Compaction of Biomass Chars in order to Increase the Apparent Density

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Two biomass chars were compacted by extrusion, tumbling agglomeration and granulation. The goal was to increase the apparent density of the biomass chars for possible usage as reducing agent in the sponge iron process at Höganäs AB.

This investigation was performed in cooperation with Höganäs AB, where two biomass chars (BC), BC 1 and BC 2, were compacted in order to increase the apparent density (AD). AD is a density measurement, where the material is loosely packed into a beaker during the measuring of AD. The total volume of the loosely packed material is taken into account, including voids between particles [1].

The materials were compacted by extrusion, tumble agglomeration and granulation. Only BC 2 were used in the extruder due to shortage of BC 1. The granulation were accomplished in a planetary mixer whereas the tumbling agglomeration was performed in a tumbling plate, which can be seen in Figure 1.

Figure 1. The tumbling plate.

A binder was necessary in all compacting methods. For the compaction in the tumbling plate, organic polymer 1 was used. The binder used during granulation in the planetary mixer was organic polymer 2. The binder used in the extruder was organic polymer 3.

The result from the compaction methods can be seen in Table 1. The AD of compacted BC 2 (tumble agglomeration) became lower than the non-compacted BC 2, which was a surprising result.

Table 1. Results from AD measurements.

Material	**AD (g/dm^3)**
Anthracite	810 [2]
Non-compacted BC 1	191 [2]
Non-compacted BC 2	253 [2]
Compacted BC 1 (tumble agglomeration)	225
Compacted BC 1 (granulation)	282
Compacted BC 2 (extrusion)	374
Compacted BC 2 (tumble agglomeration)	241
Compacted BC 2 (granulation)	314

The reason could be the difference in particle size distribution of non-compacted BC 2 and compacted BC 2 (tumble agglomeration). There is a possibility that small particles did not fit into the voids between the larger particles in the sample

with compacted BC 2 (tumble agglomeration) in the same way as in the sample with non-compacted BC 2.

The possible usage of the compacted materials in the reduction mixture in the sponge iron process at Höganäs AB were also investigated. The experiments were performed in a single sagger furnace, which is a similar process as the sponge iron process. At the moment, the reduction mixture consists of coke and anthracite, whereas magnetite ore concentrate is getting reduced. In the experiments, anthracite was exchange to the compacted materials.

The results from the single sagger furnace showed that the compacted materials are more reactive than anthracite. The time of reduction were shorter for the compacted materials than the reduction time when anthracite were used in the reduction mixture.

The goal was to reach an AD higher than non-compacted material but not as high AD as anthracite due to the high reactivity of the biomass chars. The high reactivity is an advantage and it should be utilized. However, too high reactivity could also lead to problems, such as oxidation, which is not preferable. Unfortunately, the AD reached was not enough since all reduction mixture did not fit into the capsule.

The advantages of biomass chars compared to fossil materials are mostly environmental benefits. Biomass materials are renewable and carbon neutral [3] if new plants or trees are planted after harvesting. Another reason for the interest of exchanging anthracite is because of the increasing price of high quality anthracite.

This study is based on previous investigations [2], where different biomass materials were investigated in the single sagger furnace. The problem was that all magnetite ore concentrate did not become reduced [2]. All reduction mixture that is necessary for the reduction did not fit into the capsule either [2]. The conclusion was that the AD need to be increased in order to be able to use biomass materials in the reduction mixture in the sponge iron process [2].

References

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