By the rational grain-size composition of balling up part of sinter burden

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Abstract
Definitive rational grain-size composition of balling up part of sinter burden and the way of its production are determined.
Key words: SINTER BURDEN, GRAIN-SIZE COMPOSITION, GAS PERMEABILITY, BED VOID FRACTION, PELLETIZING

Iron-bearing materials (iron ore concentrate, sintering ore, recycled material, roll scale, slimes), fluxing materials (limestone, dolomite limestone, lime, steelmaking and rare blast - furnace slags), solid fuel (coke fines, anthracite culm, peat) and variable additives are principal components of agglomerative manufacture which are used in different proportions. Each of specified components of sinter burden has specific chemical composition, physical specification (grain-size composition, hardness of the particles, reactive capacity, mass fraction of damp, etc.) influencing both on chemical composition and on its quality. In simple version the quality of agglomerated cake is estimated by two its characteristics: the content of iron and group (-5mm) in agglomerate supplied into smelting vessel. Grain-size composition of primary components and pelletized sinter burden considerably influence gas permeability of sintered layer, sintering rate, efficiency and finality proceeding reactions of interaction in the process of sintering, and, in the whole, metallurgical characteristics of finished sinter.

At high temperatures chemical reaction between finely divided solids of burden constituents flow at full speed, although gas permeability of such particles is very low and the blowing practice of layer is characterized by the lack of stability in the process of its sintering. Maximal porosity of layer and its gas permeability in the particles of the same fineness do not depend on its sizes but hereby the more coarse particles the more slow speed of chemical reactions at particles interactions of burden constituent and more time is needed for its complete fusion.

The increase of layer gas permeability by means of accretion of equivalent diameter portholes is the main method of putting on speed of gas filtration. Pelletizing of sinter burden is the most effective method of increasing equivalent diameter of pores in layer.

Factors connected with granulometric composition of sinter burden components influencing pelletizing process in the coarse of long-term industrial production history of agglomerate and conducted researches were spesified:

- fineness and particle quantity serving as seeds in the process of sinter burden pelletizing;
- close density composition of such particles;
- chemical reacting of these fractions in the process of burden sintering.

It is reported in the work [1], that to provide necessary sinter machine productivity and agglomerate quality, sintering ore must be of fineness less than 6 mm, limestone – less than 2 mm, solid fuel (coke fines) – 0,1 – 2 mm. Conspicuous is the fact that the fractions – (0,5-1 mm.) in sintering ore in all cases impair the process performance of sintering.

According to [2] pelletizing of sinter burden including concentrate and sintering ore is fulfilled by means of molecular and capillary bonding forces in three-phase system: solid moisture-retentive lump material, water, air, at that, the process is carried out by fines rolling (baled up part of charge material) on the seed of fixed size (balling up part of charge material). It is proved, that pelletizing of sinter burden occurs effectually with ratio of dimensions of balling up part to balled up part more than 10, at that particle sizes of balling up part at pelletizing concentrate ($d^k_{max} = 4{,}074$) must be not less than 0,074×10≈1 mm. For large group of sinter burden optimum size of fragments release was arranged 3-5 mm. In parallel with release, the addition into charge material of crushed ore with fineness of 3-5 mm was considered to be useful, but it reduced iron content in agglomerate

In rolled on seeds material there were no particles with fineness of 0.4 – 1.0 mm. Herein it is important to note that all the data are obtained at optimum moisture of sinter burden that in every particular case depends on mineral, physical and grain-size composition of charge material components.

S.V. Bazilevich [3] considers it is expedient to limit upper bound of introduced into sinter burden crushed ore with dimensions 6 – 8 mm, and additive of limestone with fineness of 0 – 1 mm which improves pelletizing.

In more recent work [4] V.I. Korotych considers that fraction of sinter burden and recycled material with fineness of 0.4 – 1.7 mm are neither balling up nor balled up parts of sinter burden and almost do not participate in the process of pelletizing of sinter burden because they are too big for rolling on seeds and too small for becoming seeds. Supposition was made, that friction of sinter burden and recycled material with fineness of (4 ± 1) mm are optimally fineness of balling up parts of charge materials.

In the work of V.I. Korotych and others [5] introduction of lump ore into sinter burden is not considered but specified that balling part of charge materials should be recycled material at a rate of 20 – 30 % with fineness of 3 – 6 mm.

In other works iron ore and recycled materials are used as pelletizing centers at granulation of sinter burden, so it is recommended to use them with fineness of 3 – 5 mm and 5 – 6 mm. It should be noted, that correct choice of center dimensions of pelletizing and their quantity does not only improve efficiency and thus bed porosity of charge materials on sinter machine, but also to increase the content of iron in agglomerate.

Conclusions

For successful pelletizing of charge material used at present in agglomerative units, it must contain a certain amount and fineness of seeds, which is the balling up part of sinter burden, on which there rolled balled up part of sinter burden. Iron ore and recycled materials can serve as balling up part of sinter burden. In a majority of works the interval of suggested fineness of balling up part of sinter burden is less than 6 mm, 2 (3) – 5 mm, 3 – 6 mm at that there considered that required close-cut fractionation is rather complicated process.

On the principle that used sintering ore has considerably lower iron content (55 – 58 %), than concentrate (65 – 68 %). Non-normative (increased) using of sintering in manufacture of agglomerate is economically unviable.

As the material containing balling up particles, it is reasonable to use materials, which do not boose charge material by iron: recycled material with dimensions of 2 – 5 mm, furnace dust with fineness of 0 – 5 mm (which contains particles with dimensions of 2 – 5 mm) and in case of shortage of balling up part - ore of close-cut fraction 3 – 5 mm, free of class less than 3mm.

It is necessary to make the following actions for economization of production process of agglomerate necessary for preparation of sinter burden for sintering:

- to divide compounding and pelletizing processes, to use modern, local, effective blending machines for compounding of charge material.
- to oversize the pelletizer in order to pelletize the sinter burden with minimum amount of balling up fraction with low iron content.

It is complex engineering problem to obtain on screens the balling up fraction of sintering ore and recycled material on the basis of its calibration measurement per classes (-2 (3)…5 (6) mm). For this reason the question of recovering the balled up fraction from sinter ore using its granulation on suitable crackers providing minimum content in granulated product of (-2 (3)mm) and (+5 (– 6) mm) classes.

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