checked & determined periodically & regularly. The values of the component are maintained in a range as per the norms. The values of CaO-SiO2 which is within the range of norm are termed as percentage consistency. The higher consistency of CaO-SiO2 plays following effects on to the Blast Furnace operation.

- Better thermodynamic behavior of Blast Furnace burden.
- It also improves the easy separation of slag.
- Improved movement of burden into the Blast Furnace stack will require lesser coke rate for hot metal production.

The Blast furnace needs various raw materials for manufacturing the hot metal, Sinter is one of the most important inputs for the blast furnace. The utilization of sinter in blast furnace burden facilitates efficient furnace dynamics with reduction in flux and fuel consumption. The sinter plants have the responsibility to manufacture and supply the super fluxed sinter of the required chemical properties to blast furnace.

The revamping was based on Schenck weighing controllers[1].At first traditional control system in section of hard wiring & interlocking has been replased by old control systems which included the terminology of belt weigh feeder automation technology. In this project we are follow the new control functions.Communication system based on new hardware and software.PLC controls the process for automation.

II. PROPOSED METHODOLOGY

The Sinter Making process substantially depends on efficacious functioning of series of operations. All the raw materials are discharged into a conveyor belt in definite proportion and taken to primary mixing drum. The Proper granulation / nucleolus formation is very important. All the raw materials are fed to Secondary Mixing Drum,

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where the final moisture is maintained. The moisture content in the granulated material is extremely important for quality of sinter which is generally controlled through Feed Water Flow Control and Moisture Measurement. Balling drum rotation input feed rate and spraying water flow or Moisture addition are all interlinked in a cascaded control system with an objective to achieve desired moisture for optimum granulation of Raw Sinter Mix. After balling drum material is charged through roll feeders and hoppers on to continuous horizontally travelling palette of Sinter Machine. The material level control system in the hopper controls the hopper level by adjusting input feed rate of raw material in Balling Drum by an automatic weigh feeder control mechanism. The top layer of bed granulated material on sinter palette is first heated inside an Ignition Furnace. The fuel used in the furnace is a combination of gas emanated from Coke Oven called CO gas. The ignition is maintained at temperature 850-950°C[2].

The surface of the bed is ignited by furnace burners. Air is continuously drawn downwards from top to bottom, bed all along the length of travelling palette grate by suction created through exhauster fans. The carbon present in raw mix material burns with the aid of air. The heat or flame front thus created moves vertically down the material bed layer by layer as the palette travels in forward direction. The hot air is sucked out by exhauster through a series of channels called wind boxes mounted below the palette. The progress of sintering along the length of grate is determined by measuring hot air temperature in different wind boxes by thermocouples. BTP is generally regulated by adjusting the palette speed in such a way that it occurs in the last but one wind box. However it also depends on Bed Height, Moisture and Raw Mix Quality. After leaving the palette the hot sinter is cooled, in the straight line cooler, the hot sinter is dropped on another travelling stand and air is blown from the bottom. The rate of cooling is controlled by adjusting speed of cooler strand and Blower Fans. Under size Sinter is sent to Storage Bins as internal Sinter Return. The cold sinter is finally sent to Blast Furnaces through series of conveyor belts called Sinter Dispatch Route. Process is shown in Figure-1.

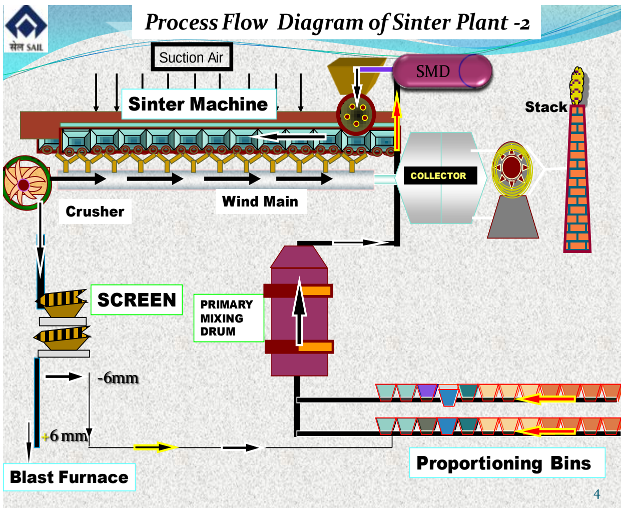


Figure-1 Process flow diagram of sintering plant -2

III. AUTOMATION WORK IN MODERNIZATION

A. Replacement of Belt Weigh Feeders and Belt Weigh Scales:

A.1 Present Status:
There are 24 Bins in the Mixing Bins Building for storage and proportioning of various components of Sinter Mix. These bins are of RCC Construction with volumetric capacity of 100 M3 each. These are arranged in two rows with 12 bins in each row. Belt weigh feeders are mounted at the out let of these bins and also under the Intermediate Raw Mix Storage Bunkers prior to Secondary Mixing Drum in each Sinter Machine circuit in the Sintering Building (Ref Technological Flow Diagram). The condition of existing Belt Weighs Feeders in Mixing Bin Building (Total 24 Nos for 2 rows x 12 bins) and Sintering Building (4 Nos) is reported to be very bad and it has become very difficult to control accuracy of weighing and proportioning of Sinter Mix components with the help of existing Belt Weigh Feeders.[3]

A.2 Proposed Modifications:
Inefficient weighing and proportioning in Mixing Bin Building is making adverse effect on sinter quality and productivity of Sinter Plant. Therefore new Electronic Belt Weigh Feeders with weighing accuracy level of +/- 0.5% (total 28 nos.) have been envisaged in SP-2. Out of 24 nos. in Mixing Bins, 2 nos. of Belt Weigh Feeders will be designed for Lime Dosing.

IV. PROPORTIONING OF WEIGH FEEDERS

24 number of Proportioning bins with Weigh Feeders (2 rows each with 12 bunkers).
4 Bins for Iron Ore.
1 Bin for Burnt Lime,
3 Bins for Fluxes,
2 Bins for Coke Breeze
2 Bins Sinter Returns.

- Local / Remote: Each BWF can be controlled from Local Control Box (LCB) as well as Remote (PLC).
- Auto / Manual: Any number of Bins can be selected from HMI (for example any number of bin/s out of 4 Iron Bins can be selected) either in 'Auto' or in 'Manual' provided its BWF is healthy, ready and remote selected.
- In auto mode total set point (TPH) for any type of raw material from HMI given by operator will be equally divided among the selected BWF.

Ex.:- If total set point for Iron Ore is 360 T/Hr.
No of Iron Ore Bins selected = 2
Each BWF will carry 360/2 = 180 T/Hr and
No of Iron Ore Bins are selected= 3
Each will carry 360/3 = 120 T/Hr.
No of Iron Ore Bins are selected= 4
Each BWF carries 360/4 =90T/Hr.
Five Groups in auto mode were there.
1. Iron Ore Group
2. Burnt Lime Group

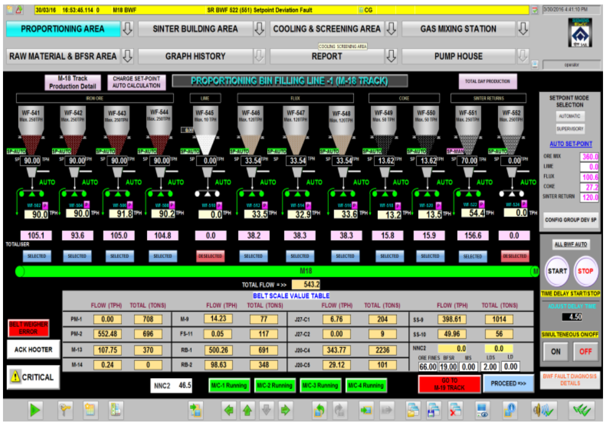
3. Flux Group
4. Coke Breeze Group
5. Sinter Return Group

Separate "Group Start/ Stop" command for each is there as shown in figure 2.

- If in running condition, one BWF in any group trips or stops due to any fault, then load will be equally distributed among the running BWFs of same group.
- All BWFs in particular group should either in "Auto" or "Manual" mode. Mode change over can be done in running condition.
- If proportioning ratio of the mixture is hampered due to any reason, then selected BWF will stop.

Above all actions are performed by Automation with PLC step 7 – 400 of SEIMENS.

PROPOTIONING AREA



Figer-2 Screenshot of automation for proportioning

V. RESULTS AND DISCUSSIONS

By implementation of the improved PLC based Raw Material feeding or proportioning system, SP II is able to produce Sinter of consistent quality. This consistency in quality will help in smooth operation of Blast Furnaces with higher productivity in producing Hot Metal (Liquid Iron). Since Raw material like Iron ore fines & Fluxes are consumed from various sources, having different chemistry, the sinter chemistry can be very well controlled with the help of new BWF system.

PARAMETERS		14-15	13-14	12-13	11-12	10-11	09-10
SINTER CHEMISTRY							
1	Fe	52.30	52.42	52.61	53.37	54.53	54.29
	%Consistency	**86.17**	**82.35**	62.4	68.3	64.3	73.9
2	FeO	9.24	9.06	8.86	8.81	8.52	8.66
	%Consistency	**96.2**	**93.79**	82.4	83.6	82.7	89.7
3	%MgO	3.13	3.14	3.09	2.97	2.99	3.10
	%Consistency	**84.9**	**86.80**	75.2	70.0	76.5	80.9
4	CaO-SiO2	4.91	5.48	5.80	5.93	5.75	5.57
	%Consistency (BF Norm ± 0.25)	**81.91**	**77.05**	61.22	56.0	60.2	53.2

Table: Difference between old and new weigh feeders.

From table dark digits are new weigh feeder consistency. Old feeders consistency is very less. There is a lot of improvement by using new modernization technics, which are improves sinter chemistry and consistency of Fe, Feo, Mgo, Cao-Sio_2.

VI. CONCLUSION

In view of the benefits being taken from the modernisation steps implemented at Proportioning of Sinter Mix at SP II, we may conclude that similar old plants & processes may also be planned for sustaining production with better quality consistency by PLC based Raw Material feeding or proportioning system. The newly installed PLC systems, modern Belt Weigh Feeders, on line Belt Weighing Scales, VVF drive motors & gas flow controlling instrumentation may shall help in better Sinter Chemistry, product quality control, ease of maintenance, early identification of equipment defects & improved equipment logistics, which in turn ensure consistent quality & production.

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REFERENCES

1. Nandesh KN1, Kiran BV2, Jiby C Jose3, K Souryasen4 2014, "Improving the Efficiency of Weigher Using PLC Control", International Journal of Research in Engineering and Technology.
2. Rishi Sumeet Kumar, R Soni, B K Prasad, V K Shrivastava, D S Nigam, D Thiyagarajan 2013, "Implementation of an Advanced Process Automation System for Improvement of Sinter Machine#3 Operation at Bokaro Steel Plan"', Journal of Mechanical Engineering and Technology.
3. KoshtiMohit D1, Patel PavanN2, Chaudhari TanviN3 2014, "Concept of Sinter Plant using Automation" International Journal of Advanced Research.
4. Angelika Klinger, Thomas Kronberger, Martin Schaler, Bernhard Schurz and Klaus Stohl 2010, "Expert systems Controlling the iron making processing in closed loop operation" Expert systems book edited by Petrica Vizureanu, INTECH, Crcatia ISBN 978 – 953 – 307 - 032 – 2, pp.238.
5. R. J. Coelho, M. M. Fioroni and L. B. da Silva 2006, "Operational simulation Model of the Raw Material Handling in an integrated Steel Making Plant", Conference for controlling Sinter chemical composition" proceeding of Iron Making and Steel Making.
6. S. Mitra, M. Gangadaran, M. T. Raju, S A. Balaji, B.K. Santra and N. Neogi 2005, "A process model for uniform transvars temperature distribution in Sinter Plant", Steel Times International, vol.27 issue 5, pp.17-18.
7. Sun Wendong, D. Bettigar, G Straka and K Stohl 2002, "Sinter Plant Automation on a new level" Proceedings of AISE Annual Convention, N Ashville, USA.
8. Nandesh KN1, Kiran BV2, Jiby C Jose3, K Souryasen4 2014, "Improving the Efficiency of Weigher using PLC Control", International Journal of Research in Engineering and Technology.