

| SAFETY GUIDELINES FOR IRON & STEEL SECTOR | | |
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| MINISTRY OF STEEL, GOVT. OF INDIA | SINTER PLANT | Doc. No: SG / 31 |
| | | Rev no. : 00 |
| | | Effective Date : -- |

1. OBJECTIVE:

Sintering is an agglomeration process of fine mineral particles into a porous mass by incipient fusion caused by heat produced by combustion within the mass itself. Iron ore fines, coke breeze, limestone and dolomite along with recycled metallurgical wastes are converted into agglomerated mass at the Sinter Plant, which forms 70-80% of iron bearing charge in the Blast Furnace.

This entire process of sinter making is associated with various safety hazards like hit / entanglement with mobile equipment, burns, fire, slip & fall, exposure to dust, smoke, noise, heat & gas etc.

2. SCOPE:

This guideline is applicable to Sinter manufacturing plant as well as Sinter Plant Department of an Integrated Steel Plant.

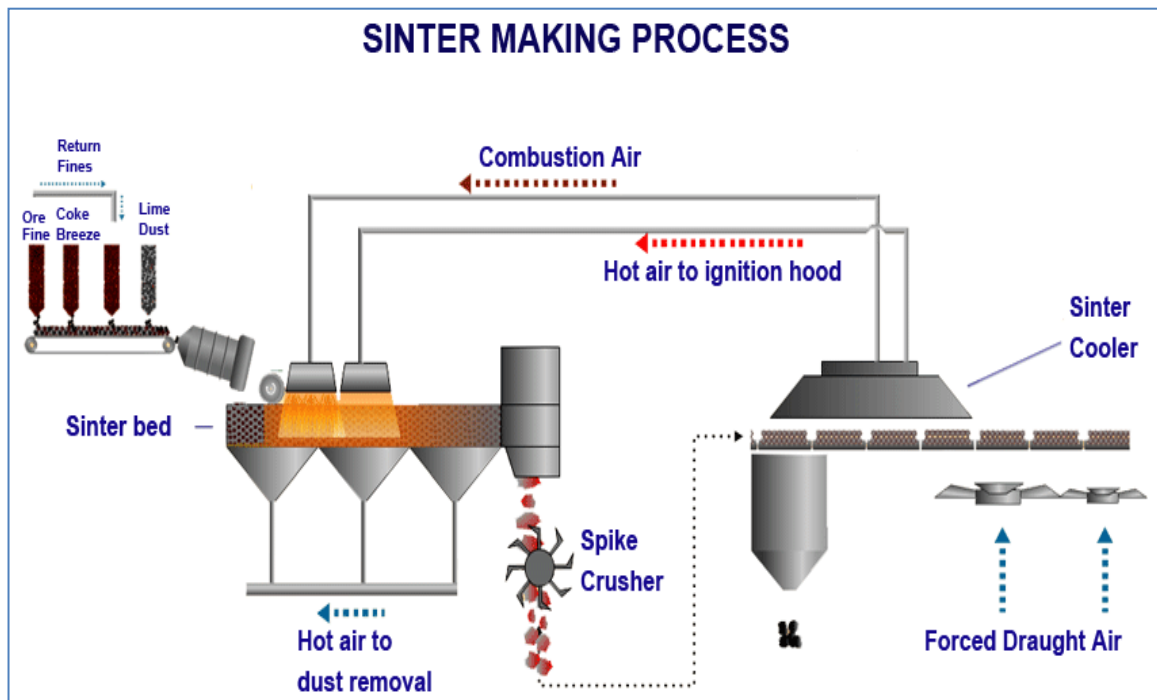
3. PROCESS BRIEF

Sintering process is developed mainly to utilize under size of lump ore called iron ore fines; which otherwise, could not be charged directly in blast furnace. In order to conserve these, otherwise waste material, they are compacted together and made into lumps by a process known as sintering. Sintering is defined as the agglomeration of the Iron ore fines (generally <8 mm) by incipient fusion of fine mineral particles with heat produced by burning of coke breeze, uniformly distributed in raw mix bed. During the sintering process, iron ore fine particles agglomerate into a porous compact heterogeneous lumpy mass called SINTER by incipient fusion caused by the heat produced during the combustion of the solid fuel within the moving bed of loosely particles.

The coke at the top of the blend is ignited by gas burners that can be fueled by coke oven gas, blast furnace gas, or natural gas. As the sinter bed moves, air is sucked from the top through the mixture, enabling combustion through the entire layer and complete sintering – where the temperatures may reach 1300 – 1480°C. At the end of the strand, the material is fed onto the sinter cooler where it is cooled by air. At cooler discharge, the sinter is fed onto the belt conveyor for further transportation either through sinter crushing unit or directly to sinter screening unit. In sinter screening unit, the sinter is sized to different required fractions.

As per given burden, raw materials are collected on a common conveyor from the respective bunkers through weigh feeders and then mixed homogeneously in

mixing drums (primary & secondary mixing drums) or in High intensive mixer & granulator by adding required water (7 to 8 %) and then feed on sinter machine. Generally, raw mix bed height is 550 mm but for large size sinter machines, total bed height on sinter strand shall be 700 mm including hearth layer of 40-50 mm (approx.) and is adjusted based on quality of the raw material. The bed in running (motion) condition is 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 (<150 – 200 mm) will be fed to the sinter cooler from sinter strand. Emergency water spray system shall be there at the end of sinter strand for emergency cooling. After cooling in sinter cooler, sinter will be fed to the belt conveyor for further transportation to sinter screening unit either through sinter crushing unit or directly to screen. In sinter screening unit, the sinter is screened to different required size fractions. Sinter of size <5mm will be re-cycled in the sintering process.



Some of critical Equipments/ facilities in Sinter Plant are as under:

| S.No. | Major equipments |
|-------|--|
| 1. | Conveyors, charging bins for Iron Ore Fines/ Coke Breeze/ Lime Dust/ Return Fines, Mixing Drums, Sinter Machine, Sinter Breaker/ crusher, Screens (Hot & Cold), ESPs (Electrostatic Precipitator), Exhausters, Storage Bunkers, High intensive mixer & granulator/ noduliser, weigh feeders, air blasters, cranes, hoists, bag filters, drum roll feeder, crash deck, grizzly bars, cooling air fans, combustion & hot air fans etc. |

4. PROCESS HAZARD ANALYSIS & NECESSARY RISK CONTROL MEASURES:

| S.No. | Equipment | Hazards | Risk Control Measures |
|-------|------------------------|---|--|
| 1) | Conveyors | Rotating parts of conveyor system, like head pulley, tail pulley, snub pulley, coupling guards etc. | a) Guarding of All rotating parts of conveyor system. b) Pull chord in conveyors. c) Emergency switch. <i>(Refer: SG-09: Safety Guideline for Equipment and Machine Guarding, SG-19: Safety Guideline on Operation and Maintenance of Conveyor Belts)</i> |
| 2) | Charging Bins/ Hoppers | a) Fine Dust deposition b) Electrical Drives c) Noise d) Confined space hazard | a) Use of PPEs. b) Dust Extraction (DE) System. c) Guarding of all rotating parts of conveyor system. d) Pull chord in conveyors. e) Emergency switch. f) Use of Ear Plug. g) Display of Noise level at site. h) Adherence to electrical safety precautions. i) Protective cover/ grill at storage bin top. j) Dislocation stopper at bin top. <i>(Refer SG-18: Safety Guideline for Personal Protective Equipment (PPE) management, SG-19: Safety Guideline on Operation and Maintenance of Conveyor Belts, SG-15: Safety Guideline for Electrical safety, SG-03: Safety Guideline for Working in confined space)</i> |
| 3) | Mixing Drums | a) Rotating Machineries b) Burden Spillage c) Noise | a) Guarding of all rotating parts. b) Use of Ear Plug. <i>(Refer SG-09: Safety Guideline for Equipment and Machine Guarding)</i> |

| S.No. | Equipment | Hazards | Risk Control Measures |
|-------|---------------------|---|---|
| 4) | Sinter Machine | <ul style="list-style-type: none"> a) Moving Sinter Bed b) Gas Leakages c) Rotating Machineries d) Handling Hot Burden e) Spill over of hot burden f) Hot burden splinter during sintering g) Fire in Electrical panel/cable nearby h) Electrical Drives i) Hot Flue Dust j) Contact with hot surface k) Fine Dust deposition l) Structural Corrosion m) Heat & Burn | <ul style="list-style-type: none"> a) Barricading. b) Online gas detector on both sides of ignition furnace, portable gas detector. c) Guarding of all rotating parts. d) Use of Fire retardant jacket in hot zones. e) Smoke detectors in electrical rooms. f) Periodical inspection as per SOP to be developed by user. g) Display of Hot Area at site. h) Adherence to electrical safety precautions. i) Use of PPEs. j) Ensure dedusting suction from sinter machine discharge hood to avoid localised heat. k) Application of heat insulation at required places <p><i>(Refer SG-11: Safety Guideline for Barricading, SG-16: Safety Guideline for Fire Safety, SG-15: Safety Guideline for Electrical safety, SG-21: Safety Guideline for Handling Fuel Gas)</i></p> |
| 5) | Sinter Breaker | <ul style="list-style-type: none"> a) Rotating Machinery b) Handling Hot Sinter c) Electrical Drives d) Fine Hot Dust e) Noise | <ul style="list-style-type: none"> a) Guarding of all rotating parts. b) Fire retardant jacket, in hot zones. c) Use of PPE. d) Adherence to electrical safety precautions. <p><i>(Refer SG-09: Safety Guideline for Equipment and Machine Guarding, SG-15: Safety Guideline for Electrical safety)</i></p> |
| 6) | Screen (Hot & Cold) | <ul style="list-style-type: none"> a) Handling Hot Sinter b) Hot Dust c) Noise | <ul style="list-style-type: none"> a) Guarding of all rotating parts. b) Access Control. c) Use of PPE. d) DE System. e) Use of Ear Plug. f) Display of Noise level at site. g) Fire retardant jacket / fire suit, in hot zone. <p><i>(Refer: SG-09: Safety Guideline for Equipment and Machine Guarding)</i></p> |

| S.No. | Equipment | Hazards | Risk Control Measures |
|-------|--|---|--|
| | Sinter cooler | a) Rotating/ moving equipment b) Partial handling of hot sinter c) Dust d) Noise e) Occasional red hot sinter discharge from cooler | a) DE system. b) Use of PPE. c) Guarding of rotating parts. d) Display of noise level. e) Ensure water spray on belt conveyor (below cooler) based on sinter discharge temperature. <i>(Refer SG-09: Safety Guideline for equipment and machine guarding, SG-11: Safety Guideline for barricading, SG-15: Safety Guideline for electrical safety, SG-16: Safety Guideline for fire safety)</i> |
| 7) | ESP | a) Hot Flue Gas b) Fine Hot Dust c) Electrical Transformers d) High Electrical Voltages | a) Access control. b) Use of dust mask. c) Application of heat insulation at required places. |
| 8) | Exhauster | a) Rotating Machinery b) Electrical Drives c) Noise | a) Guarding of all rotating parts b) Access control. e) Adherence to electrical safety precautions. c) Use of Ear Plug. d) Display of Noise level at site. <i>(Refer: SG-09: Safety Guideline for Equipment and Machine Guarding, SG-15: Safety Guideline for Electrical safety)</i> |
| 9) | Raw Material receiving bins top trolley, Trolley over Surge bin, Trolley over Sinter Storage bin top | Moving Shuttle | a) Auto hooter blowing whenever shuttle shifting command given. b) Guards / Barricading. <i>(Refer: SG-11: Safety Guideline for Barricading, SG-19: Safety Guideline on Operation and Maintenance of Conveyor Belts)</i> |
| 10) | Lime lifting facilities or lime dosing | a) High Pressure Lime dust b) Tanker movement | a) Use of helmet with wiser b) Separate glass cabin for tanker staff. c) Access control. |

| S.No. | Equipment | Hazards | Risk Control Measures |
|--------------|------------------|-------------------------|------------------------------|
| | | c) Fine dust deposition | d) Dedusting system. |

Note:

- 1) The operating procedure as given in the write-up may vary from shop to shop due to different equipment disposition and type. Safety precautions under each head may be separately identified.
- 2) Other standard plant safety procedures shall be followed.
- 3) Signages and emergency escape route shall be shown covering the entire shop.
- 4) Provision & operability of safety fences should be ensured covering the entire shop.
- 5) The above safety guidelines have been prepared keeping in view standard points applicable to the area of work in the steel industry. SOPs (Standard Operating Procedures) & SMPs (Standard Maintenance Procedures) are to be developed and followed by users as per specific processes / equipment/ technologies deployed as well as prevailing site conditions, in respective plants.