STUDYING AND IMPROVING
BLAST FURNACE CAST IRON QUALITY

In the article there are presented the results of studies to improve the quality of blast furnace cast iron. It was established that using fire clay suspension for increasing the mould covering heat conductivity improves significantly pig iron salable condition and filtration refining method decreases iron contamination by nonmetallic inclusions by 50 – 70 %.

Key words: blast furnace, cast iron, fire clay, filter, filtering elements

INTRODUCTION

With the development of motor transport industry, machine-tool building and other machine building branches there increased the requirements to the quality of blast furnace cast iron. With the use in the cupola mixture of cast iron melted in large-volume furnaces with the melting progressive parameters, at machine building plants there became often defective castings with shrinkage defects, friability, cracks.

To increase the quality of blast furnace cast iron there were carried out scientific-research works. Pig cast iron, under the condition of observing the melting parameters and pouring, was obtained with high carbon content, rough surface with graphite-and-slag clusters on it. In large-crystal bright fracture of pigs there were voids, blisters filled with graphite kish.

To increase heat conductivity of mould coverings in the lime solution there were added carbon-containing additives: graphite, coal charge of coke-chemical production of 3 – 0 mm fraction, coke breeze of 1 – 0 mm grade after processing in the ball mill. The best results were obtained with the addition in the lime of graphite solution, but its deficit and high cost limit its use. However, hydration water and underburning of lime lumps cannot be eliminated when preserving the lime covering. For this purpose lime solution was completely replaced by the suspension of unburnt fire clay.

The fire clay suspension with density 1,13 – 1,15 g/cm³ waters moulds well, possesses sufficient refractoriness and its protective layer on the mould does not practically contain water after mould drying with coke gas. Therefore, pig iron salable condition improves significantly.

Besides, the use of fire clay for mould coverings excludes claps in dissolution and prevents the lime solution corroding action when split on the open parts of the worker’s body, increases the culture of production and decreases labor intensity when making solution, as there is excluded the waste presence up to 30 – 40 % in the form of underburning with the use of lime. The weight clay rate is 1,5 – 1,7 decreased as compared with lime.

Starting from the fact that with iron temperature decreasing the carbon solubility reduces, there were carried out experiments for artificial decreasing liquid iron temperature in ladles by the way of smelting in them unlettered iron scrape. In the iron-transporting ladle of 100 t volume there were loaded 5 t of preliminarily heated scrape, then the ladle was filled with iron.

At present alongside with the abovementioned methods for the product quality improving there is more widely used the filtration method of refining alloys, mainly based on iron and aluminum. Its essence is in passing metallic melt through a special device (filter) where as a result of physical-chemical, adsorption, mechanical phenomena there takes place the melt purification from harmful impurities, inter-metallic compounds, nonmetallic and gas inclusions.

Filters used in metallurgy can be structurally divided into two groups: two-dimensional and depth filters.

A two-dimensional filter is a grid (a plate) of ceramics or glass fiber. At present ceramic grids present a widely used type of filters and are manufactured in a wide range of shapes and sizes. Such filters with the openings diameter ≥ 2 mm purify the metal from large inclusions of exogenous character, but they do not permit to decrease the content of fine, thin-dispersed inclusions whose size is significantly smaller than the openings in the grid.
The characteristic feature of such filters (grain, lump) is their large contact surface with metal in the course of filtering and presence of long and thin intergrain channels of variable section, which causes removing from the melt of both large and fine inclusions [1].

A depth filter presents a layer of filtering material grains of certain size and thickness located in a crucible or a funnel with openings in the bottom part, or a whole block of ceramics. Depending on the ratio of the densities of the filtering material and the melt, the grain (lump) filter is either laid in the funnel [2] or located between two crucibles [3, 4], grids [5, 6] in the funnel for preventing their floating.

**EXPERIMENTAL STUDIES**

The results of the experiments for changing liquid iron temperature (Table 1) and its chemical composition (Table 2) are shown below (iron temperature was measured with optical pyrometer). The keeping from the beginning of the ladle filling to the beginning of pouring was in the usual range of 40 – 50 minutes.

**RESULTS AND DISCUSSION**

The fracture of cooled iron by the way of scrape additive does not differ from uncooled iron with an insignificant increase of the pig density. However, due to the fact that in scrape melting in iron transporting ladles there takes place graphite additional emission, the surface of pig iron was respectively obtained more contaminated with the graphite kish.

---

**Table 1 Changing iron temperature when melting scrape in iron transporting ladles**

<table>
<thead>
<tr>
<th>Method of carrying out experiment</th>
<th>Iron temperature at discharge / °C</th>
<th>Iron temperature in pouring / °C</th>
<th>Iron temperature changing / °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>With scrape melting</td>
<td>1 430</td>
<td>1 302</td>
<td>128</td>
</tr>
<tr>
<td>Without scrape melting</td>
<td>1 415</td>
<td>1 322</td>
<td>93</td>
</tr>
<tr>
<td>With scrape melting</td>
<td>1 400</td>
<td>1 230</td>
<td>160</td>
</tr>
<tr>
<td>Without scrape melting</td>
<td>1 400</td>
<td>1 330</td>
<td>70</td>
</tr>
</tbody>
</table>

**Table 2 Changing iron chemical composition when melting scrape in iron transporting ladles**

<table>
<thead>
<tr>
<th>Method of carrying out experiment</th>
<th>Iron chemical composition / %</th>
<th>C</th>
<th>Si</th>
<th>Mn</th>
<th>P</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>With scrape melting</td>
<td>4,05 2,71 0,46 0,16 0,03</td>
<td>4,05</td>
<td>2,71</td>
<td>0,46</td>
<td>0,16</td>
<td>0,03</td>
</tr>
<tr>
<td>Without scrape melting</td>
<td>4,02 2,47 0,42 0,15 0,03</td>
<td>4,02</td>
<td>2,47</td>
<td>0,42</td>
<td>0,15</td>
<td>0,03</td>
</tr>
<tr>
<td>With scrape melting</td>
<td>3,80 2,78 0,45 0,13 0,04</td>
<td>3,80</td>
<td>2,78</td>
<td>0,45</td>
<td>0,13</td>
<td>0,04</td>
</tr>
<tr>
<td>Without scrape melting</td>
<td>3,94 2,85 0,45 0,16 0,03</td>
<td>3,94</td>
<td>2,85</td>
<td>0,45</td>
<td>0,16</td>
<td>0,03</td>
</tr>
</tbody>
</table>

**Figure 2** Diagram of assembled filter (a) and blast furnace iron filtering (b)
CONCLUSIONS

At the considered stages of the study there were improved the appearance of pig iron quality: the pigs were obtained with clean surface, there was liquidated the pockmark affection of the pigs bottom surface, the fracture on the pig thickened part was more compact.

Thus, by implementing the considered measures it can be improved the salable condition of pig iron, to increase the product quality and the efficiency of its manufacturing.

LITERATURE


Note: The translation of the N. M. Drag, Karaganda, Kazakhstan