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RESEARCH OF THERMOPHYSICAL PARAMETERS FOR PRIMARY BLAST-FURNACE SLAGS

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Results of research of thermophysical descriptions for primary slags of the blast-furnace melting by method of noncontact differential thermoanalysis are brought. A temperature of melting, total heat and specific heat capacity of primary slags with content of FeO from 1.90 to 19.85 % are certain.

Keywords: blast-furnace melting, primary slag, temperature, total heat, specific heat capacity

The primary slag of blast furnace is characterized by the subzero temperature of melting and high content of *FeO*. The quantity of primary slags and their composition render substantial influence at run of blast-furnace process and expense warmth in the zone of primary slag-making for furnace.

It is known that some properties of slag (temperature of melting, viscosity) can be defined at the diagrams of the state for multicomponent systems. In paper [1] for determination of composition for slags appearing on different temperature horizons of blast furnace, used the system CaO-FeO-SiO_2. Results executing researches confirm possibility of application of the indicated diagram for the study of change of composition primary slag.

In work [2] Yu.M. Potebnya, studying the processes of primary slag-making during work of blast furnace on fluxed agglomerate, got the good coincidence of composition of synthetic slags with real primary slags, which permits with an insignificant error to use the data got at the study of synthetic slags, for the real primary slags.

An aim of the executed research is determination of temperature values and total heat and also the specific heat capacity primary blast furnace slag. The obtained data are needed for making zonal thermal balances, which allow to estimate of zone primary slag-making.

To study the real primary slags of the blast furnace melting is not possible. Therefore experiments to determination of thermophysical characteristics' of synthetic slags with different content of *FeO* carried out. Slags are got by an alloying chemically of clean components: CaO, SiO_2, Al_2O_3 and MgO. For the receipt of the set content of *FeO* in a slag a fayalite ($2FeO{\cdot}SiO_2$) separately alloyed and added his necessary quantity to fusion. Five compositions of slag were prepared with content of *FeO* a from 1.90 to 19.85 %.

The analysis of thermograms of heating for investigational slags shows that in these slags there is an isotherm effect that from the increasing concentration of *FeO* is displaced to the area of subzero temperatures. So, for a slag № 1 (1.90 % *FeO*) his begins is at a temperature 935 °C, and for a slag № 5 (19.85 %) - at a temperature 765 °C. For determination of possibility of reversibility of these processes slags № 2 and 3 exposed to the thrice-repeated heating and cooling. Disappearance of isotherm effect is set at the second heating for every slag, which testifies to irreversibility of this process. Processes leak with calorification at heating of matter are explained by the return of surplus energy at transition from the balanced state in the nonbalanced state [3]. One of such transitions is crystallization of glass formation mass. For silicates and borates is especially sharply expressed ability of formation of glass from fusion.

Slags for research alloyed in a stove and outpoured in mould, here part of slag at snap-chilling did not have time for crystallize. At heating of glass that flowed found in-bulk slag, took to the threshold whereupon passing to the steady phase was accomplished quickly with calorification, which is represented on thermogram as the «peak» aimed upward. At the further heating on thermograms there was the endothermic effect caused by melting of slag. There is a decline of temperature for his melting from 1225 to 1160 ºC at the increase of content of *FeO* in a slag from 1.90 to 19.85 %.

It is applied the methodology presented in works [3,4] for determination of warmth for melting of synthetic slags. From the analysis of data evidently, that with the increase of content of *FeO* in a slag the warmth of his melting diminishes from 366.35 Jou/g for a slag № 1 (1.90 % *FeO*) to 347.85 Jou/g for a slag № 5 (19.85 % *FeO*) the specific heat capacity of slag of C_p, Jou/(g·°C) at different temperature was expected with the use of formula [1]:

$$C_p = \frac{\Delta q_s \cdot \Delta S}{m}\ , \qquad (1)$$

where Δq_s is reverse thermal receptivity, Jou/mm^2; ΔS is an area, restricted of curve of heating, written in with a sample and without a sample, that behaves to getting up of temperature on one degree, mm^2/°C; m is mass of sample.

The results of calculations showed that at the increase of temperature the specific heat capacity of slags increases. Increase of content of *FeO* in a slag from 1,90 to 19,85 attended by the decline of specific heat capacity from 0,494 to 0,293 Jou/ (g·°C) at temperature 100 °C and from 1,909 to 1,540 Jou/g °C) at temperature 1465 ºC.

Using data on the specific heat capacity of slags total heat of primary slags expected at different temperatures. Results are showed that increase of content of *FeO* in a slag from 1,90 to 19,85 % to the decline of his from 47,930 to 27,209 Дж/of g at a temperature 100 ºC and from 1924,430 to 1464,430 Дж/of g at a temperature 1465 ºC.

For the marking of zonal thermal balances of the blast-furnace melting it is necessary information about thermal content of primary slags. In this connection,

using data about relation to the specific heat capacity of slags, expected them thermal content as [5]

$$H = H_{inif} + \int_{t_1}^{t_{пл}} C_{p_1}\, dt + L_{melt} + \int_{t_{пл}}^{t_2} C_{p2}\, dt \ , \qquad (2)$$

where H_{inif} is thermal content of slag at an initials temperature, Jou/g; C_{p1}, C_{p2} are accordingly specific heat capacity of slag in a hard and liquid phase, Jou/(kg·°C); L_{melt} is a warmth of melting for slag, Jou/g.

It is set that increase of content *FeO* in a slag from 1.90 to 19.85 % make in the decline of him thermal content from 47.930 to 27.209 Jou/g for temperature 100 °C and from 1924.430 to 1464.430 Jou/g for temperature 1465 °C.

Conclusion. Researchs of temperature and total heat and also with content of FeO 1.90...19.85 % are executed. It is set the specific heat capacity of primary blast furnace slags, that increase of content of *FeO* in a slag from 1.90 to 19.85 % to bring down the temperature of his melting from 1225 to 1160 °C, total heat from 366.35 to 347.85 Jou/g, and specific heat capacity from 0.494 to 0.293 Jou/(g·°C).

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