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Optimization of the Output Regime on the Basis of Drainage Conditions in the Blast Furnace Hearth

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The method of position-fix and size of "deadman" is developed in the furnace of high furnace. By means of the offered technique of definition of a site and the rough size "deadman", there was a possibility to estimate its influence on work of a heart of a blast furnace. The conducted researches on a blast furnace of № 1 PSJ "AMC" have shown that a hearth work appreciably depends on a site and the size of the "deadman". On the basis of the data about influence of the "deadman" on a drainage of products it was offered to organize a mode of releases so that not to create stagnant zones in the hearth. For a blast furnace of № 1 PSJ "AMC" it is recommended will use a mode release in which every second release to be made through removed from others notch, and the others of release are made serially on others notches.

Keywords: BLAST FURNACE, HEARTH, DEADMAN, OUTPUT REGIME, LOCATION, SIZE, STAGNANT ZONE

Introduction

Providing the intensive work of hearth is an important condition for effective work of modern blast furnace. Significant impact on the operation of the furnace has a melting residues that remain in the hearth of blast furnace after output closing.

The volume of melting residues in a hearth of furnace depends on the drainage conditions in the coke packing to traffic the materials for melting.

In the hearth of the blast furnace, the part ofcoke packing is embedded in a layer of the materials for melting . Its effect on the speed of the fusion products to the tap-hole at the time of output is determined by the porosity of such coke packing [1] and To determine the "deadman" center is possible for blast furnace with two or more tap-holes equipped with such systems. It will be located at the intersection of lines drawn from the axes of pig iron tap-holes to the places with the highest level of slag at the end of output, as shown in **Figure 2**. The "deadman" center gives us an approximate location of area with poor drainage conditions.

Also the value and location of zone with poor drainage conditions, so-called "deadman" [2].

Control system of condition the blast furnaces [3] allows to determine the height of the layer melting products around the hearth. The level of melting products in the hearth of blast furnace is shown in **Figure 1**. It's fixed the height of layer melting products in every second tuyere. Using data from this system, it is possible to estimate the size and location of "deadman" by analysis of the distribution of products melting.

There is a develop technique, allowing to determine the location of the "deadman" center and its approximate radius. From this information, we can estimate the influence of the "deadman" on hearth work of blast furnace, and calculate the parameters of the "deadman" and identify possible ways of correction.

The volume of "deadman" can be determined by comparing the total volume of output produced products from the hearth, without volume products, coming into the hearth of furnace, and the volume of the hearth, which has got free from the products of melting without "deadman".

$$V_D = V_{осв}^{кажс} - V_{осв}, м^3, \qquad \text{(Eq. 1)}$$

where V_D – the volume of "deadman" m^3; $V_{осв}^{кажс}$ – residual volume of melting products, obtained according to the system, m^3; $V_{осв}$ – residual volume of melting products, equal to the difference of the output hearth of furnace and came for this period in the furnace melting products, m^3.

"Deadman" can have a horizontal cross section of the form, which is different from the circle, and in the vertical section of this can be a truncated cone or irregular shapes figure. At the first approximation for calculation was accepted, that "deadman" has the shape of a cylinder [4], then the radius of the "deadman" is defined by the formula:

$$R_D = \sqrt{\frac{V_T}{\pi \cdot h_m}}, м \qquad \text{(Eq. 2)}$$

where R_D – radius of the "deadman", m; h_m – height of the "deadman", m.

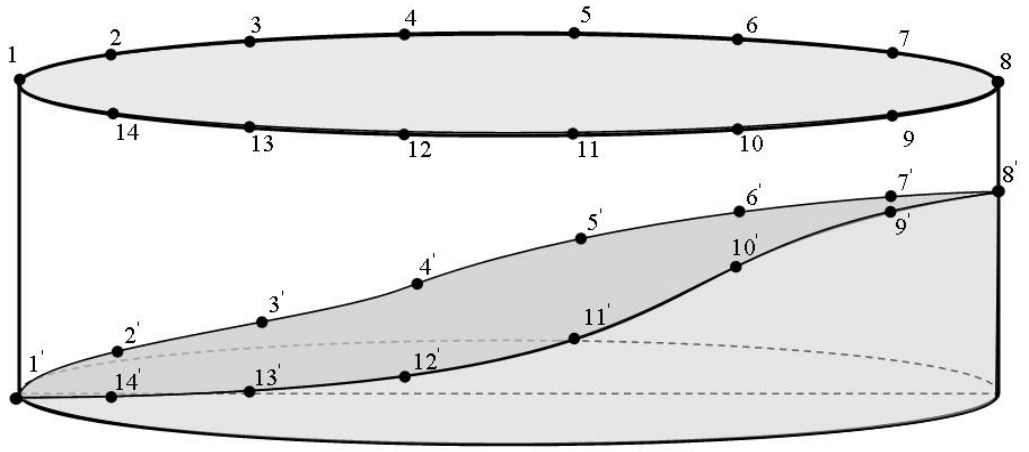

Figure 1. The level of residues around the hearth of blast furnace № 1 PSJ "AMC": 1-14 – positions of the sensors monitoring system for level of the melt in the hearth of blast furnace; 1'-14' – levels of the melt in the hearth of blast furnace, which defined by sensors

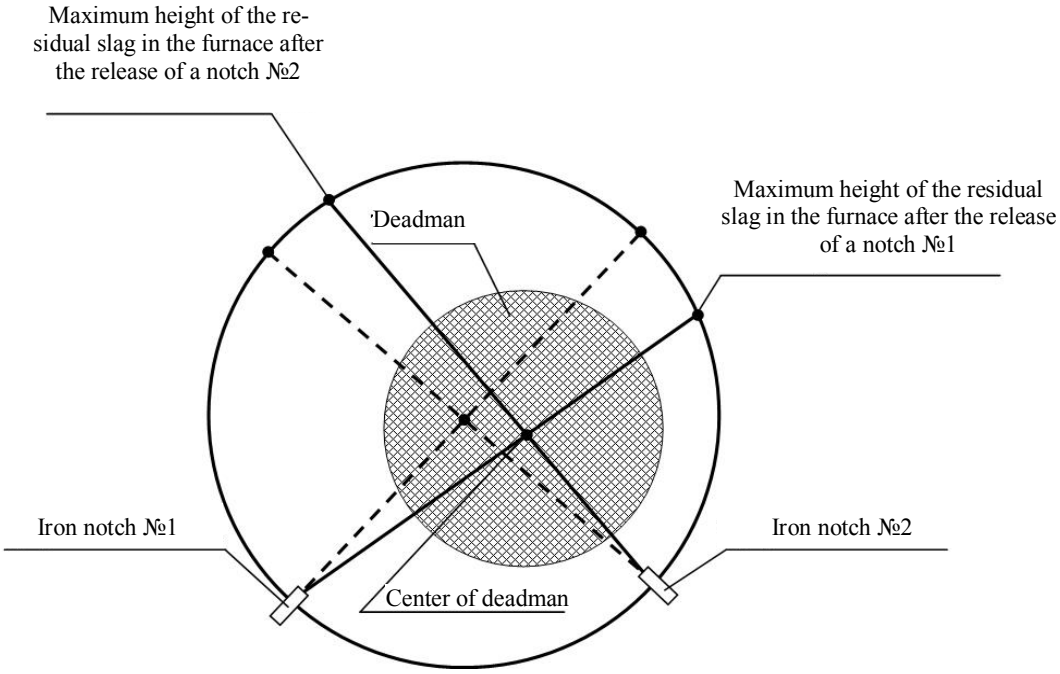

Figure 2. Blast furnace hearth. Top view. "Deadman" is offset from the center of the furnace

Based on the data control system of melting level around the hearth of blast furnace, which is set on the blast furnace № 1 PSJ "AMC", it was conducted the analysis of changes of melting product level in the hearth of blast furnace, during the output through different tap-holes.

At the moment of the output closing, level of the melt in the hearth of blast furnace, changes depending on the moving off from the tap-hole through which the output was held (**Figure 3**).

As a rule, the output mode on blast furnace № 1 PSJ "AMC" was with consistent change of tap-holes (first, second, third).

With uneven distribution of pig iron tap-holes around the furnace, some areas are set up in which the residual slag will be significantly higher than in other areas of the hearth of furnace. The presence of such "stagnant" zones depends on the location of "deadman" in the hearth and characterized by an increased rate of combustion air tuyeres.

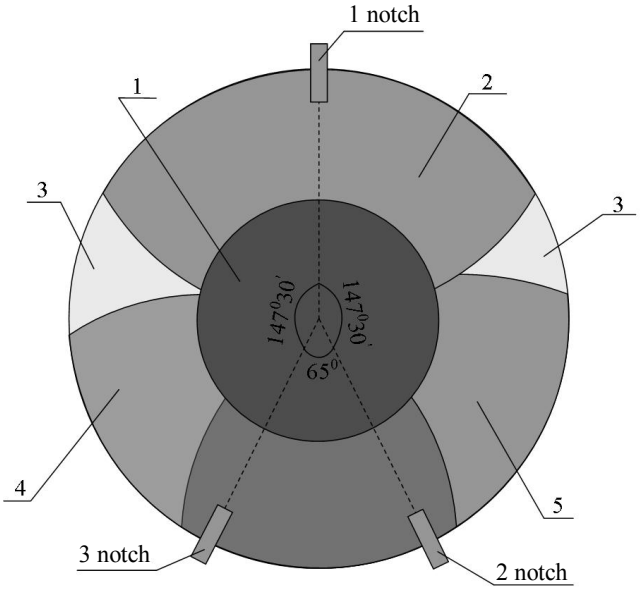

Figure 3. Location of zones of intense moving off melt products and "deadman": 1 – "deadman"; 2 – zone of intense moving off melt products after output through the tap-hole № 1; 3 – stagnant zone; 4 – zone of intense moving off melt products after output through the tap-hole № 3; 5 – zone of intense moving off melt products after output through the tap-hole № 2

Conclusions

The increase of "deadman" volume shows about the general deterioration of drainage conditions in the hearth of blast furnace.

For example, on the blast furnace № 1 PSJ "AMC" it is clear, that the output mode for blast furnaces with three pig iron tap-holes, located at different angles, it is necessary to organize so as to minimize the size of stagnant zones.

In this case, it is optimal mode of output, in which every second output is through the tap-hole, moving off from the others, and the remaining outputs are through other tap-holes, by turns.

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Оптимизация режима выпусков на основе данных о дренажных условиях в горне доменной печи

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Разработана методика определения местоположения и размера "тотермана" в горне доменной печи. С помощью данной методики появилась возможность оценить влияние "тотермана" на работу горна. Проведенные исследования на доменной печи № 1 PSJ "AMC" показали, что работа горна в значительной мере зависит от местоположения и размера "тотермана". На основе данных о влиянии "тотермана" на дренаж продуктов плавки было предложено организовать режим выпусков так, чтобы не создавать застойных зон в горне. Для доменной печи № 1 PSJ "AMC" рекомендуется использовать режим выпуска, в котором каждый второй выпуск будет производиться через удаленную от других летку, а остальные выпуска производятся поочередно на другие летки.