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METALLURGICAL PROPERTIES OF IRON SINTERS OBTAINED ON THE SINTER BELT WITH AIR OVERPRESSURE

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Feeding additional overpressure air to the sinter belt surface results in an increase in the output of the sinter belt. Iron sinters obtained by this technology are characterized by better strength properties; also, an effect of fed air overpressure on sinter quality has been found in tests. Feeding compressed air to the sinter belt is one of the methods of intensifying the iron ore sintering process.

Key words: *air overpressure, sintering process, sintering process intensification*

Metalurška svojstva sintera željeza dobivenog na traci za sinterovanje s nadtlačnim zrakom. Dodatnim dovođenjem nadtlačnog zraka dolazi do povećanja izlaza na traci za sinterovanje. Svojstva sintera željeza dobivenih na ovaj način su veće čvrstoće. Utjecaj dovedenog zraka pod nadtlakom na kvalitetu sintera ustanovljen je također na provedenim testovima. Dovođenje zraka pod tlakom na traku za sinterovanje je jedna od metoda intenziviranja procesa sinterovanja željezne rodače.

Ključne riječi: *nadtlak zraka, proces sinterovanja, intenzifikacija procesa sinterovanja*

INTRODUCTION

Works towards intensifying the sinter process is conducted all over the world with the aim to increase the output of sinter belts and improve the quality of iron sister. One of the approaches to sintering process intensification is the use of equipment that would feed overpressure compressed air to the sinter belt. The first patent applications concerning the sintering of ores with air overpressure were acknowledged in 1966 and 1967 [1, 2].

Transition from the vacuum sintering technology (with a sub-atmospheric pressure under the sinter belt) to the method of sintering with an overpressure above the sinter belt has allowed the pressure difference between the upper and lower sintering layers to be substantially increased, which results in an increased rate of air flow through the sinter layer.

When using sub-pressure under the sinter belt, and at solid fuel expenditure relatively low, but optimal for obtaining the proper sinter quality, a wave of hot air and gases within the layer restricts process intensification. Sintering with overpressure, on the other hand, increases the amount of gases and quick-coke combustion rate, which intensifies the process of iron ore sintering.

In the case of sintering an ore charge with a quick-coke amount increased above 4 %, the rate of combustion of quick-coke particles (grains), which receive more oxygen for oxidation in a unit of time, grows even further. In this connection, the vertical rate of sintering dramatically increases under the effect of increased pressure above the belt, both for a coke breeze (up to 3 mm) content of 3 - 4 %, and when sintering a pre-metallized sinter with a quick-coke content of charge of 10 to 25 % [3]. It has been found in laboratory conditions that the best effect can be obtained when sintering grainy hematite ores and a properly selected layer height and ore charge basicity. This effect is smaller for sintering fine concentrates (with a grain size above 0,1 mm), though, by increasing overpressure above the layer, the sintering process can also be considerably intensified.

TRIALS OF SINTERING ORE MIXES UNDER A PRESSURE OF 2 kPa

The effect of air overpressure above the sinter belt on the process of sintering an ore mix with a layer height of 250 mm was determined in laboratory conditions. Additional compressed air of an overpressure of 2 kPa was fed

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for 5 minutes after the ignition of ore mix quick coke, with a hard fuel (quick coke) content from 2 to 5%.

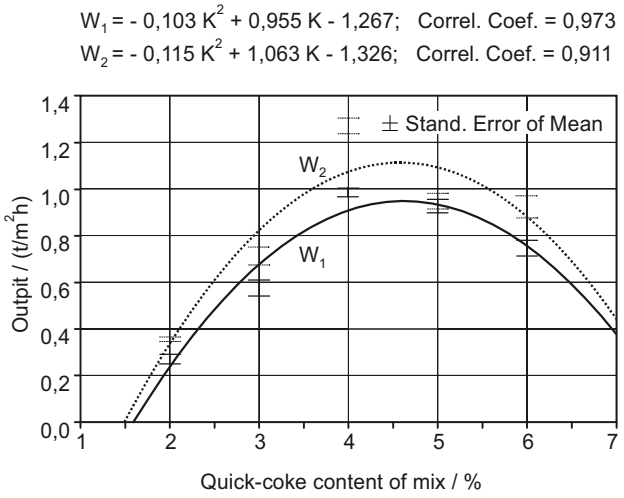

Figure 1. **The effect of overpressure and quick-coke content on the sintering machine output. Curve W_1 without feeding additional air. Curve W_2 with feeding additional air**

Slika 1. **Efekt nadtlaka i sadržaja koksa na izlaz kod postrojenja za sinterovanje. Krivulja W_1 bez dodatnog zraka. Krivulja W_2 s dodatnim zrakom**

Obtained results (Figures 1., 2. and 3.) have made it possible to determine the effect of above-belt overpressure and mix quick-coke content on the sinter belt output

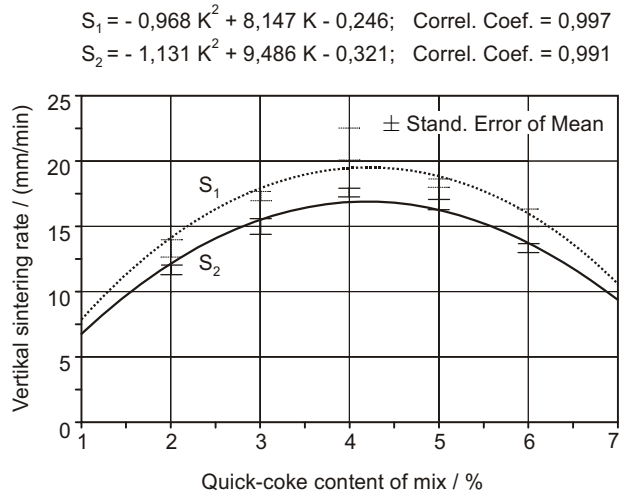

Figure 2. **The effect of overpressure and quick-coke content on the vertical sintering rate. Curve S_1 without feeding additional air. Curve S_2 with feeding additional air**

Slika 2. **Efekt nadtlaka i sadržaja koksa na vertikalnu brzinu sinterovanja. Krivulja S_1 bez dodatnog zraka. Krivulja S_2 s dodatnim zrakom**

in t/m^{2}h, vertical sintering rate, and the amount of sinter of permissible strength. The obtained relationships in the form of regression equations are shown in Figures 1., 2. and 3.

The obtained results indicate that with the feed of air forced under an overpressure of 2 kPa, the sintering time reduces on average by approx. 4 min and the vertical sintering rate increases, which causes an increase in the output of the sintering machine an average by 0,5 t/m^{2}h. The amount of sinter of permissible strength also increases, while the higher quick-coke content, the smaller is the difference between the overall sinter mass and the obtained mass of sinter with predetermined permissible strength. With a mix quick-coke content of 3,0 %, this difference is

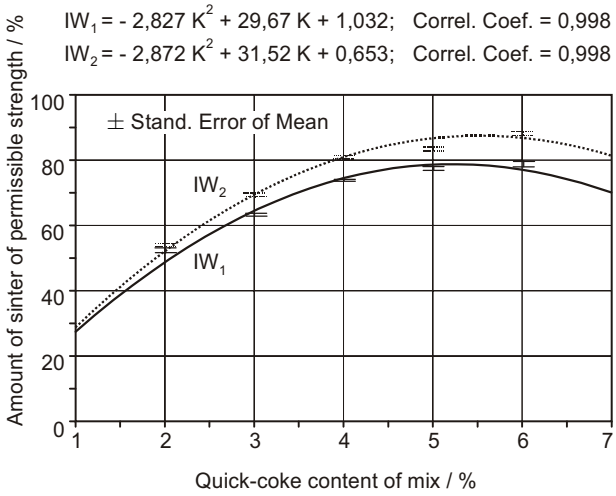

Figure 3. **The effect of overpressure and quick-coke content on the amount of sinter of permissible strength. Curve IW_1 without feeding additional air. Curve IW_2 with feeding additional air**

Slika 3. **Efekt nadtlaka i sadržaja koksa na količinu sintera dozvoljene čvrstoće. Krivulja IW_1 bez dodatnog zraka, krivulja IW_2 s dodatnim zrakom**

approx. 6 to 9 %, whereas with a mix quick-coke content of 5 to 6 %, it is smaller, ranging from 2 to 5 %. The sintering of a sinter mix with a small excess of air, in this case being 2 kPa, is only a half-measure, therefore an above-belt air overpressure of 250 kPa and more will likely to be used in the future for the production of iron sinter, which will, at a high probability, allow the sintering machine output to be increased even by several times.

PRELIMINARY TESTS OF PRODUCING IRON SINTER AT HIGH OVERPRESSURES

Figure 4. shows the obtained results of laboratory testing of the effect of the pressure difference, (kPa) – (ΔP), between the pressures prevailing, above and under the sintering pan grate (of a laboratory ore sintering device) [3].

Figure 4. indicates that enlarging the pressure difference across the layer considerably increases the vertical sintering rate, whereas increasing the layer height reduces the vertical sintering rate. The results show that the verti-

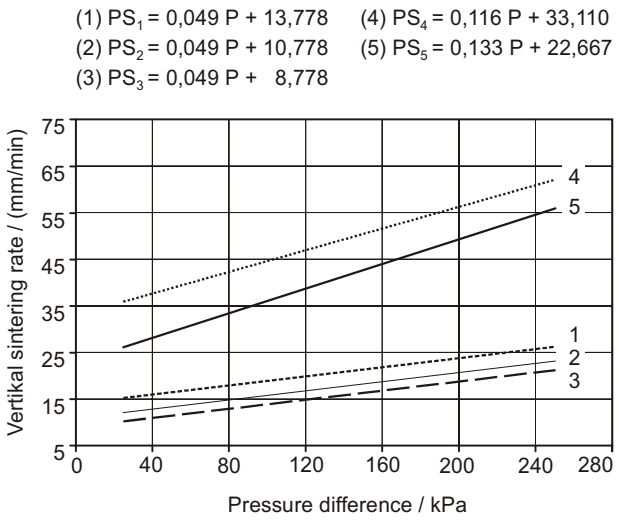

Figure 4. **Dependence between the pressure difference and the vertical sintering rate. 1, 2, 3 Mix composed of magnetite concentrates with a quick-coke content of, 10, 15 and 20 %, and a layer height of h = 500 mm. 4, 5 Ore mix of grain size below 5 mm and a layer height of h = 300 mm and 500 mm, respectively**

Slika 4. **Ovisnost između razlike u tlaku i vertikalne brzine sinterovanja. 1, 2, 3 - Smjesa sastavljena od magnetitnih koncentrata i sadržaja koksa u količini od 10, 15 i 20 % pri visini sloja od h = 500 mm. 4, 5 Mješavina rude veličine zrna ispod 5 mm i visine sloja h = 300 mm, odnosno 500 mm.**

cal sintering rate for a given layer height can be increased by appropriately increasing the pressure difference across the layer, which can be achieved by increasing the pressure of air fed above the ore mix layer.

CONCLUSIONS

By analyzing the process of sintering with air feeding from above it can be found that with an incomplete tightness of the hood of air-feeding equipment, the expulsion of dust outside the sinter belt will take place, which may lead to a deterioration of working conditions (safety) on the workers' stands in the immediate vicinity of the sinter belt. Some positive facts associated with the use of increased air pressure need also to be underlined. Firstly, the fan supplying air to the hood feeding the sinter belt operates in much better conditions compared with the exhaust fan operating under the sinter belt, where rotor parts are exposed to systematic wearing and, as a consequence, require frequent replacements. It should also be noted that in this case there is a possibility of using ordinary hard coals of appropriate graining in place of the expensive quick coke. This is important inasmuch, as the reserves of coking coals are ever smaller, and the production of coke is one of the most environmentally- hard processes. Coking plant shops belong to the world's greatest air polluters and, from the ecological point of view, need to be either modernized in the nearest future so as to improve the environmental conditions, or liquidated.

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