Processing of carbon produced by methane pyrolysis

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Overview

If hydrogen is the ‘champagne’ of the energy transition, carbon is a versatile building block that can take many forms and perform many roles in today’s industry. To identify suitable applications for methane pyrolysis carbon, we first must understand its properties. In order to achieve this, it is necessary to establish a correlation between the manufacturing process, its associated parameters, and the resulting physical and chemical properties.
Depending on the characteristics of the produced carbon and the desired application, further processing steps might be necessary. Consequently, separation processes and agglomeration are investigated.

Characterization

In carbon pre-concentrates significant differences can be observed depending on the chosen process and parameters used. While on the macro scale, bulk density is of significant importance, on the micro scale particle sizes can range from below 0.1µm to over 1mm. Hydrophobic properties can exhibit a range of variations, spanning from negligible to highly pronounced. Moreover, substantial variations in particle shape can be identified.

The objective is to supplement the information gathered at the chair of mineral processing with comprehensive analysis conducted at other chairs at Montanuniversität Leoben, in order to provide extensive knowledge regarding all possible carbon alterations.

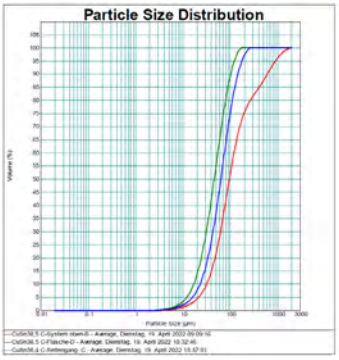

Fig. 1: Particle size distribution of carbon pre-concentrate in different parts of a molten metal reactor

Separation tests

Fig. 2: Separation of carbon and contaminants using pneumatic flotation

To separate carbon and contaminants several different properties are applicable. Different densities and hydrophobicities are the most apparent but differences in particle size of carbon and impurity might as well be suitable.
Promising results were obtained from the flotation tests. To further enhance the performance, pneumatic flotation, known for its effectiveness in fine particle separation, was chosen for subsequent testing.

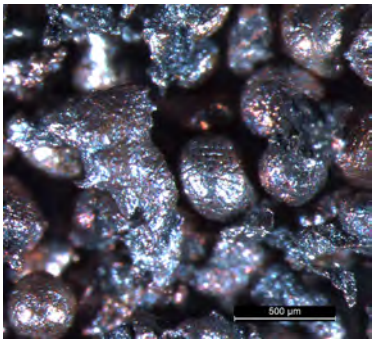

Fig. 3: Alloy concentrate from early molten metal reactor experiments after separation from carbon using differences in the terminal settling velocity

Agglomeration

Low bulk density (~10kg/m³) and fine particle sizes (k_{80} of 5µm) of some samples lead to challenges in the storage, transportation and utilization of carbon.
To address these challenges, tumble growth and pressure agglomeration tests are performed.

- Necessary water content
- Share of binder
- Share of additives

and their effect on compressive strength as well as Pellet size distribution are investigated.

Fig. 4: Process sequence of granulation and testing in high intensity mixer

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