Extracting value from aluminum production waste (red mud)

5th Scientific Seminar
13 – 14 December 2018
Berlin, Germany
Company presentation

• About Extracthive

Extracthive is a French company specialized in the recycling of industrial waste:
- 3 locations
- 40 employees
- 3.7 M€ in revenue expected (e2018)

Extracthive Process Designer:
Our RDI team

Extracthive Ceramics Recycling:
Our comminution facility

Extracthive Chemical Products:
Our chemical plant

PROMETIA, 13 - 14 December 2018
Lab scale (2l) development of a process to recover antimony from stibnite ore:

- **Stibnite ore** (Sb content 5 w%)
- **Oxidative leaching**
- **Neutralisation**
- **Precipitation**
- **Sb$_2$O$_3$ concentrate** (Sb content > 60%)

**About Extracthive Process Designers**

PROMETIA, 13 - 14 december 2018
Valorization of jarosite, a zinc by-product rich in iron, as a secondary source of zinc, iron and lead.

Jarosite (Fe, Zn, Pb)

Leaching

H₂SO₄

Solution

Electrowinning

Electrolytic alloy Fe/Zn

Source of PbSO₄

Residue
• Sources of red mud: bauxite ore

Bauxite reserves
(78 billion tons) [1]

Uses of aluminum

**Introduction / Context**

- **Alumina production**

![Flowchart of Alumina Production Process](image)

**Waste management:**
- Building material
- Pollutant adsorbent
- ...

Introduction / Context

- **Red mud characterization**

Samples used in this study have been characterized by XRD, SEM and ICP-AES.

<table>
<thead>
<tr>
<th></th>
<th>Fe$_2$O$_3$</th>
<th>Al$_2$O$_3$</th>
<th>SiO$_2$</th>
<th>TiO$_2$</th>
<th>CaO</th>
<th>P$_2$O$_5$</th>
<th>MgO</th>
<th>Cr$_2$O$_3$</th>
<th>Na$_2$O</th>
<th>LOI</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td>48.8 %</td>
<td>12.3 %</td>
<td>5.70 %</td>
<td>9.45 %</td>
<td>5.34 %</td>
<td>0.480%</td>
<td>0.140%</td>
<td>0.310%</td>
<td>3.26 %</td>
<td>11.7%</td>
</tr>
</tbody>
</table>

**Graphs and Images:**
- Size distribution of red mud particulates.
- XRD pattern with peaks identified:
  1. Fe$_2$O$_3$
  2. NaAlSiO$_4$
  3. TiO$_2$
  4. Al$_2$O$_3$
- SEM image showing particle morphology.

**ExtracthivE:**

PROMETIA, 13 - 14 December 2018
• Objectives

→ reduction of waste volume,
→ production of electrolytic iron, thus creating added value,
→ access to other metals contained in the residues (like titanium).
• Experimental device
Results

• Effect of current density

→ Faradaic yields vs. current density in a suspension of NaOH-hematite and M NaOH-Red mud at 110 °C.

→ The low yield obtained in the case of bauxite residue can be explained by the presence of impurities in the medium (vanadium, silicates, ...).
Results

• Analysis of electrolytic iron

<table>
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<tr>
<th></th>
<th>% Fe</th>
<th>% Na</th>
<th>% Al</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fe-hematite</td>
<td>99.6</td>
<td>0.125</td>
<td>0.251</td>
</tr>
<tr>
<td>Fe-red mud</td>
<td>97.3</td>
<td>0.222</td>
<td>0.134</td>
</tr>
</tbody>
</table>

These results confirm the feasibility of producing electrolytic iron from red mud!
To conclude…

Our objective was to study the feasibility of production of iron from red mud.

- Red mud analysis has shown that it contains about 50% wt. hematite
- The electrolytic iron obtained has a purity greater than 99% and 97% respectively for hematite and red mud.
- The maximum faradaic yields of electrodeposition were of the order of 93% and 20% respectively for hematite and red mud.

Prospect

To improve faradaic yields, it can be proposed to:
(i) Find a way to inhibit the effect of impurities,
(ii) Eliminate impurities by pretreatment of the red mud before electrodeposition.
Thank you for your attention