Sinter Plant

Raj Kumar Goel, Managing Director, Vankam Vasu, DGM
SLR Metaliks Limited,
Email : vasu@slrm.co.in

Abstract

The maximum utilisation / consumption of sinter in blast furnace depend on commercial benefits and technical suitability for BF operations.

As on today, sinter has become widely accepted and preferred burden material in blast furnaces. Almost, there is no blast furnace operating without sinter, nowadays.

The sintering technology was developed for the treatment of the waste fines of iron ore, coke, limestone, dolomite and metallurgical wastes.

This topic features are related and suitable for 25 m^2 annular sinter machine. All topics have been written and formatted based on the practical observations. Producing quality sinter is much similar in all types of sinter machines and producing quantity deeply depends on what raw material we choose / available.

Uses of sinter in BF operation

- Avoid / eliminate the raw flux usage in furnace
- Lower thermal load
- Better indirect reduction of the burden' will increase the productivity and decrease the coke rate with consistent quality of hot metal

Quality

For successful operation of the blast furnace, recommended quality of sinter is as follows.

Physical quality

+ 60 mm size	5 % max (AS LOW AS POSSIBLE)
-5 mm size	5 % max (AS LOW AS POSSIBLE)
Tumbler Index (TI)	69 +
Abrasive Index (AI)	6 - (As low as possible)
RDI (Reduction Degradation Index)	22 - 27
RI (Reducibility Index)	65 - 70

Chemical properties:

The main chemistry of the sinter should meet the BF requirements and it should improve the quality of burden.

The best advantage of sinter is that it is self fluxed.

CaO (from Limestone) and MgO (from Dolomite) in sinter, eliminate the direct feeding of the flux in BF which minimises the cost of the hot metal. Sinter may be charged up to 80 % safely.

This causes improving the productivity of the BF and minimising the coke (Fuel) consumption alongwith reduction of the burden material inside the furnace faster with consistent quality of the hot metal.

The effect of the self-fluxing sinter is a big asset for BF operations. Basicity (CaO / SiO_2) of the sinter should meet the BF demands depending on the sinter ratio in BF.

FeO should be 8 - 10 %.
If Al_2O_3 is < 2.3 then FeO should be 8 - 9.
if Al_2O_3 is > 2.3 then FeO should be 9 - 10.

If FeO is more, sinter will become more brittle, causing more fines generation & cause for continuous furnace hanging and increases coke rate in blast furnace.

If FeO is less, sinter will be weak causing more fines generation & leading continuous to furnace hanging

So, FeO should always be optimum.

To improve the productivity and quality of sinter following requirements to be fulfilled

Selection of raw materials

Iron ore fines

Size should be < 8 mm with Fe (T) = > 62%
SiO_2 & Al_2O_3 as low as possible

Micro fines (- 100 Mesh) = Max 25% (As low as possible) (More micro fines need more fuel consumption for sinter)

+8 mm = Max 5% (As low as possible,) will not participate in sintering process.

Fraction of 2 mm to 5 mm should be as higher as possible for better sintering process.

Normally we get iron ore fines that is having 100 mesh (- 0.15 mm micro fines) minimum of 25 % and 15 % to 20 % +8 mm size.

We are planning to install on-line screening to separate + 8 mm size from the lot and the same will be used in blast Furnace which will add more value to the fines. (Will be benefited approx Rs. 3.50 to 4 Cr per year)

Coke fines

1 mm to 3 mm size coke breeze should be 85 to 90 % with more FC (Min 76 %). The same material will minimise the fuel consumption and will distribute the heat throughout the sinter bed effectively which helps us in making good quality sinter.

Productivity and quality are determined by the coke combustion behaviour during sintering process. Due to the density difference between iron ore fines and coke fines, coke fines form layer on the surface of raw mix balls / nodules.

Suction temperature will increase with increase in coke fines up to certain limit. This is due to the fact that coke burns to liberate temperature and start agglomeration. During agglomeration the bed shrinks and forms voids. Through these voids, suction take place alongwith temperature distribution. When coke exceeds its limit beyond the requirement it forms thick stickers on hearth and drops suction and temperature. Sometimes top layer of the bed becomes hard and restrict suction, resulting drop in suction temperature.

Flux

Limestone and dolomite are used as flux materials (Both 10 to 40 mm size) which will be crushed and used in process where fraction of 1 mm to 5 mm should be 80 to 85 % always.

Metallurgical wastes

Flue dust and GCP dusts (from BF) are being used at present by collecting from proportionate bunkers. SMS & rolling mill is in project stage and planned to use EOF slag, SMS scale & mill scale etc. alongwith flue dust in future.

Process requirement of sinter

- Proper burden for quality sinter making as required by BF operation

- Moisture (water) addition to the raw mix in PMD & SMD (7 to 8 % moisture)
- Loading of raw mix on machine bed
- Ignition with proper flame length by maintaining required Ignition Furnace temperature at 1050^{0}C approx.
- Proper sintering and cooling
- Crushing of hot sinter cake in single role crusher
- Proper cooling in cooler (below 100^{0}C temperature)
- Number of falls from cooler to BF should be minimum (To avoid fines generation)

Brief description about process

As per given burden, raw materials will be collected on a common conveyor from the respective bunkers through weigh feeders and then mixed homogeneously in mixing drums (primary & secondary mixing drums) by adding required water (7 to 8 %) and then feed on sinter machine. Generally, raw mix bed height is 550 mm and will be adjusted based on quality of the raw material. The bed will be in running (motion) condition and will be taken to ignition front. The raw mix undergoes through the ignition furnace and there is a negative suction from bottom. As soon as suction takes place, hot products of combustion are sucked through the bed and transfer its heat to the next layer of the bed keeping it ready for the combustion. These flue gases are let out from chimney through ESP. After completion of the sintering process, sinter cake will be crushed and screened after discharge from the machine. Sinter having size > 5 mm will go to the cooler and then it will go to BF. Sinter with size < 5 mm size fines will be re-cycled in the process.

Best achievements so far

- Highest production achieved so far is 1,168 MT / day @ 1.95 t/m^2/hr productivity with 99 % plant availability
- Sinter return fines (- 5 mm size) controlled < 15 %
- Sinter plant is the best housekeeping area with high greenery and got award for Best Housekeeping & Best Safety Practice in SLR Metaliks Ltd.
- Every month achieving 100 % safety compliances
- Average tumbler is 70.5

Chemestry	Range (@ present)	Range (Expected)
Fe (T)	52 - 53	55 - 56
Feo	9 - 10	8 - 9

Chemestry	Range (@ present)	Range (Expected)
SiO2	6.5 - 8.0	4.5 - 6.0
CaO	11 - 12	9 - 11
MgO	2.3 - 2.5	2.0 - 2.3
Al2O3	3.50 - 4.50	> 2.3
Basicity	1.4 - 1.5	1.80 - 2.00
Tumbler index	69 - 71	71 - 74

If above expected quality sinter will be replaced with iron ore in blast furnace, maximum ratio (80 - 85 %) of sinter can be used safely.

Production cost of the sinter has to be considered while using the sinter in blast furnace which is depending on the cost of raw materials for sinter making.