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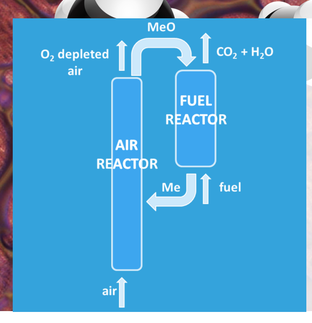

INFLUENCE OF SPRAY DRYING SUSPENSION ON THE MORPHOLOGY OF FE-BASED OXYGEN CARRIERS FOR CHEMICAL LOOPING

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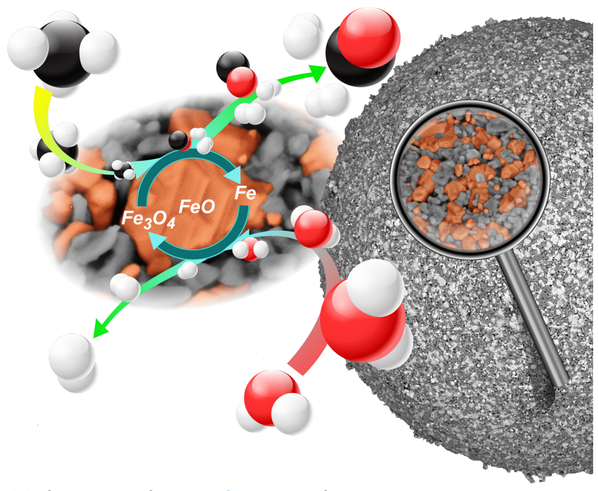
Introduction

Chemical looping processes

CL-reforming → Production syngas and H_2 from methane → Chemicals

CL-combustion → Energy production + CO_2-capture



Oxygen carrier particles

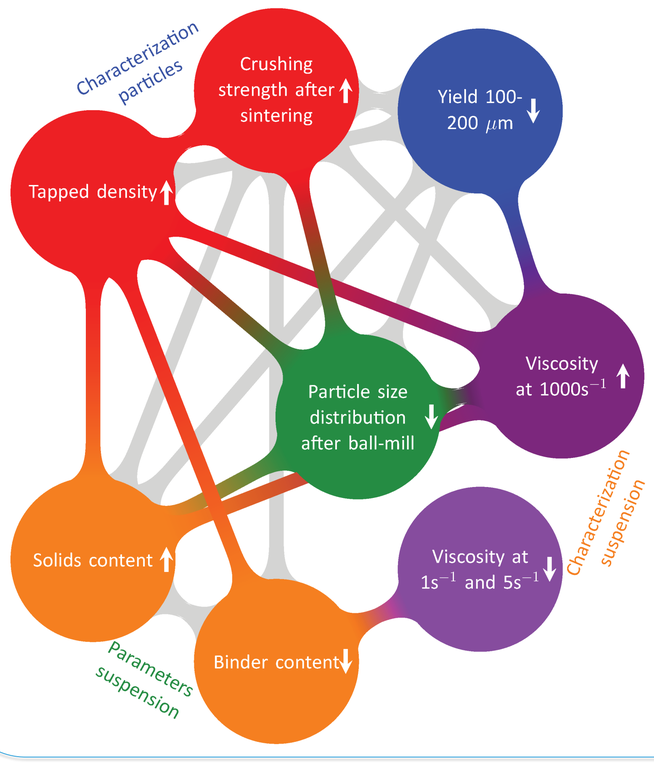
- Transfer of oxygen + energy between reactors
- Active material (Fe, Mn, Cu, Ni, Co) & inert support
- Dimensions for CFB processes
- Scale-up ready and manufacturing methods → spray-drying

What is the **relation** between **suspension** used for spray drying and the **morphology** and **properties** of the resulting oxygen carriers?

Morphology → Mechanical performance; Chemical performance

Relation between Viscosity and Oxygen Carrier

Besides correlation between binder/solids content and resulting tapped density, **other correlations were also observed**:

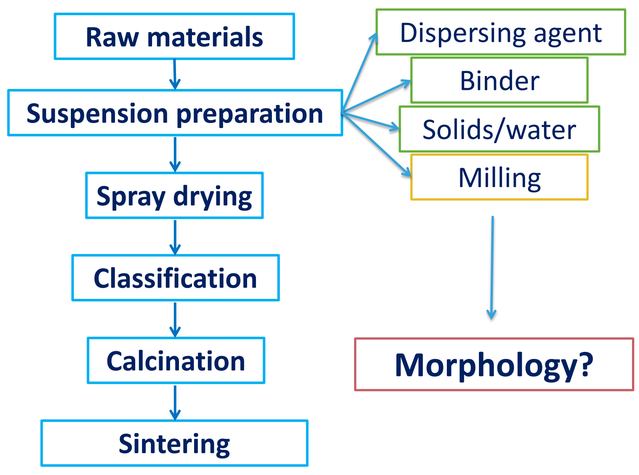


- Clear correlation between **tapped density and strength**
- Increase in **solids content intensifies ball-milling**
- **Viscosity** at relevant shear-rates **interesting parameter** for **predicting properties of resulting particles (size & shape)**

Limited viscosity range suitable for spray-drying (shape/clogging)

Suspension and Morphology

Synthesis of particles – Spray-drying



Tapped density

Depends on:

Particle size distribution
Morphology
Pore size distribution
Skeletal density, …

Suspension parameters

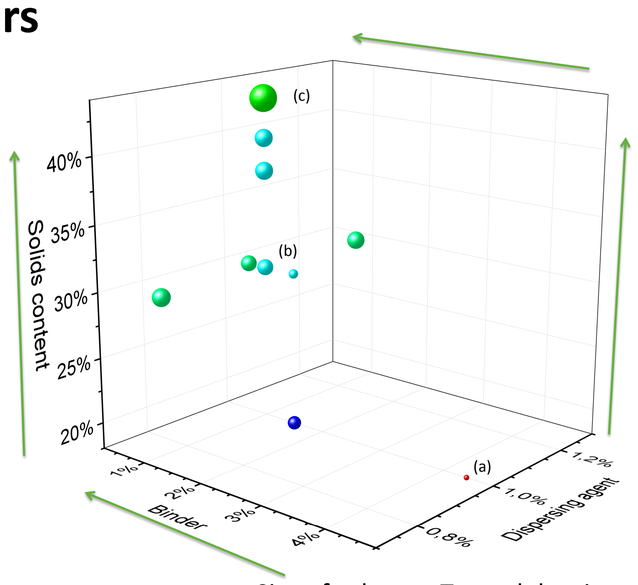
Tapped density ↗ as:

- Solids content ↗
- Binder content ↘

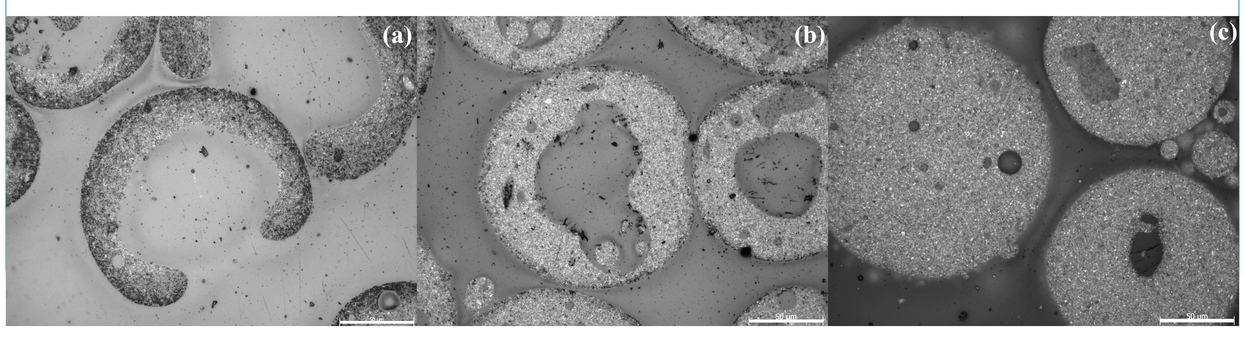
→ Influence on interactions between particles resulting in:

- Changed droplet formation
- Changed motion of particles in droplet during drying
- Segregation of polymeric layer due to free binder

→ Characterized by **rheology/viscosity**



Size of sphere = Tapped density
Color of sphere = Strength



Conclusions

The size of the internal cavity of hollow spray dried particles was significantly decreased by increasing solids content and decreasing the amount of polymeric binder in the suspensions used for spray drying[1].

Several correlations between suspension parameters, properties of the suspensions and properties of the resulting spray-dried particles were established:

Clear correlation between size of internal cavity, tapped density and crushing strength of the particles.

Clear correlation between viscosity at relevant shear rates and properties of the resulting particles.

Spray-drying is a technique for the production of oxygen carriers with a controlled morphology and porosity that fit chemical looping processes.

Reference[1]: De Vos, Y. et al. Optimization of spray dried attrition-resistant iron based oxygen carriers for chemical looping reforming. Chem. Eng. J. 309, 824–839 (2017).

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