EFFECT OF THE OVERPRESSURE OF AIR FED TO THE SINTERED BLEND LAYER ON THE METALLURGICAL PROPERTIES OF SINTER

Budzik R.1)  
Mróz J.1)  
Pyrikow A.2)

1) Technical University of Częstochowa, Faculty of Process & Material Engineering and Applied Physics, Department of Production Management and Logistics, budzik@mim.pcz.czest.pl  
2) International Academy of Ecology, Man and Nature Protection Sciences, Moscow, Russia

Abstract

The sintering experiments of blend of iron ores were made with the using of excess pressure of air given on the surface of sinter blend. The increase of the air pressure from 1.0 to 3.0 kPa has caused the rise of productivity by 20% and the sinter strength has been improved. These results were confirmed in the tests carried out on industrial scale.

INTRODUCTION

Increasing the production volume and enhancing the quality of pig iron depends primarily on the appropriate preparation of the iron-bearing charge fed to the blast furnace. Presently, the main component of the blast-furnace charge is iron-bearing sinter (agglomerate). Despite of huge financial outlays on researches aimed to develop new technologies of obtaining iron mainly in the form of metallized pellets, the blast-furnace process continues to be the primary technology. Therefore, great efforts are being continued to intensify this process. The intensification of the blast-furnace process can only be achieved through the use of a suitably though and well reducing iron-bearing material.

The main blast-furnace charge material is sinter or pellets. Sinter is formed in the processes of sintering suitably prepared iron ores ground and broken up, with the addition of calcium of magnesium fluxes and a solid fuel. Despite the increasingly wide use of iron-bearing pellets, iron-bearing sister continues to be the basic component of the blast-furnace charge.

Practice shows that no change in the use of iron sister in the blast-furnace process in favour of another component, such as pellets or briquettes will occur in the nearest future [1,2,3].

It can be noticed from researches carried out over the last 50 years that studies on the intensification of iron ore processing are still continued. As has been shown by the experience of recent years, one of those methods is the use of air blow (feeding of overpressure air) above the sintering blend [3].

1. SINTERING OF ORE BLENDS WITH AIR BLOW

The sintering of iron ores aimed at process intensification was carried out in laboratory conditions on a sintering bowl (a sintering device) of a diameter of 1 metre. Compressed air supplied above the sintered layer had a pressure of 2 to 4 kPa. At the same time, a vacuum (negative pressure) was created below the sintered layer with installed fans.
Figure 1 shows the effect of a pressure difference occurring in the sintered layer, formed during sintering with air blow, on the specific efficiency of the sintering process.

![Graph showing the effect of total difference of pressures on efficiency.

Fig. 1. The effect of the total difference of pressure above and below the layers on the efficiency of the burning process.

It can be seen from Fig. 1 that there is a nearly linear effect of occurring pressure difference on sintering process efficiency.

Figure 2 shows the results of testing of the effect of sintering duration on the amount of air supplied to the sintered layer.

It was from the tests that the optimum time of compressed air feeding occurred approx. 5 minutes after the ignition of the ore blend top layer, that is when 50-60 cm high sinter (agglomerate) formed in normal vacuum conditions.

The performed calculations have made it possible to establish a mathematical model for the effect of the differences of pressure above and below the layer on sintering process efficiency in the following form:

\[ Q = 0.2167 \times \Delta P^{0.655} \]

\[ \Delta P = (1 \text{ to } 4 \text{ kPa}) \] – pressure difference

\[ Q = \text{process efficiency} \]

It can be seen from the above formula that, in proper laboratory conditions, that the efficiency could be increased by several times.
1 - with excess - 2kPa
2 - without excess

Fig. 2. Variation of air consumption during sintering with a blend quick-coke content of 3%

Figure 3 shows the obtained data for the effect of air pressure above the layer on the production capacity of the sintering device.

Fig. 3. Effect of air pressure above the layer on the production capacity of the sintering device
It is evident from the data shown in Fig. 3 that the greater overpressure above the layer and negative pressure below the layer, the higher sintering process efficiency is. For an overpressure of 1.0 kPa and 3 kPa, the difference in efficiency is about 20%, so there is an extensive practical possibility of increasing this index.

Sintering under pressure with air blow substantially increases the pressure difference in the sintered layer, increases the rate of air filtration through the layer, and increases vertical sintering rate without changing sinter strength indices. An important element of the introduction of possible air blow (compressed air) above the blend layer are the achieved metallurgical properties of obtained sinter. Figures 4 and 5 illustrate obtained results for the effect of air overpressure above the blend layer and blend quick-coke content on the strength index during reduction using CO (carbon monoxide).

Fig. 4. Dependence of sinter strength in a reducing atmosphere on pressure above the sinter layer

Figure 4 shows that the greater overpressure above the layer, the larger strength index is during reduction with carbon monoxide. At an air overpressure of 100 kPa, 200 kPa and 300 kPa, the strength with the same blend quick-coke content decreases, whereas with increasing blend quick-coke content at the same overpressure, the strength diminishes. The decrease in sinter strength is caused in this case by preliminarily reduced sinter which contains, on the average, 7.0 to 36% of metallic iron.
CONCLUSIONS

Sintering of ores with feeding compressed air above the ore blend layer can be applied to a larger scale by intensifying the process.

The use this sintering process can yield the following positive results:
- increasing the production capacity of sinter belts,
- increasing the strength of sinter,
- promoting the reduction processes that occur during sintering, and
- promoting metallization processes at an increased quick-coke content of sintering blend.

The negative aspects of this sintering process include:
- increasing costs resulting from the use of special devices for feeding compressed air above the layer,
- increasing the requirement for technical supervision in departments producing sinter with devices feeding compressed air above the layer.

REFERENCES