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## Organic Thermal Insulation Based on Wheat Straw

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### Abstract

This work is part of a larger project which aims to promote traditional, environmentally friendly materials, such as wheat straw, which mixed with organic or inorganic binders can lead to the formation of new materials for thermal insulation. These can be good temperature and moisture regulators, ensuring a pleasant environment and having a positive impact on human health.

This study intends to obtain a new insulation material using our own recipe which contains milled wheat straw, mixed with a traditional binder in order to finally form a mortar. Straw represents waste in agriculture, which in most cases is burned in the field, thus contributing to carbon dioxide emissions, an annually recurring phenomenon which has become a concern for authorities.

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### 1. Introduction

Traditional, environmentally friendly materials have been studied more and more in the past few years. The main goal was to find out new thermal insulation materials that would not only be better temperature and moisture controllers, but would also bring a positive impact on human health. This can be achieved by mixing the traditional materials with organic and inorganic binders.

Wheat straw is an example of such a material, and it is the subject of this paper.

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During their life cycle, thermal insulation materials can have a negative impact on the environment, particularly because of their chemical composition or of the expanded materials. This can have a negative impact on air, water quality and human health. Many of the substances used in insulating materials are carcinogenic and some can be harmful especially to those with breathing disorders [1].

Even if the main purpose of insulation is related to reducing energy consumption, one must not forget that the materials used have an impact on the environment throughout the life cycle of the building.

In assessing the impact that thermal insulation materials have on the environment, we must take into account several aspects: the resources needed for production and those entering the manufacturing process, the pollutants emanated during the life cycle, during the recycling process and their impact on air quality [2].

The raw materials used for thermal insulation are very diverse: from sand used in glass fibers to petrochemicals used in polystyrene insulation or recycled paper used in making cellulose insulation.

Acquiring or purchasing the raw materials necessary for making thermal insulation products is another aspect that must be taken into consideration since these resources may be unfortunately limited or polluting. A positive aspect would be using as many recyclable materials as possible.

The durability of building materials, including that of insulation materials is very important to consider if we assess the environmental impact. More sustainable materials are superior to the ecological ones which quickly lose their qualities and performances and which must be replaced after a shorter period of time.

Wanting to reduce pollution and costs, researchers' attention was directed towards non-conventional building materials with properties similar to those traditionally used in civil engineering. These materials would help reduce pollution and housing shortages, could provide low-cost housing and would thereby allow people to own houses easier [3].

This study intends to obtain a new insulation material using our own recipe which contains milled wheat straw, tied together with a traditional binder, and which should finally form a mortar with insulating qualities.

While cereal grains represent the main objective of the agricultural activity, there is great interest in developing uses for residues which are currently burned or returned into the soil.

The most common agricultural waste is wheat straw, which is burned most of the times in the field. Consequently, this contributes to emissions of carbon dioxide, an annually recurring phenomenon which has become a concern for authorities. In order to return it to the soil as fertilizer, straw needs to be chopped and scattered, which implies a mechanized process, energy consumption and carbon dioxide emissions. As a result, using straw in construction started being recommended [7].

Constructions of bales of straw is a new method of building using bales of straw (wheat, rice, barley, etc.), as well as filler or insulation structural elements. This method is very common in natural construction projects, in green construction [8].

While prices for building materials have increased in recent years, recycling of agricultural waste represents a continuing challenge for the fields of engineering. Attention is being directed to materials made from agricultural waste, with similar features to those traditionally made at a considerably smaller price of production.

## **2. Materials and Methods**

### *2.1. Materials*

The study aims to obtain new types of thermal insulation materials using milled wheat straw, tied together by various organic and inorganic binders.

Wishing to improve the thermal characteristics of the new material, the study focused on the influence of milled wheat straw as a thermal insulation material in the composition of new mortars made with traditional binders: cement, plaster and glue, and lime.

Cereals represent the group of plants with the largest area of distribution in all growing areas of the world, by default in Romania as well.

In Table 1 one can observe the chemical composition of wheat straw:

The ash present in wheat straw is composed of 10-13% potassium and 70-80% silicon.

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