



Proceeding Paper

Possibilities of Using Agri-Food Waste as a Construction Material for Furniture Purposes [†]

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Abstract: Waste from the agri-food sector has great potential for use as a building material. The paper concerns a pilot study of the use of buckwheat husk for board production. Buckwheat husk, obtained as waste during buckwheat hulling, is a material with a low bulk density (about $180 \text{ kg}\cdot\text{m}^{-3}$); hence, its use through compaction to form a board is a valuable solution to increase the value of this material. The preliminary research conducted proved to be the basis for the implementation of a broader study. Additional motivation to develop the project of ecological boards is the fact that their product uses buckwheat hulls, which is a waste product from the agri-food industry. With the right technology, boards of this type could be an alternative to furniture boards.

Keywords: agri-food waste; furniture; fiberboards



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1. Introduction

Plant materials are commonly used for thermal and acoustic insulation of buildings. Still, there is an increasing demand for products with a low environmental impact, which are in line with the assumptions of the European Union Green Deal [1]. Despite the upward trend, the overwhelming majority of conventional synthetic materials are still used, without taking into account the possibility of using waste generated in agri-food production [2]. Liu et al. [3] showed great interest in energy-efficient construction, which does not constitute a greater burden for the environment. Asdrubali et al. [4] conducted a review of insulation panels made of natural or recycled materials. Abu-Jdayil et al. [5] reviewed thermal insulation materials made from renewable resources as well as remnants and composite materials, both having a low environmental impact.

Waste from the agri-food sector has a high potential for use as a construction material. This paper concerns a pilot study on the use of buckwheat hull for the production of boards. Buckwheat husk, obtained as waste during the shelling of buckwheat, is a material with low bulk density (approx. $180 \text{ kg}\cdot\text{m}^{-3}$); hence, its use by compacting it to form a board is a valuable solution to increase the value of this material.

2. Materials

The buckwheat husk (*Fagopyrum esculentum*) produced as a result of groats production was used for the tests. The husk was ground into two size fractions using a laboratory mill: 1–2 mm and less than 1 mm. Unground husk was also subjected to compaction. Each time, 10% wt of natural binder was added to the mixture.

3. Methods

The buckwheat husk and binder mixture were conditioned in a water vapor environment for about 30 minutes, and then, subjected to hot compaction using a 50 t press.

Compaction took place in a specially designed matrix that allowed us to obtain boards with dimensions of 20 cm × 10 cm.

The boards produced were tested for their breaking force using the Inspekt Table 50 kN testing machine via a 3-point bending test. The boards produced, depending on the size of the buckwheat hull fraction used, are shown in Figure 1.

4. Results

The boards produced, depending on the size of the buckwheat hull fraction used, are shown in Figure 1.



Figure 1. Buckwheat husk boards prepared from size fractions below 1 mm (left), 1–2 mm (middle), and raw (right).

It has been found that decreasing the compacted fraction size causes a decrease in the bending force of the boards (Table 1). The boards produced from raw buckwheat husks were found to have ca. 23% more strength than the ones produced from the fraction size below 1 mm: as visible in Figure 1, the particles of the raw husks overlapped each other and created “layers” during compaction, which most probably resulted in the strongest boards.

Moreover, there was a binder added to each compacted mixture, which might more appropriately mix in with the volume of raw buckwheat husks, resulting in stronger physical and chemical bonds.

For chipboard, according to EN 310 [6], the flexural strength should correspondingly equal to 11 N·mm⁻². The average strength of the boards produced was 0.72 N·mm⁻². This result is over 15 times weaker than the standardized materials of furniture structures, and therefore, more detailed and advanced methods for the production of boards from agri-food waste are required.

Table 1. Values of the bending force that caused destruction for boards made of buckwheat husks.

Fraction Size	P (N)	P Average (N) ± SD
	58.00	47.62 ± 13.03
	48.70	
	55.65	
	59.05	
	27.30	
	56.75	
	27.90	
1–2 mm	41.20	40.61 ± 3.31
	45.10	
	36.40	
	45.55	
	38.70	
	37.50	
<1 mm	46.95	36.73 ± 7.50
	45.15	
	32.20	
	28.00	
	30.30	
	43.60	
	30.95	

5. Conclusions

The conducted preliminary research turned out to provide the basis for the implementation of more extensive research. An additional motivation to develop the project of environmentally friendly boards is the fact that their production uses the husks of buckwheat, which is a waste from the agri-food industry. With the use of appropriate technology, boards of this type could be an alternative to furniture chipboards.

The technology used for buckwheat husk board production does not provide adequate strength. For chipboard, according to EN 310, it should correspondingly equal to 11 N·mm⁻². On the other hand, the average strength of the boards produced was 0.72 N·mm⁻². This result is over 15 times weaker than the standardized materials of furniture structures.

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