BAUXITE RESIDUE VALORISATION AND BEST PRACTICES CONFERENCE

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EXPERIMENTAL INVESTIGATION ON RECOVERY OF Fe-Ni ALLOY FROM BAYER RED MUD AND LATERITE NICKEL

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This experimental work aims to

1. Extract Fe alloys from red mud and laterite nickel by carbothermic reduction, and

2. use this alloys directly to shape investment castings with different compositions and various properties, so as to reduce production cost.
Process flow chart

- Bayer red mud
- Laterite nickel
- Coke powder

1. Carbothermic Reduction in EAF
2. Fe-Ni alloy
3. Slag
4. pelletizing
5. Production of castings
6. Additives for concretes
Electric Arc Furnace

Schematic of melting in electric arc furnace (EAF)

Photo of the EAF during carbothermic reduction
Electric Arc Furnace

Schematic of melting in electric arc furnace (EAF)

Photo of the EAF during carbothermic reduction
## Chemical composition (mass %)

<table>
<thead>
<tr>
<th>materials</th>
<th>Fe$_2$O$_3$</th>
<th>NiO</th>
<th>TiO$_2$</th>
<th>Cr$_2$O$_3$</th>
<th>MnO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red mud</td>
<td>35.30</td>
<td>0.001</td>
<td>4.90</td>
<td>0.31</td>
<td>0.17</td>
</tr>
<tr>
<td>Laterite</td>
<td>45.28</td>
<td>1.09</td>
<td>0.12</td>
<td>2.25</td>
<td>0.97</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>materials</th>
<th>Al$_2$O$_3$</th>
<th>CaO</th>
<th>SiO$_2$</th>
<th>Na$_2$O</th>
<th>MgO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red mud</td>
<td>18.48</td>
<td>16.20</td>
<td>11.32</td>
<td>8.24</td>
<td>0.39</td>
</tr>
<tr>
<td>Laterite</td>
<td>7.36</td>
<td>0.29</td>
<td>5.08</td>
<td>0.88</td>
<td>0.45</td>
</tr>
<tr>
<td>Coke %</td>
<td>Total Recovery</td>
<td>Fe</td>
<td>Ti</td>
<td>Ni</td>
<td>Cr</td>
</tr>
<tr>
<td>--------</td>
<td>----------------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td>20</td>
<td>70.13</td>
<td>71.22</td>
<td>20.13</td>
<td>56.45</td>
<td>45.39</td>
</tr>
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<td>25</td>
<td>74.87</td>
<td>73.24</td>
<td>25.34</td>
<td>72.36</td>
<td>58.45</td>
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<td>30</td>
<td>82.16</td>
<td>78.61</td>
<td>37.45</td>
<td>80.56</td>
<td>52.85</td>
</tr>
<tr>
<td>35</td>
<td>88.95</td>
<td>82.13</td>
<td>48.69</td>
<td>94.98</td>
<td>56.46</td>
</tr>
</tbody>
</table>
Cementite + retained austenite
Cementite + ledeburite
Graphite + ledeburite
Grey iron
Coke content and impact work

Impact work (J)

Coke addition

Coke content and impact work
Coke content and hardness
manufacturing Investment casting using the alloys recovered from red mud and laterite nickel

Alloys from EAF

Making pattern by 3D print

Making ceramic shell round the pattern

Shaped casting
The final casting with different compositions can be produced by changing the ingredients and coke addition.

The pattern was made by 3D print, using a starch powder which will be burn off after the ceramic shell has been shaped.
Conclusions

1. By carbothermic reduction, Fe-Ni alloys along with other elements can be recovered from bayer red mud and laterite Nickle.

2. Investment castings with different chemical compositions and different mechanical Properties can be cast directly from alloys Recovered from red mud and laterite Nickle, lowering the production cost greatly.
Our experimental work is only preliminary and we hope to seek cooperation with you!

Thank You!