PREHEATING OF SINTER MIX

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SYNOPSIS

The importance of gas permeability in sinter mix is emphasised with reference to productivity of the Sinter machine. Based on the favourable experience of preheating of Sinter mix in U.S.S.R., the Sinter Plant Number 2 of Bhilai, in association with RDCIS, Ranchi, has evolved a system of preheating the mix in the bunker with the steam, resulting in a 10°c increase.

Increase in gas permeability is one of the main objectives of sinter mix preparation. It is desired that the gas permeability should be increased initially during ignition of mix and subsequent heat treatment of the corresponding lower layers in the bed. It is known that various sinter mix having different permeabilities under the influence of hot gases can correspond to one and the same permeability in the cold state of sinter mix.

What happens with wet sinter mix during initial period of its sintering may be examined. After entering under the ignition hood of sinter strand, the sinter mix is heated with hot gases, whose initial temperature is above 1200°C. This heat transfer agent while passing through the bed, exchanges heat with the sinter mix by decrease in its temperature and simultaneously is saturated with water vapours from the mix. At some level in the bed during sintering there is a moment when the temperature of the gas decreases below 100°C and hence becomes saturated with water vapour. Then the moisture condensation from gas into mix begins, provided the temperature of gas continues to drop. Hot moisture disturbs the stability of contact between particles of sinter mix, by filling the pores of earlier formed granules. The granules lose their strength and below the critical values, they are destroyed by combined influence of the weight of sinter mix above it and the force of gas flow. Consequently, porosity of the bed is decreased and permeability drops sharply, thereby lowering the productivity of the sinter strand.

Phenomena of loss in strength can be explained by a simple test. If some prepared green granules are kept above a flask containing boiling water for about a minute then a part of granules would be destroyed, even without any additional load from above. In addition, the remaining granules would lose as much as half of their initial compression strength.

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There are two ways to avoid the loss of strength of granules due to over moistening of sinter mix, which refer

To prevent saturation of the heat transfer agent with water varpour before the critical value. In principle, this is possible to attain by increasing the amount of heat transfer agent and decreasing the interaction period between it and the sinter mix and so on and

To prevent moisture condensation into sinter mix from heat transfer agent having water vapour near critical value. This is possible by maintaining the temperature of heat transfer agent above dew point. This approach is analysed in detail below.

In case of sintering, it is known that the dew point is approximately 60°C. If sinter mix is preheated upto this temperature, the temperature of waste gas will not be below 60°C. Hence, moisture condensation and loss of strength in granules of sinter mix would not be observed.

At present, a few techniques of sinter mix preheating are available. The simplest one was developed in USSR, in 1949. It consists of heat utilization from hot sinter return. This technique is highly efficient, but it deteriorates working enviornment and equipment. and therefore not used in modern sinter plants of USSR.

At Magnitogorsk steel plant and Novokrivorogskii beneficiation plants, the preheating of Sinter mix in the secondary mixing drum by combustion product of coke oven gas was developed. The unit consists of a system for supplying a controlled amount of gas and air, a main burner, an ignition burner and an automatic flame controller. The gas burner, using coke oven gas having a calorific value 17640 K Joule/Nm^3 (4200 KCal/Nm^3) is installed on the discharge side of the mixer. The combustion products are withdrawn through the mixer by a fan on the charging side. The entire length of the mixer is used to preheat the sinter mix. The gas and air are delivered to the burner from the same system, which supplies them to the ignition hearth. The unit is also equipped with automatic withdrawal of gas from the main burner in case of drop in gas pressure, stoppage of the mixer and exhaust fan and the lack of proper flame from the ignition burner.

The main sintering indices without preheating and with preheating of the mix are shown in Table 1, overleaf

The results show a distinct improvement in the sintering indices, resulting in improved quality, productivity increase by 1.4 percent, and reduction of solid fuel consumption by 4.2 percent. It shall be noted, however, that this preheating technique is not simple to implement and it could be beneficial only if surplus and inexpensive coke oven gas is available.

Krivorgskii steel plant uses steam for preheating sinter mix as shown in Figure 1. Steam from plant steam pipeline is supplied to the main steam pipe installed in the balling drum. Steam is supplied into sinter mix through steam outlets. To prevent abrasive wear from sinter mix, the ends of pipes are protected by rubber hoses. In case the sinter machine stops, the steam is switched off automatically by electrical valve control or by manual control. steam pressure is measured with pressure gauge and a steam flow recorder is installed on control panel of the sinter machine.

Table 1

	Without preheating	With preheating
Consumption for mix preheating, m^3/hr.		
Coke oven gas	-	285
Air	-	1215
Temperature of sinter mix, °C	34	54
Suction in the sintering machine Wind box, k Pa.	6.7	6.5
Vertical speed of sintering, mm/min	18.0	20.8
Production of sintering machine t/hr	78.3	79.4
Concent of sinter, FeO, percent	12.9	12,0
0-5 mm fraction, percent	15.3	14.9
Drum index, per cent	27.5	27.0
Consumption of solid fuel, kg/t	59.4	56.9

The results of investigation on influence of sinter mix preheating with this technique showed that the optimal consumption of steam was 12.4 - 14.0 kg per ton of sinter, provided the temperature of steam is 290-300°C. In this case, the temperature of the sinter mix increased from 33-36°C upto 57-58°C, while without steam it decreased by 3-4°C. Further increase in steam consumption did not raise the temperature of sinter mix, but intensive steam release from the drum was observed. With preheating of sinter mix, sinter machine productivity was increased from 113.5 to 121.0 t/hr, or by 7.0 percent, content of 0-5 mm fines in skip sinter was reduced by 2.5 percent and drum test index was improved by 0.4 percent. It was also found that granulometric composition of sinter mix was improved by preheating. Without preheating the content of 0-3 mm size fraction in sinter mix was 44.3 percent compared to 35.8 percent with preheating.

Donetsk Research Institute for Iron and Steel has developed another technique for preheating sinter mix with steam which enables the utilization of the entire heat of steam. In this, the steam is supplied into the sinter mix in the lower part of the bunker before balling drum, as shown in Figure 2. Laboratory tests and industrial trials at Makeevskii steel plant showed that with preheating of sinter mix from 26 to 60°C, the sintering process is accelerated and the productivity increased in proportion to the increase in vertical speed of sintering. The productivity was found to increase rapidly, especially when sinter mix was preheated above 45°C. However, in case of preheating of sinter mix from 35 to 45°C, productivity of industrial sinter machine was also increased by 3.4 percent.

From the above, it follows that preheating of sinter mix is an effective way of increasing the productivity of the sinter machine and the quality of sinter. At Bhilai, the problem of over moistening of charge on the strand also takes place and by solving it the techno-economic indices of sinter machine as well as that of blast furnace operation could be bettered. Calculations showed that steam consumption of approximately 25 kg/t of sinter is necessary for preheating of sinter mix from 30°C to 60°C, under the conditions prevailing in sintering plant Number 2 of BSP. Presently BSP together with RDCIS has developed the system of sinter mix preheating by steam. The scheme for supply of steam into the bunker of sinter mix before balling drum has already been tested. According to this scheme, steam goes through one main pipe of 25 mm diameter and is distributed in the bunker through eight outlet nozzles of 10 mm diameter. With the available steam at plant site, sinter mix was preheated by 10°C. Presently the work is in progress for the increased supply of steam and further monitoring of the preheating process.

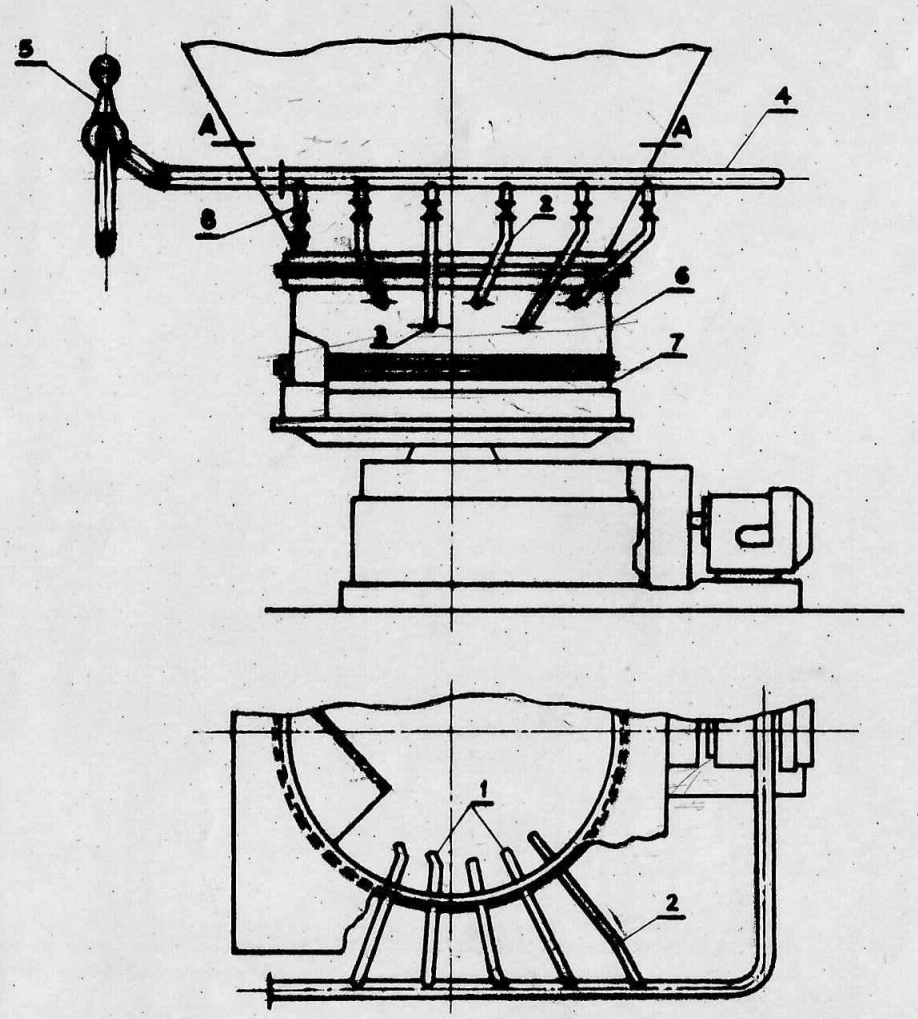
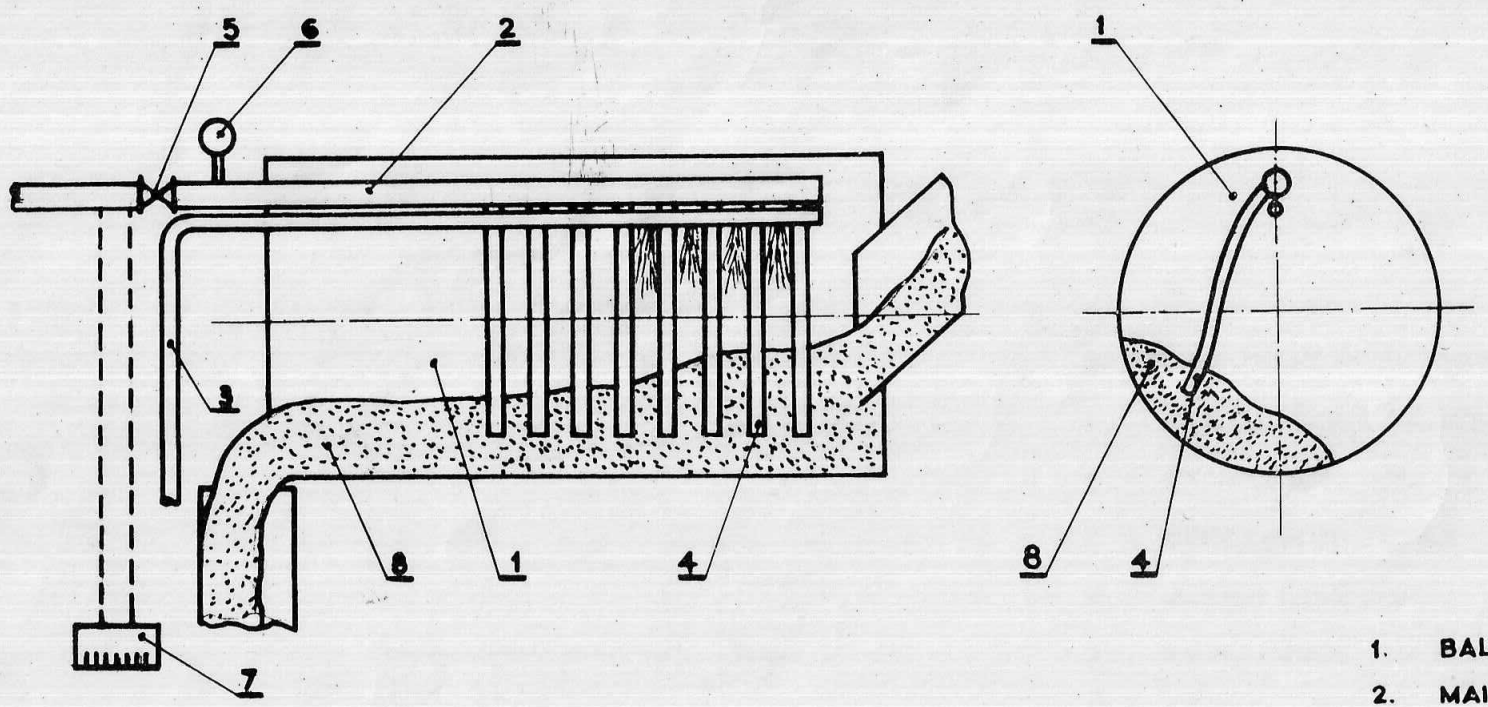


FIG. 2 SCHEMATIC DIAGRAM OF STEAM INJECTION IN BUNKER FOR PREHEATING SINTER MIX

1 NOZZLE FOR STEAM
2 CONNECTING PIPE
3 REMOVABLE LID FOR CLEANING
4 STEAM PIPE LINE
5 ELECTRICAL VALVE
6 CYLINDRICAL PART OF BUNKER
7 REMOVABLE PORTION OF BUNKER
8 PIPE TO REMOVE CONDENSATE



1. BALLING DRUM
2. MAIN STEAM PIPE
3. WATER PIPE
4. STEAM OUTLET
5. ELECTRICAL VALVE
6. PRESSURE GAUGE
7. STEAM FLOWMETER
8. SINTER MIX

FIG. 1 **SCHEMATIC DIAGRAM OF STEAM INJECTION SYSTEM IN BALLING DRUM**