THERMAL, SOUND AND RADIATION PROPERTIES OF INSULATION MATERIALS MADE WITH SAWDUST, WHEAT, SUNFLOWER, ASHES OF CORN STALKS AND EGG WHITE

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ABSTRACT

Rapid decrease in energy sources led to extensive research on alternative energy generation methods all over the world, including Turkey. In this context, insulation plays an important role in energy saving. Energy loss can be minimized with thermal insulation technology. Insulation materials produced with proper methods can be more durable, healthier and more economical. Because heat and sound insulation is crucial for the dwellings, demand for insulation products will grow largely. The aim of this research is to produce a material, which is resistant to radiation, with organic ashes, perlite, egg whites, egg whites, and plaster and epoxy as binders acquired by burning tons of sawdust, wheat stalks, sunflower stalks and corn stalks contained in wood warehouses of our country. In this sense, sawdust, organic ashes in varying proportions, perlite, egg, egg white and epoxy or plaster shell as binders were used producing insulation material. Obtained mix was placed into 4×16×16 cm molds. Ultrasonic sound velocity, thermal insulation coefficient and radiation absorption coefficients of the specimens were found. It was confirmed that specimens having more sawdust, egg shell and corn ash are better against radiation. Moreover, their Ultrasonic sound velocity and thermal insulation coefficient were obtained lower.

Keywords: Sawdust, corn ash, egg white and shell, heat, sound and radiation insulation.

INTRODUCTION

Today, the most important part of energy saving in buildings is heat energy saving. In buildings, heat insulation can only be achieved by a correctly applied heat insulation. Also, insulation procedures are implemented to protect the health of the building roofs [1,5].When selecting heat insulation materials, costs as well as applicability convenience are important factors. Along with increasing the first cost of a building, insulation contributes to individual and national economy regarding reduced operating costs. The important point is to determine the appropriate insulation material and optimum thickness [6-8]. In our country, sunflower, wheat and corn are produced in large quantities. In warehouses, tons of sawdust are stored as waste material every year. Sunflower stalks, corn stalks, wheat stalks and sawdust arising out of production pose an important problem both for farmers and wood factories. These lead to important problems both for farmers and environment during the insemination next year. With this study, sawdust, wheat stalks, sunflower stalks and corn stalks will be reutilized to produce an insulation material that fits the standards. This insulation material will be wholly local manufacture and produced with waste materials. Thus, people in the region will benefit from waste materials, jobs will be created with the help of mass production and national economy will develope. The most important constructional problems are properties of heat, sound and water insulation [9-11]. By using composite materials in buildings, useful areas increase, physical problems such as heat, sound and moisture insulation are solved and costs of maintenance, restoration and operating are reduced [12]. Energy sources in the world are running out. Around %40 of energy consumed in Turkey is consumed in dwellings [13]. %80 of this energy is used for heating. More than %65 of the energy consumed in Turkey is

imported. So, the materials that will be produced will contribute significantly to heat insulation of buildings. The blocks produced with sawdust and organic ashes is described as having outstanding heat insulation capacity. In this sense, the aim is to produce a proper insulation material with waste materials. For this project, waste materials such as sawdust, wheat stalks, sunflower stalks, perlite and corn stalks found all over the country will be used. With the research, an insulation material with much lower heat transfer coefficient has been produced.

MATERIAL AND METHOD

Material

Sawdust

It is a waste material formed during the planing and turning of woods and timbers obtained from warehouse in Kahramanmaraş. Sawdust is collected and used as admixture material for insulation (Figure 1).

Figure 1. Sawdust used as admixture material

Perlite

Perlite, especially having an important role for construction sector, is used as building material. It contains SiO around %74 and Al_2O_3 around %15. It has volcanic characteristics. Its lightness is its key feature. It is two times lighter than alternative materials used as building materials. Moreover, it is seven times more durable than alternative products. Despite the temperature difference between daytime and night, it ensures the required durability. It was supplied by the Kütahya office of Genper Genleştirilmiş Perlit San. Tic. Ltd. Şti. (Figure 2).

Figure 2. Expanded Perlite

Ash of Sunflower Stalk

Sunflower stalks, cultivated in the plains of Elbistan, Kahramanmaraş, were collected, ignited in suitable environment and temperature, then sifted with 0.6 mm sifter and used as admixture material.

Ash of Wheat Stalk

Wheat stalks, cultivated in the plains of Elbistan, Kahramanmaraş, were collected, ignited in suitable environment and temperature, then sifted with 0.6 mm sifter and used as admixture material.

Ash of Corn Stalk

Corn stalks, cultivated in the plains of Elbistan, Kahramanmaraş, were collected, ignited in suitable environment and temperature, then sifted with 0.6 mm sifter and used as admixture material (Figure 3 and 4).

Figure 3. Collecting corn stalks

Figure 4. Porcess of sifting organic ashes and acquired ashes

Plaster

Gypsum is a naturally occurring calcium sulphate mineral containing two moles of water. It is a building material produced by heating, blowing and grinding gypsum, which contains two molecules of crystal water, so that half molecule of water remains and binding characteristics will be acquired when mixed with water(Figure 5).

Figure 5. Binding material, plaster

Epoxy

It is a adhesive, chemical resin from thermosets group. Its water, acid and alkali resistance is very good, not losing its resistance features over time. This adhesive material was obtained from Kahramanmaras Maksiser Chemical Industry factory.

Egg White

The egg white that we bought from village and separated from egg yolk was used as composite material in (Figure 6).

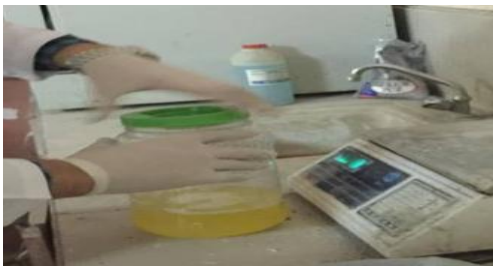

Figure 6. Weighing egg white

Egg shell

The mix was acquired by grinding egg shells from villages at different sizes (Figure 7).

Figure 7. Ground egg shells

Method

Preparation of Specimens

Mixture ratio are given in Table 1.

Table 1. Mixture Ratio(%)

No	Egg white	Ash of sunflower stalk	Ash of wheat stalk	Ash of corn stalk	Perlite	Sawdust	Egg shell	Plaster	Epoxy	Water
X1	27		14		17				21	21
X2	19	5	5	5		14			32	16
X3	40	7	7	7	8	7	7	7		10
X4	33		20		19			14		13
X5	35	5	5	5	15	5		14		14
X6	33			15		22		15		15
X7	31	6	6	6		14	10	13		14
X8	30	6	6	6	12		12	12		16
X9	33	6	6	6	9	9		14		17

Sawdust, organis ashes, perlite, egg white, egg shell and epoxy as binder was mixed up homogenously at different proportions and placed into 4×16×16 cm molds. Later,for two hours, it was placed with molds to stove for gaining epoxy resistence to 105°C. Then, it was taken from stove, rested for 24 hours and taken out of the molds. After the composition, mixes were placed to molds given in Figure 8.

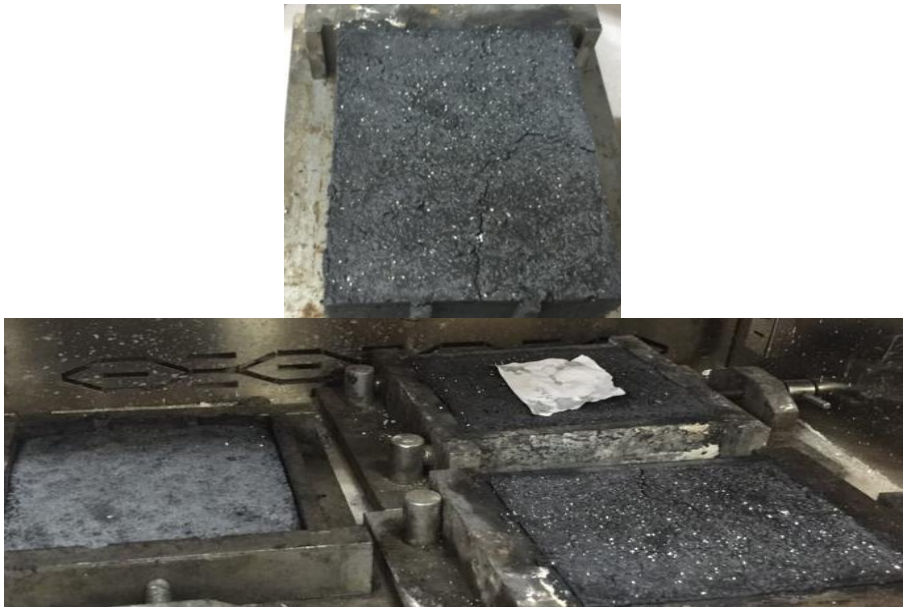

Figure 8. Acquired Specimens

Ultrasonic Pulse Velocity

Sound is a kind of energy that spreads in waves and is formed by vibrating objects. Ultrasonic *pulse velocity* values of X1, X5 and X6 specimens were measured. It was found out that material with perlite has a higher value than the material with sawdust.

Table 3. Ultrasonic Pulse Velocity (km/sc)

X1	0.53
X5	0.96
X6	0.40

Thermal Insulation coefficient

According to Turkish Standards TS 825 and German DIN norm 4108, materials with lower thermal insulation value of 0,1 kcal/mh°C are insulation materials, those higher than that value are building materials. Acquired thermal insulation coefficients are given in Table 4.

Table 4. Thermal Isulation coefficient (kcal/mh°C)

Specimen Code	Thermal Insulation
X1	0.1828
X2	0.2041
X3	0.1743
X4	0.1719
X6	0.1292
X7	0.1146

In Table 4, specimen X7 is seen to have the lowest thermal insulation coefficient. This result is explained with plaster and egg whiter in composite affecting space structure and composing heat bridges.

Radiation Permeability

Table 5. Radiation Absorption Rate(%)

No	Kev			
	6	17.7	26	60
X1	100	100	83,7	35,9
X2	100	91	87,9	43,5
X3	100	88,43	92,81	41,4
X4	100	100	92	47
X5	100	100	97,1	39,3
X6	100	100	99,45	47,9
X7	100	100	87,4	47,7
X8	100	100	100	47,6
X9	100	100	92.83	38,3

In Table 5, it is seen that all specimens can keep radiation at energy levels of 6 ve 17.7 kev. On the other hand, on the level of 26 kev, specimens X6 and X8 are seen to perform absorption close to %100. This result is explained with the positive contribution of egg white to absorption. As for the level of 60 kev, although similar results were attained, the best result again came from specimen X6.

RESULTS

1. With this preliminary research, it was found out out that the composite with sawdust is better at absorbing radiation. Also, it is seen that plaster used as binder is more convenient at keeping radiation than epoxy.
2. Composites with sawdust kept ultrasonic pulse velocity in them. They can be the choice for places requiring sound insulation.
3. Sizes of egg shells are also important. The thinner egg shells get, the more homogenous composition becomes. Also, Many insulation features of the composite improves.

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