Sustainable Attrition-Resistant Oxygen-Carriers for Chemical-Looping Reforming by Spray Drying

**Oxygen-Carriers**

**First Gen. Ni-based**
- High cost
- S-poisoning
- Toxicity
- Harm to environment

**New Gen. Fe-based**
- Much more cheap
- Less deactivation
- Non-toxic
- Environment-friendly

Optimization of the suspension
- Dispersing agent
- Binder
- Water
- pH

Optimization of sintering temperature
- Phase transition to FeAlO₃ @ 1320°C
  - Lower density and strength
  - Magnetic properties change
- Optimized to 1h@1275°C
  - Sintering time
  - Tapping density & strength increases (to 2.3 g/cm³ and 3.1 N)

**Material Lifetime in reactor**

<table>
<thead>
<tr>
<th>Material</th>
<th>Lifetime in reactor</th>
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</thead>
<tbody>
<tr>
<td>Fe₂O₃/γ-Al₂O₃ (impregnation)</td>
<td>1100 h</td>
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<tr>
<td>NiO/γ-Al₂O₃ (impregnation)</td>
<td>3000 h</td>
</tr>
<tr>
<td>NiO/Ni₃AlO₅ (spray-drying)</td>
<td>33000 h</td>
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</tbody>
</table>

**Mechanical properties need improvement**
- Strength
- Attrition resistance

**Spray-drying → spherical particles**

Increase viability of CLR by developing Fe-based O-carriers

By optimizing the composition of the suspension used in the spray-drying process and the heat treatment of the resulting particles, the strength of the oxygen-carriers increased five-fold.

Chemical-looping tests in future research will investigate the chemical performance of the synthesized materials.