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Utilization of Fermentation Residues in the Production of a Brick Block

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Abstract. Use of fermentation residues burden a number biogas plants. Its incorporation into arable land remains the most common practice, although application costs represent approximately the same benefits for fertilization, despite the risk of soil formation and the associated degradation of the soil's ability to retain water. An alternative to the use of spent dust is to re-enter the raw material of the biogas plant or a second alternative to the use of particulate coal as wall surfaces in the interior because of its sorption capacity that captures a wide portfolio of air pollutants.

This article focuses on further possible liquidation and a beneficial alternative to the use of bio-waste and is the use in building ceramics. Samples were made of brick fragments of varying amounts of biochar in which to perform different measurements, such as determining the length change and the weight loss, apparent porosity, determining the compressive strength and further. Measurements have shown that burning bricks containing this substance will cause burns and thus formation of pores. Besides porosity, influenced by the presence of biochar and other properties of the brick body. These properties article also describes. Not only do we get rid of this waste, but we also use bio-waste to improve the material commonly used in the construction industry.

1. Introduction

Biogas stations produce fermentation residues, which are then difficult to get rid of. Fermentation residues are most often added to arable land, despite the risk of soil formation and the associated degradation of the soil's ability to retain water. Further disposal is the reintroduction of a biochar into a biogas station or the use of particulate coal in the interior to capture air pollutants. [1]

This article focuses on further possible disposal and a beneficial alternative to the use of biochar and is used in building ceramics.

Samples of brick shards of varying amounts of biochar were made. In particular, six sets of samples were created. The three sets of samples were used brick clay, and the remaining 3 rows were used ceramic clay. The sets differed by the percentage of the biochar used, always 0 %, 5 % and 10 %. There were 6 samples in each set.

Burning bricks with a biochar is expected to burn, creating pores. In this paper we find measured values of compressive strength, length changes and weight changes by burning.

Increasing the porosity of a ceramic shard can be accomplished by various waste materials. Specifically, for example: power fly ash, cement-chip waste, paper slurry and building debris [2]. Biochar is also a waste material.



2. Formation sample

Creation of test bodies, their subsequent drying and burning were carried out according to ČSN 721565. [3] Brick clay was used as the basic raw material, from which 3 sets of samples were created. Each of these sets consisted of 6 samples.

The first set served as a reference, that is, it was created with pure brick clay and the remaining series could be compared with it. The second set was made of the same clay with the addition of 5 % of biochar (weight ratio). The third set included samples with 10 % of biochar. For more accurate results and better insight into what biochar causes in a ceramic specimen, we have created additional series of samples of the same concentrations using ceramic clay, only. This clay was chosen for the absence of other admixtures used in brick clay.

Samples can be seen in Figure 1. Both clays have already undergone a grinding process, so the maximum grain size was 2 mm.



Figure 1. Sample of brick

Drying was conducted in three phases, the first 24 hours covered, the other 24 hours exposed in air, and the third phase in an oven at 110 °C until the weight was constant. Drying was carried out according to ČSN. [3] The firing was carried out according to the firing curve shown in Figure 2.

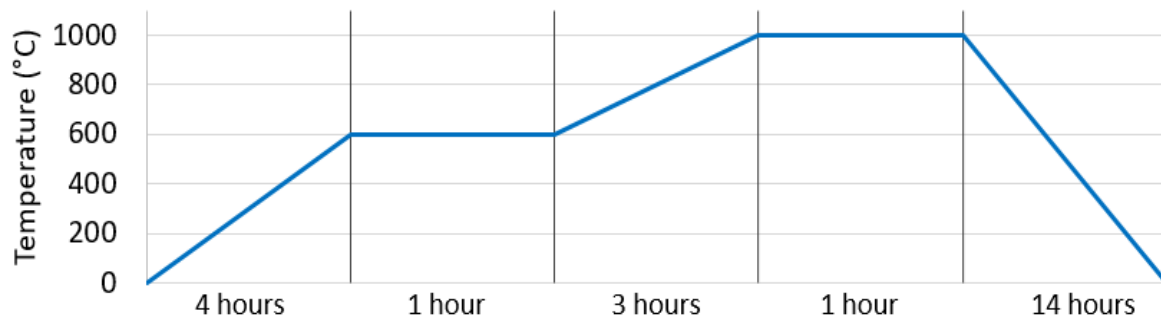


Figure 2. Firing curve

3. Subject a method of research

The main research question of the work is to monitor changes in the use of biochar in brick clay, in terms of to observe the changes in the finished ceramic body. To answer these questions, sample sets were made, see the previous chapter. The following tests were subsequently performed on these samples: Long tan changes, Determination of weight loss by burning, Water absorption, Apparent porosity, Bulk density and Determination of compressive strength.

4. Results

From the following graph (figure 3), where the values of the length changes are noted by tanning, it is obvious that there were only slight length differences, in order of washing. Nevertheless, the second graph (also figure 3), where the weight changes are recorded, is significantly different. Loss of weight is higher, the higher the proportion of the impurity. This means that the biochar is burned, and thus it is possible to assume the occurrence of a greater number of pores.

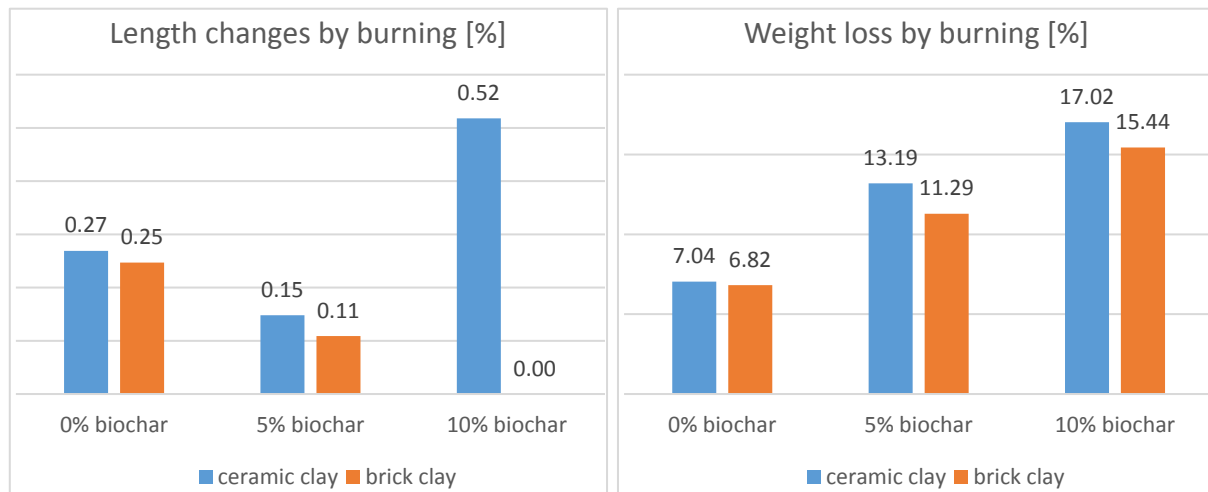


Figure 3. Graph of Length changes by burning and Weight loss by burning

The hypothesis of increasing pore size has also been verified by the apparent porosity test (Figure 4) given by the ČSN standard, [3] where it is clear that the more impurities are, the material is more comparable. Porosity increases with water absorption, as can be seen on the water absorption chart (Figure 4). The hypothesis has also been verified by the graph of the bulk density in Figure 5. There is a noticeable decrease in the bulk density as the percentage of admixture increases.

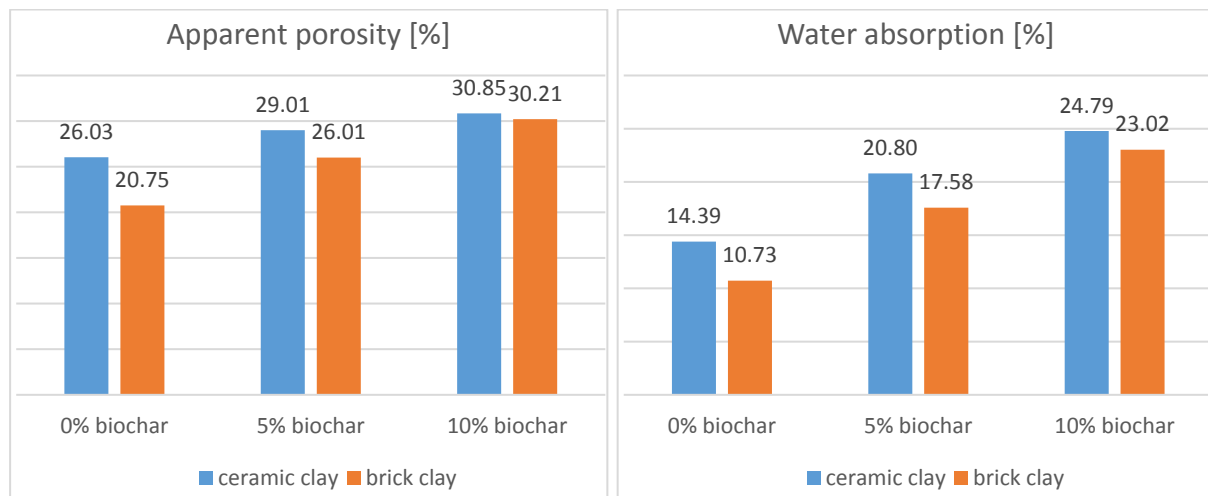


Figure 4. Graph of Apparent porosity and Water absorption

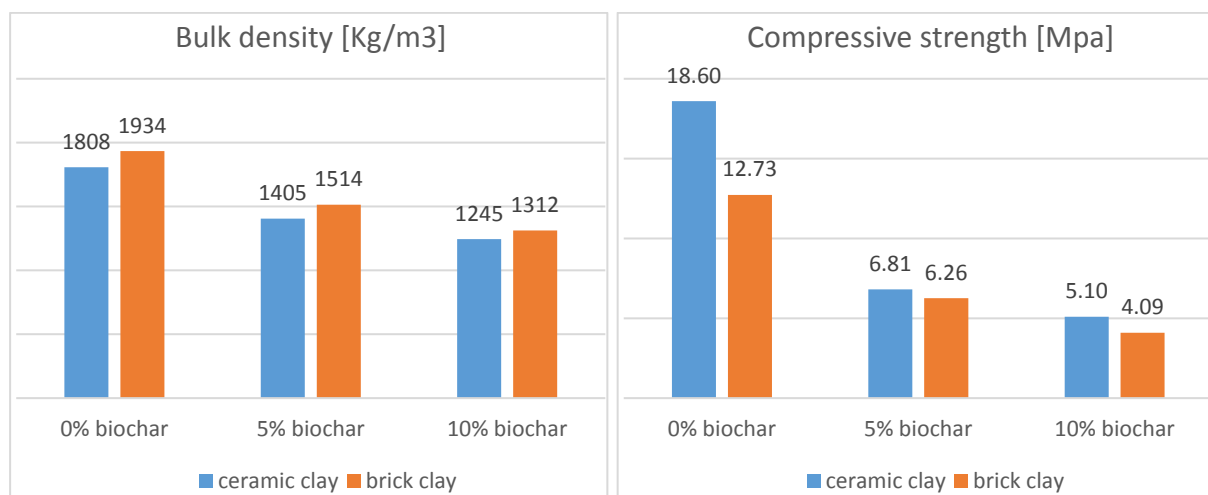


Figure 5. Graph of Bulk density and Compressive strength.

The compressive strength, (Figure 5) which is the most important property for brick products, unfortunately, at about 5 % of this admixture, the strength drops roughly by half and decreases by 10 %. However, a 5 % bio-brick shale has sufficient strength to be classified in the 6 Mpa class according to the European standard.

5. Conclusion

It has been confirmed in the article that the biochar improves many properties of a ceramic shard. Among the main features that improves biochar addition is porosity and bulk density. Both properties indicate improved thermal properties. However, not all features will be improved. Deterioration is evident in water absorption and compressive strength. Both of these exacerbations were expected. For use in masonry, it is possible to remove it with suitable use. Their 6 MPa strength is not much lower than conventional 8 MPa brick blocks, especially when we can afford smaller dimensions of the honeycombs in perforated blocks compared to commonly sold brick blocks due to the better thermal properties of the material itself. It is used here for interior masonry, where the emphasis on strength is not necessary, but on thermal properties yes. Which can be the internal walls between heated and unheated rooms.

There was no undesirable efflorescence on the surface of the samples during burning, and the length changes with tan decreased compared to the pure brick mix. This indicates a decrease in the tension in the ceramic body during burning and thus a lower risk of cracking.

We must not forget that biohazard is waste and its use in brick blocks is more environmentally friendly than landfill. Because biofuel is waste, the cost of its purchase and the cost of replacing 5 % of brick clay with biochar is eliminated, and so it will make production less expensive, especially for large manufacturers of building ceramics.

References

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