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Green Plastering Mortars Based on Clay and Wheat Straw

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Abstract

This paper is part of a larger project which seeks to promote traditional, organic materials with similar features to classic building materials used in construction, but with a lower price and a positive impact on human health.

The aim of this study is to find a way to improve the mechanical characteristics of green plastering based on clay and wheat straw. Wheat straw is waste from agriculture, which most often are burnt in the fields, thus contributing to higher emissions of carbon dioxide. The study's objective is to achieve green mortars based on clay. To improve the mechanical characteristics, the influence of wheat straw as a reinforcing material was studied. It was studied how the geometric characteristics of wheat straw affect the properties of studied material.

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Keywords: ecology; straw; building materials; clay plaster.

1. Introduction

This paper is part of a larger project, which seeks to promote traditional and organic materials with similar characteristics to the conventional materials used in constructions, but with a lower price and a positive impact on human health. Environmentally friendly building materials have been used since ancient times, the first constructions being made from natural materials: stone, clay, straw, and sand. Along with industrialization, new materials started being used. These were produced on a large scale and contributed significantly to the increase of carbon dioxide emissions.

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The aim of this study is to find a way to improve the mechanical characteristics of clay-based plasters using wheat straw. Clay-based plasters are commonly used in ecological buildings, but lately, new demands have begun to emerge for classical buildings as well, especially for renovations. Since classical plasters contain substances that create allergies, people tend to choose organic clay-based plasters, which allow the walls to breathe and which represent, at the same time, a significant thermal mass.

Wheat straw is treated as waste in agriculture and it is most of the time burnt in the fields, thus contributing to higher emissions of carbon dioxide. This phenomenon is repeated annually and has become a concern for the authorities in charge. In order to use wheat straw as fertilizer, they should be chopped, which implies a mechanized process with high energy consumption and carbon dioxide emissions.[1]

Recycling wheat straw represents a continuous challenge for engineering, the focus being on materials made from wheat straw or on those containing wheat straw.

One of the great problems mankind is facing is carbon dioxide emissions. All governments encourage the construction of housing with a carbon footprint which tends towards zero. If one takes into account the materials classical buildings are made from and analyzes both the amount of carbon dioxide released into the atmosphere during their production process, and the carbon dioxide emissions during transportation, it can be noted that the total carbon dioxide emission is much greater than the amount of carbon dioxide materials can retain over their lifetime.[2]

Constructions with negative carbon footprint can be made using environmentally friendly, natural materials, such as wheat straw, wood, hemp. Since these raw materials grow directly from the ground and do not require a particular processing, like any other plant, they have the ability to retain carbon dioxide and to release oxygen, thus having a negative carbon dioxide footprint.

It is well known that after water and sand, cement is the most used material worldwide, making it the largest polluter in the world. This is why this paper aims to provide the characteristics of clay-based plasters and ways to improve the mechanical strengths by adding wheat straw.[3]

2. Materials and Methods

2.1. Materials

The suggested innovative material is represented by a composite material made of clay and wheat straw. In order to improve the mechanical characteristics, the influence of wheat straw as a reinforcing material needs to be studied. The focus was on the way in which the geometrical characteristics of wheat straw influence the properties of the analyzed material.

There were made six recipes of mortars, two recipes with simple clay and four recipes with clay and wheat straw. Two types of clays were used: commercialized clay and clay extracted from the region of Năsăud. Two types of wheat straw from the August 2013 crop were also used: straw with the length of (1 -2) cm and chopped straw with dimensions (from 0.1 to 0.2) cm.

Clay is a fine-grained sedimentary rock (<2 μm) consisting of a mixture of silica and of fragments of quartz, mica, etc. Clay minerals are formed by the long chemical action of carbonic acid and other natural solvents. Clay prevents the proliferation of microbes or of pathogenic bacteria. Knowing its antiseptic action, Egyptians used clay for mummification.

In order to study the characteristics of clay mortar, the used plaster was made from commercialized ProCrea clay and clay extracted from the ground.

Cereals represent the phytotechnical group of plants with the highest area of distribution in all growing areas of the globe, including Romania as well.

In Table 1 below we can see the chemical composition of the wheat straw:

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