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# THE INFLUENCE OF MODIFICATION LIMONITE ORE BASICITY ON THE QUALITY OF SINTER

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## ABSTRACT
*Improving quality of iron ore by sintering and adding specific components has positive effects on the blast furnace productivity. Optimizing basicity in the blast-furnace charge is one way of improving all production process indices. Basicity is the ratio between basic oxides and acid oxides in the ore mixture. Adjusting basicity aims to achieve formation of new phase compounds which are favorable for metallurgical and mineralogical properties of sinter. The chemical analyses are not sufficient to monitor the phase transition of multicomponent systems, because it is necessary to know the structure of all constituents. For that reason, X-ray diffraction is used for identifying minerals in sinter. Also, physical-mechanical properties of sinter are investigated. On the basis of experimental results, optimal basicity of limonite ore from mine „Omarska“ Prijedor is determined.*
**Keywords:** Basicity, sinter, limonite, limestone, XRD

## 1. INTRODUCTION
Having regard to the technology of preparation and method of excavations limonite ore in the mine "Omarska" Prijedor, there is a large amount of fine material. Small ores, can not be used directly in the production of iron in the blast furnace, but must be enlarged in previously, and the most common way of enlarging the sintering. The processes of ore are thermally processes and take place at temperatures beginning smelting, which enables interconnection of mineral grains. At such high temperatures there is a chemical, structural and mineralogical changes and improvements metallurgical characteristic of the resulting product. In order to achieve phase transformations in the sintering process, it is necessary in the process of preparing to add certain chemical compounds, and is preferably added limestone. Limestone in the sintering process will react with other compounds and thus will lead to the creation of some other compound are favorable for metallurgical and mineralogical properties of sinter. Limit addition of limestone must be clearly defined as it will lead to changes in characteristics of sinter, [1]. Changes in characteristics of sinter can be positive or negative, therefore expedient to find the optimal basicity or determine the amount of limestone that will be given in limonite ore to obtain the best sintered. [2]
Given that for each iron ore must specify the maximum percentage of adding limestone or determine basicity, in this paper, the aim was to determine the optimal basicity for limonite ore from Prijedor.

## 2. SINTER PRODUCTION IN SEMI-INDUSTRIAL PLANTS WITH DIFFERENT RELATIONSHIPS BASICITY

As part of planned testing and the experiment at the Department of ore and iron Metallurgical Institute "Kemal Kapetanović" of the University conducted researches on six experiments with different content basicity. Sinter production was performed at the pilot plant facility discontinuous type with capacity up to 70 kg. Labels sinter mixture, as well as planned basicity sinter are shown in Table 1.

*Table 1. Labels sinter mixture with planned basicity*

| **Mark sintered mixtures** | A1 | A2 | A3 | A4 | A5 | A6 |
|---|---|---|---|---|---|---|
| **Planned basicity** | 0 | 0,5 | 1,2 | 1,5 | 2,0 | 2,5 |

Limonite ore „Omarska", limestone from the locations Grapska-Doboj and coke from Arcelor Mittal Zenica are used for sinter production. All components of the mixture are prepared to achieve particle size distribution required by technological conditions for production of sinter.
After sintering all samples were cooled in air, and after that an investigation of properties of sinter produced according to current standards. Recording samples for XRD analysis was performed on a Shimadzu diffractometer XRD 6000.
Table 2 shows the chemical analysis of produced of sinter.

*Table 2. Results of chemical analysis of sinter [1]*

| **Mark of the sample** | **The components, %** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Fe** | **FeO** | **$Fe_2O_3$** | **$SiO_2$** | **MgO** | **MnO** | **CaO** | **$Al_2O_3$** | **S** | **True Basicity** |
| **A1** | 54,23 | 21,10 | 61,54 | 11,42 | 1,93 | 1,83 | 0,00 | 1,92 | 0,006 | 0,00 |
| **A2** | 52,11 | 17,63 | 60,48 | 9,58 | 1,82 | 1,94 | 4,22 | 1,68 | 0,007 | 0,44 |
| **A3** | 50,10 | 13,92 | 59,07 | 7,86 | 1,62 | 2,44 | 8,65 | 2,16 | 0,010 | 1,10 |
| **A4** | 49,62 | 14,29 | 56,13 | 8,49 | 1,91 | 1,99 | 12,31 | 1,96 | 0,018 | 1,45 |
| **A5** | 47,16 | 10,16 | 58,42 | 8,21 | 1,91 | 1,93 | 17,24 | 1,89 | 0,019 | 2,10 |
| **A6** | 46,29 | 8,66 | 56,21 | 11,28 | 1,84 | 1,86 | 27,75 | 1,84 | 0,029 | 2,46 |

## 3. PROPERTIES OF PRODUCED SINTERS

### 3.1. Index of strength and index of abrasion (Cold strength)

As indicators the quality for sinter that is index of strength (*Ti*), as well as index of abrasion (*Ai*), are shown on diagram on Figure 1. With the diagram it can be seen that these parameters by literaltures indicators of fairly good when for sinter with small basicity until basicity 1,2 marked with A3 which reaching maximum values and then these parameters getting worse. Clearly see that sinter with smaller basicity stronger that is have a lower degree of abrasion, however, with viewpoint of mineralogical composition are not favorable due to the melting point and softening point. [3]

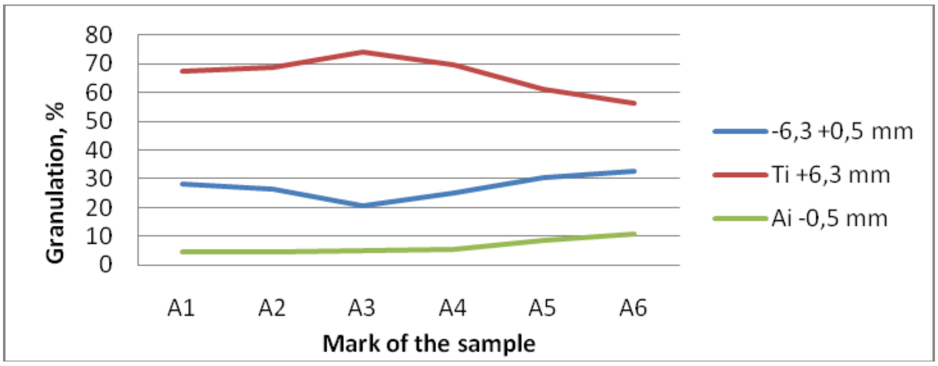


*Figure 1. Dependence of the cold strength of sinter basicity*

### *3.2. Metallurgical properties of sinter*

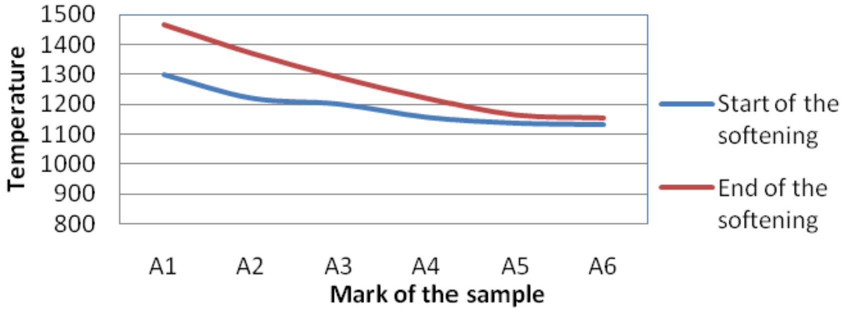


*Figure 2. Effect of basicity of the softening temperature sinter*

Watching the tested sample sinters on Figure 2. can be concluded that the interval softening point changes depending on the changes basicity. For sinter temperature with smaller basicity beginning and end of of melting are quite high, and the of softening interval is wide which is not good. For sinter with larger basicity softening interval is quite short, but the onset of softening temperature low. The aim is get sinter who will have a high softening temperature and the melting a narrow interval of softening. Thermoplastic properties of sinter conditional on their mineralogical composition of which varies depending on the basicity, which is confirmed by mineralogical tests.

### 3.3. Mineralogical properties of sinter

Figures 3 and 4 are shown roentgenogram samples produced of sinter, [1].

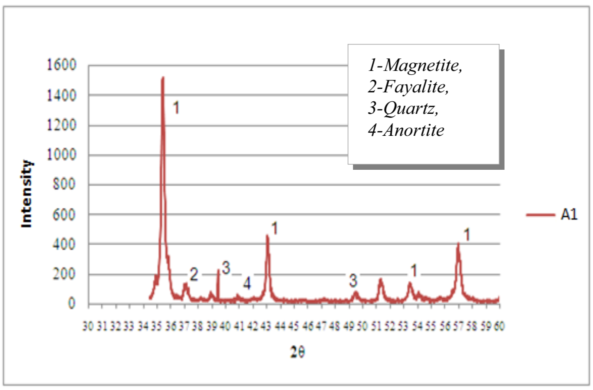


*Figure 3. X-ray sinter labels A1*

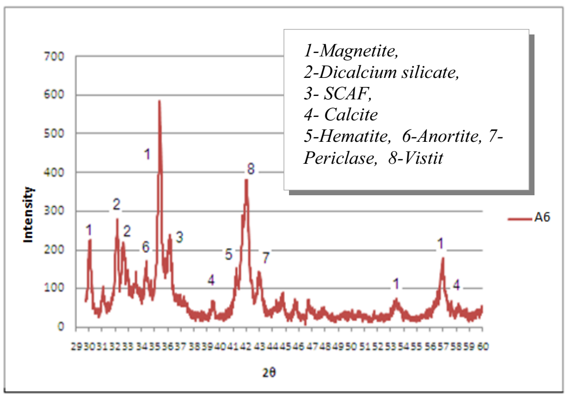


*Figure 4. X-ray sinter labels A6*

In Figure 3 according the roentgenogram of sinter with the marks A1 and basicity 0.0 can be clearly seen that the present phase of compounds leadership role has magnetite, then fayalite and quartz. The reason is primarily that used limonitna ore with their natural basicity. Adding limestone sought to

achieve the creation of the new phase of the compound that with the metallurgical sides have had better sintering characteristics.
Figure 4 notes that there has been the creation of new compounds and calcium silica and combinations SCAF, and as a result of adding of limestone.
The radiograph shown sinter with the marks A6 and basicity 2.46 where it can be clearly see that prevails large number of compounds. Also, is notable that all fayalite tied the in the form of other compounds or practically nonexistent. By adding limestone replaced by calciumferrite in calciumsilicate which has practical importance in metallurgy in the production of iron because of the softening temperature and the melting. Since it is limited basicity other characteristics in this case must be take into account that which it is optimal basicity that will best suit for all properties of sinter, [1].

## 4. CONCLUSION

On the basis of the results obtained during the experimental research is clear to see that with the change in basicity sinter mixture, significantly changes occur characteristics of sinter. The analysis of the obtained results can be concluded that the optimal basicityt for this type of iron ore 1,2 marks A3. Maximum basicity with which could go into production is up 1.5 A4 labels above which the properties of sinter change drastically, is primarily a decline in strength and a bad granulometrical composition of sinter, which will produce negative consequences in the process of obtaining iron in the blast furnace. Analyzing by X-ray diffraction can be accurately and quickly determine the phase composition of the of sinter through which one can see the influence addition limestone to creating favorable compounds, which will ensure better metallurgical properties of sinter.
In some research that will follow beside limestone one might be added and dolomite or other similar raw materials, and observe the influence on the properties of sinter obtained by from limonite ores from the locality "Omarska" Prijedor.

## 5. REFERENCE


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