A brief Introduction to Stainless Steel Industry Side Streams
STAINLESS STEEL – NOT ALL STEEL IS THE SAME

• Like all types of steel, stainless steel is not a single metal but an alloy that is a material made from two or more separate elements alloyed together; the major ingredient is the metal iron with a minimum of 11 % chromium content and a maximum of 1.2 % carbon

• For applications where both the strength of steel and corrosion resistance are required such as cookware, kitchens, food processing plants

• More information: https://www.worldstainless.org/

• Production process
  • EAF (Electric Arc Furnace) in which ferrous scrap and ferro alloys (Fe Cr, Fe-Ni, Fe-Mo...) are melted
  • AOD (Argon Oxygen Decarburization) allows the removal of carbon and other composition adjustments to achieve the desired composition
  • LF (Ladle Furnace) adjust the final chemical composition and temperature
  • VOD (Vacuum Oxygen Decarburization) enhances decarburization
  Continuous Casting in which the molten metal is solidified into slabs (0.2m x 2m) or blooms (0.2m x 0.2m)

<table>
<thead>
<tr>
<th>Stainless steel</th>
<th>Carbon steel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resistant to rust</td>
<td>Vulnerable to rust</td>
</tr>
<tr>
<td>Less wear-resistant</td>
<td>Wear-resistant</td>
</tr>
<tr>
<td>Less brittle</td>
<td>Brittle</td>
</tr>
</tbody>
</table>

58.3 M\(\text{V/a}\) (in 2021)  
1,911.9 M\(\text{V/a}\) (in 2021)

As a rule of thumb, stainless steels cost four to fives times much as carbon steel in material costs
STAINLESS STEEL SLAG

• Stone or powder-like by-products left over after a desired metal has been smelted from its raw material amounting to one third of steel

• Tasks of the slags in steel melting shop:
  • Formed by adding lime, which removes excess elements from steel
  • Assist in the temperature control
  • Minimize re-oxidation of the liquid metal

• Heterogeneous slag is caused by several steel grades, steel scrap as raw material, several parallel production lines, several unit processes, batch processing ➔ Heterogenous slag production

<table>
<thead>
<tr>
<th>Unit process</th>
<th>CaO (%)</th>
<th>SiO₂ (%)</th>
<th>MgO (%)</th>
<th>Al₂O₃ (%)</th>
<th>Cr₂O₃ (%)</th>
<th>CaO+MgO/ SiO₂</th>
<th>Amount (kg/t steel)</th>
<th>Minor components</th>
</tr>
</thead>
<tbody>
<tr>
<td>EAF</td>
<td>40...45</td>
<td>25...30</td>
<td>5...12</td>
<td>5...10</td>
<td>3...7</td>
<td>1.7...2.0</td>
<td>100...150</td>
<td>T, V, Ni oxides</td>
</tr>
<tr>
<td>AOD</td>
<td>55</td>
<td>25...30</td>
<td>5...10</td>
<td>1...5</td>
<td>0.5...1</td>
<td>2.5</td>
<td>100...120</td>
<td>CaF₂</td>
</tr>
<tr>
<td>LF-CC</td>
<td>55...60</td>
<td>20...30</td>
<td>5...10</td>
<td>1...5</td>
<td>1...5</td>
<td>2.2...3</td>
<td>15...20</td>
<td>CaF₂, Ti, Nb, V</td>
</tr>
</tbody>
</table>
PRESENT SLAG PROCESSING AND SLAG-BASED PRODUCTS

- Slags contain metal some 10...15% ➔ Main target for slag processing is to recover metals and return them to the smelter as raw material
- Often slags are wet-ground, metallics are separated out and residual slag is landfilled

- Modular slag processing method by Tapojärvi
  - Metal separation is combined with the production of CE-marked slag-based products
  - Reduces landfilled slags
  - Products replace virgin natural resources