USING THE SPONGE IRON FOR CASTING OF DUCTILE IRON WITH REDUCING THE COST

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Abstract

Increasing the price of steel scraps has increased demands for finding a new raw material for producing the ductile iron parts. In this project sponge iron was tested and results showed that mechanical properties and microstructure are acceptable in comparison with standard conditions. For example ultimate tensile strength is more than 420 MPa, hardness 174 HB and impact energy is 12 J. microstructure included 75% ferrite and 25% pearlite. In fact with keeping on properties and structure, the price reduced to 15%.

Keywords: sponge iron, ductile iron, price

1. INTRODUCTION

More using of types of scraps for manufacturing the metals and alloys saves the energy, decreases the environmental contaminants and increases the productivity time of sources. It remains these rewarding sources for futures[1].

Generally for decreasing the using of energy, refractory and increasing the efficiency the optimum amount of sponge iron is 30% of furnace capacity. Although in some conditions 70 to 80% of capacity was used[2].

For different reasons such as failure, erosion, changing the technology and etc many types of steels and cast irons will remelt and convert to new products. Five hundred million tons of scraps and returns were used in 2012 and result in shortage of scrap in world. In this direction and in present work, substitution of scrap with sponge iron for manufacturing of ductile iron was considered[3].

Fig. 1 Increasing the using of scraps in different countries
2. **EXPERIMENTAL PROCEDURE**

For manufacturing the ductile iron (GGG40) with specified chemical composition in table 1, after melting the scrap in induction furnace, 25% of furnace capacity continuously was charged by sponge iron. For preventing the bridging simultaneously with previous step pressed scrap was used. After slagging the samples were prepared.

Then hardness, tensile and impact tests was done and metallography for determining the percentage of phases, nodularity, nodule count of graphite was done.

In continue the cost of ductile iron production with and without sponge iron was evaluated.

Table 1 Chemical composition of ductile iron

<table>
<thead>
<tr>
<th>Element</th>
<th>C</th>
<th>Si</th>
<th>Mn</th>
<th>S</th>
<th>Cr</th>
<th>Fe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent</td>
<td>3.55</td>
<td>2.60</td>
<td>0.31</td>
<td>0.01</td>
<td>0.08</td>
<td>Res</td>
</tr>
</tbody>
</table>

3. **RESULTS AND DISCUSSION**

The most important parameters in production of these parts are microstructure and formed phases. Therefore resulted and accepted structures were compared and results showed that formed microstructure is in accepted range.

Figures 2 to 6 represent there are 150 graphite nodules per mm$^2$, nodularity of 90% and structure with 85% ferrite and 15% pearlite. And in comparison with standard condition these are accepted.
**Fig. 3** Microstructure of ductile iron after etching

**Fig. 4** Comparison of pearlite percentage in different conditions
In next step the result of mechanical tests showed that hardness of 174HB for sponge iron not only is more than standard condition but also is more suitable than scrap and it is because of difference of pearlite percentage. This comparison is represented in figure7.
The considerations on mechanical properties show that yield strength of 280 MPa and impact energy of 12 J for sponge iron lay in standard range. But the decrease in comparison with scrap is because of pointed difference in microstructure.

**Fig. 7** Comparison of hardness in different conditions

**Fig. 8** Comparison impact energy in different conditions
In aspect of cost evaluations with regard to production 150 tons melts in a day, 2,000,000 $ is saved in a year. With regard to results of microstructure and mechanical properties, use of sponge iron as substituent of scrap is acceptable.

4. CONCLUSIONS

With replacement the 25% of scraps with sponge iron, microstructure with 15% pearlite, 90% nodularity and nodule count of 150/mm$^2$ is formed and all are in standard range.

New condition has 280 MPa yield strength, 174HB hardness and 12 J impact energy and all are in standard range.
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LITERATURE