PRODUCTION OF PERLITE BASED THERMAL INSULATING MATERIAL

Hanifi Binici, Firdevs Kalaycı
Kahramanmaras Sutcu Imam University, Department of Civil Engineering
Kahramanmaras 46100, **TURKEY**

ABSTRACT

In this study, the usability of perlite as a heat insulating material has been examined. The heat insulating coefficient of producted samples have been determined. Instead of calcite as coat filling material, heat insulating coefficient has been examined by using less-weighed pumice, diatomite and vermiculite. To increase the void ratio, different chemicals are tested. Mostly the reaction of aluminum and sodium hydrochloride are made use of. Air entraining admixtures are efficient in decreasing heat insulting coefficient. By following the heat insulating coefficient of produced samples, it has been aimed to dispense. The heat insulating coefficient of perlite-based material has been found between 0,189 - 0,0618.

Keywords: Perlite; Pumice; Diatomite;Vermiculite; Aluminum Powder; NaOH

INTRODUCTION

Increase of population, the constant advancement of technology bring up the consumption of energy sources. Today consumption of enery sources has reached serious dimensions and it has been started to take precautions. The large part of energy has been spent on houses and industry in Turkey.As 15% of energy consumption in buildings are for hot water supply, lightening, electrical home appliance, 85% of it are spent on cooling and heating [1]. Efficient use of energy sources are obvious.With the extensification of heat insulting system, approximately 7.5 billion dolar energy saving is possible [2]. Not efficiently used energy has caused energy waste, importation and enviromental pollution. Most important part of energy saving in today's buildings is heat energy saving. Heat insulation is possible through well-applied heat insulation and heat insulations are applied on roofs [3,4]. The most important structural problems are heat, water and acoustic[5]. The purpose of insulation is to decrease maintenance cost and to provide healthy, peaceful place to use easily [6]. Enviromental consciousness is not restricted to only energy saving. At the same time it takes part in the ecological structure. It is essential to use heat insulation materials for minimum energy input, source consumption and pollution [7]. Our country has 74% of perlite reserves in the world [8]. It is possible to achieve the highest heat insulation by using light betons which are produced by using light aggregates [9]. Betons which cotain perlite provide nearly ten time larger heat insulation when compared to general beton [10]. It is really crucial to use energy in the world as we see from the studies. The purpose in this project is to produce alternative heat insulation material with repository perlite rocks of Turkey.

MATERIAL

In this study perlite is used in the production of heat insulation material. As a coat filling material, pumice, diatomite and vermiculite have been used. Instead of lime, sugar factory wastes are used. To increase void ratio, the reaction of aluminum, sodium hydrochloride and air entrainer.

Perlite

Perlite is an acidic and volcanic glass. Perlite has a property of expanding with heat. It has 700 million tone reserves in the world. The total reserve in the world is 7.700 million tone and 5.700 tone (74%) of it is in Turkey. (8) Perlite used in this study has been supplied from Saftaş Madencilik in Kahramanmaraş.

Calcide

Calcide is an industrial mineral of which chemical dormula is CaCO3. Carbonate rocks which are also named limestone and lime are formed by the compression. Micronized calcide in this study is supplied from Saftaş Madencilik.

Pumice

Pumice is a volcanic, porous glass which is formed by the sudden cooling of the gases during the running lavas eruption. As it is porous, it is an ideal material for the insulation building's heat and sound. The use of pumice reduces heat abduction to 50%.(11) The pumice used in this study is supplied from Kayseri.

Diatomite

Diatomite is an organic sedimentary rock which is formed by the small gathering diatomite's siliceous shells. (12) The most important properties of diatomite is its high porousness and low specific weight. (15) the diatomite which is used in this study is supplied from Nevşehir region.

Vermiculite

Vermiculite is a mineral of aluminio silicat clay mineral which is formed by the natural wear of plexiglass. Some of the important vermiculite depodits are around the regions of Malatya-Darende-Kuluncak, Sivas-Yıldızeli- Demircik-Karakoç, Eskişehir-Sarıcakaya ve Elazığ-Harput-Arduçluk. (16)The vermiculite which is used in this study is supplied from Sivas region.

Cement

In this study white cement CEM I 42,5 is used. It is supplied from Adana Çimento Factory.

Lime

Lime is formed by the baking of limestone (CaCO3 - CaMg(CO2)2) through different degrees (850-1400 °C). When mixed with water, it show a property of hydraulic binder which is hydraulic-based.

Waste of Sugar Factory

Slam is a composite organic and inorganic substance which is formed by the carbonation with carbondioxide. It forms muddy grout. It has been strained through fitler.(17)

In this study, it has been aimed to determine the changes that the factory waste can do to soil mixture and if it can be used instead of building limes. Slam used in this study is supplied from Elbistan Sugar Factory.

Glass Fibre

In this study, chopped glass fibre is used. It is a material whose tracking force is high and it is noninflammable but liquify under high temperature.

Air Entrainer

The purpose of air entrainer is to provide heat and sound isolation by forming air voids i the other materials. In the study INCA BH air entrainer is used. The guantity of air entrainer is used between %1,5 - %3 values and its effect on the sample are examined.

Sodium Hydroxide ve Aluminium Powder

Sodium Hydroxide is a white and hygroscopic substance. Its formula is NaOH. It can dissolve in water easily and forms solution which feels soft and slippy soap. Its density is 2,13 g/cm^3 . Aluminium is soft, silvery and light material. Its Formula is Al. It is not contagious and magnetic. It is found as bauxite ore in nature. It has been known with its resistant towards oxidation. When they are put together, chemical reaction occurs.

$$2Al + 2NaOH + 6H_2O \rightarrow 2NaAl(OH)_4 + 3H_2 + \text{head.}$$

Water

The property of water affects the quality of beton as much as cement and agrea. (18) Fort his reason, in this study as mixture water drinking water supplies are used.

EXPERIMENTAL STUDIES
The Production of Heat Insulation

Heat insulation is produced as perlite-based. As a start, it is prepared as perlit-based. According to the prescription, samples are started to be produced. After leaving them in a mould for a day, they are dried in a drying stove at 60^0 C for 12 hours. After the drying process of the samples, the densities and heat transmission coefficient are examined. The prescriptions are revised and the new samples are started to be produced. The results are tried to be healed.

During the production of samples, cement is used as a binder. As a filling coat calcite was used at first. However, as the calcite is a weighted material, in the further samples vermiculite, pumice, diatomite and the other materials that are formed by those as they are lighter are used.

In this study it has been aimed to diminish the sample and by this mean to get positive feedback about insulation and to produce more porous material have been aimed. Samples that have been produced throughout this study are molded into the chambers as 15*15*2 cm but because of the chemical substances there has been an increase in the overrun of the samples and it couldn't be pegged.

Insulation Materials Produced with the use of Chemical Sodium Hydroxide and Aluminium Powder

When sodium hydroxide and aluminium powder are mixed, chemical reaction occurs. In this reaction;

$$2Al + 2NaOH + 6H_2O \rightarrow 2NaAl(OH)_4 + 3H_2 + head$$

The purpose of detaining the reaction in the prepared mortar is to detain the gases in the sample and by this mean to produce more porous material. Before the samples produced with the use of sodium hydroxide and aliminium powder as a chemical substance, dry mixture has been prepared and dry mixture has been tried to form as homogeneous and afterwards mortar is prepared with the mixture of water. It has been aimed to keep it short to fit into the chamber as with the mixture of ater the reaction starts. After the mixture of water, by the the heip of the mixer, it has been mixed for 2 minuted and poured into the chambers. After leaving them in a mould for a day, they are dried in a drying stove at 60^0 C for 12 hours and they get ready for the experimentations. The contents of insulation materials which are formed by sodium hydroxide and aliminium powder as a chemical substance can be seen on the chart 1.

Table 1. Chemical Additives as sodium hydroxide and aluminum powder produced by using Insulation Materials Content

sample no	**Sample Content (gr)**										**Chemical %**
	Thick perlite	Thin perlite	Calcite	Pumice	Diatomite	Vermiculite	Sugar waste	lime	Cement	Glass Fiber	
1	36	81	120	-	-	-	-	25	180	0,5	-
2	36	81	120	-	-	-	-	25	180	0,5	0,2
3	36	81	120	-	-	-	25	-	180	0,5	-
4	36	81	120				25	-	180	0,5	0,2
5	36	81	-	-	120	-	25	-	180	0,5	0,2
6	36	81	-	120	-	-	25	-	180	0,5	0,2
7	36	81	-	-	-	-	145	-	180	0,5	0,2
8	36	81	-	-	-	120	25	-	180	0,5	0,2

Insulation Materials Produced by using Air Entraining as a Chemical Substance

In the study INCA BH brand air entrainers have been used. The quantity of air entrainer has been used between göre %1,5 - %3 according to the quantity of cement and its effect on the sample has been examined. In the insulation materials produced by using air entraining as a chemical substance, dry mixture has been prepared first. The substances has been well mixed. Then, into the mixture water, air entrainer is added. Prepared mortar has been poured into the 15*15*2 cm^3 chambers. They have been taken from the chamber after a day. They are dried in a drying stove at 60^0 C for 12 hours and they get ready for the experimentations. The contents of insulation materials which are formed by sodium hydroxide and aliminium powder as a chemical substance can be seen on the chart 2.

Table 2. As air -entraining Admixtures Insulation Materials Produced Content

Sample No	Numune içeriği(gr)										Chemical %
	Thick Perlite	Thin Perlite	Calcite	Pumice	Diatomite	Vermiculite	Sugar Waste	Lİme	Cement	Glass Fiber	
9	-	158	79	-	-	-	-	25	180	0,5	1,5
10	-	158	79	-	--		25	-	180	0,5	1,5
11	-	158	-	79	-	-	-	25	180	0,5	1,5
12	-	158	-	79	-	-	25	-	180	0,5	1,5
13	-	158	-	-	79	-	-	25	180	0,5	1,5
14	-	158	-	-	79	-	25	-	180	0,5	1,5
15	-	158	-	-	-	79	-	25	180	0,5	1,5
16	-	158	-	-	-	79	25	-	180	0,5	1,5

Determination of Specific Bulk Density

At the end of the dried produced sample, the weight of the sample has been calculated and the has been calculated via g_1 outer dimension, bulk density through V as stated below.

$B = g_1 / v \ gr/cm^3$

Determination of Heat Transmission Coefficient

The heat transmission coefficient of the produced composite insulation material has been calculated by KEM brand QTM-500 thermal conductivity meter. The experiment of thermal conductivity has been done according to ASTM C 1113-90.

RESULTS AND DISCUSSION

Chemical additives have lower unit weights used.

Unit Weight In

Using chemical additives as sodium hydroxide and aluminum powder Bulk Density of produced Insulation Materials

Unit volume weight values are given in Figure 1 .

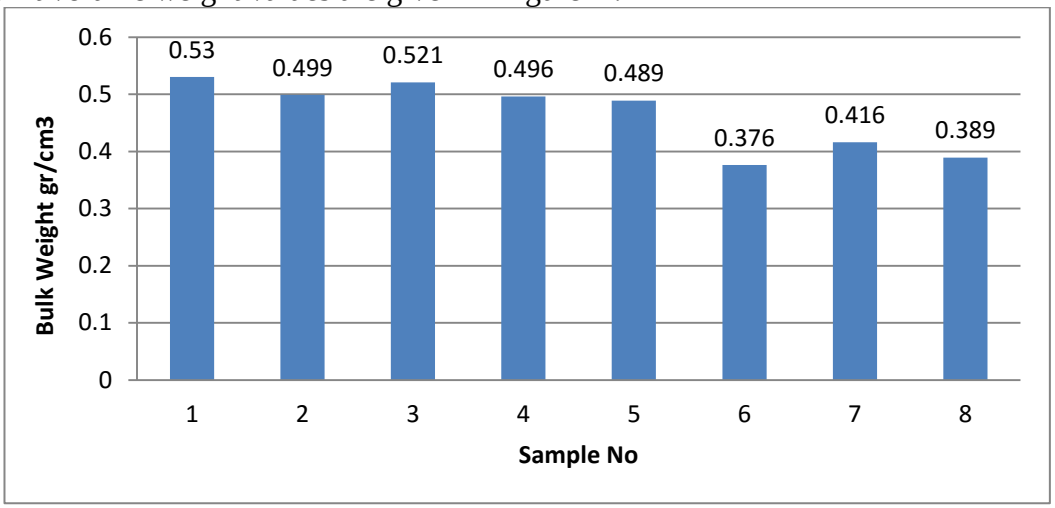

Figure 1. Using chemical additives as sodium hydroxide and aluminum powder Bulk Density of produced Insulation Materials

Bulk density of the air -entraining Admixtures Insulation Materials Produce
Unit volume weight values are given in Figure 2 .

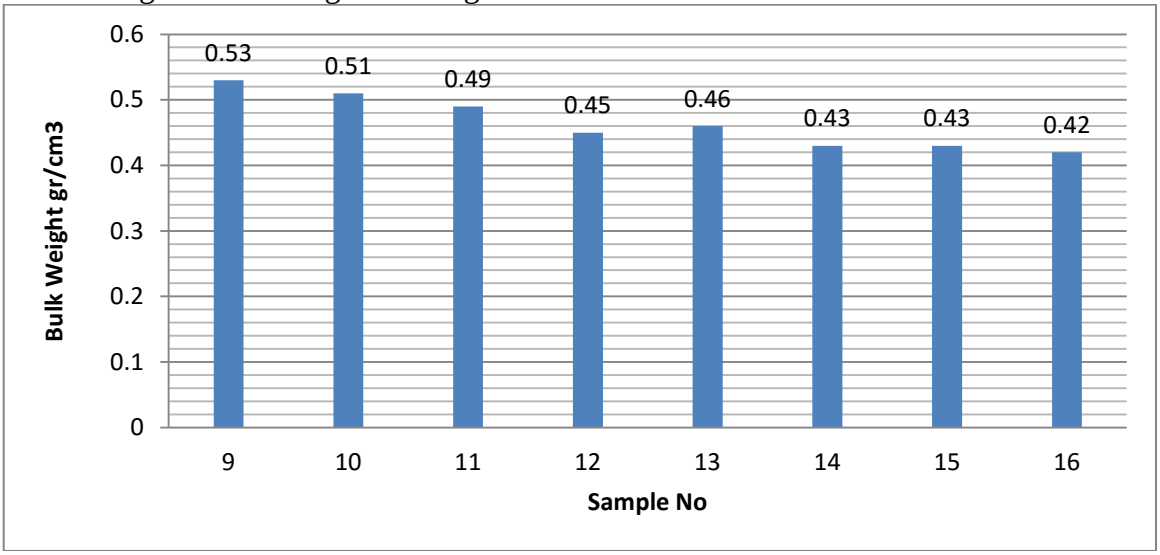

Figure 2. Using chemical additives as sodium hydroxide and aluminum powder Bulk Density of produced Insulation Materials

Heat Transmission Coefficient
Contribution as sodium hydroxide and aluminum powder manufactured using Thermal Conductivity of Insulation Materials

Thermal conductivity values are given in figure 3.

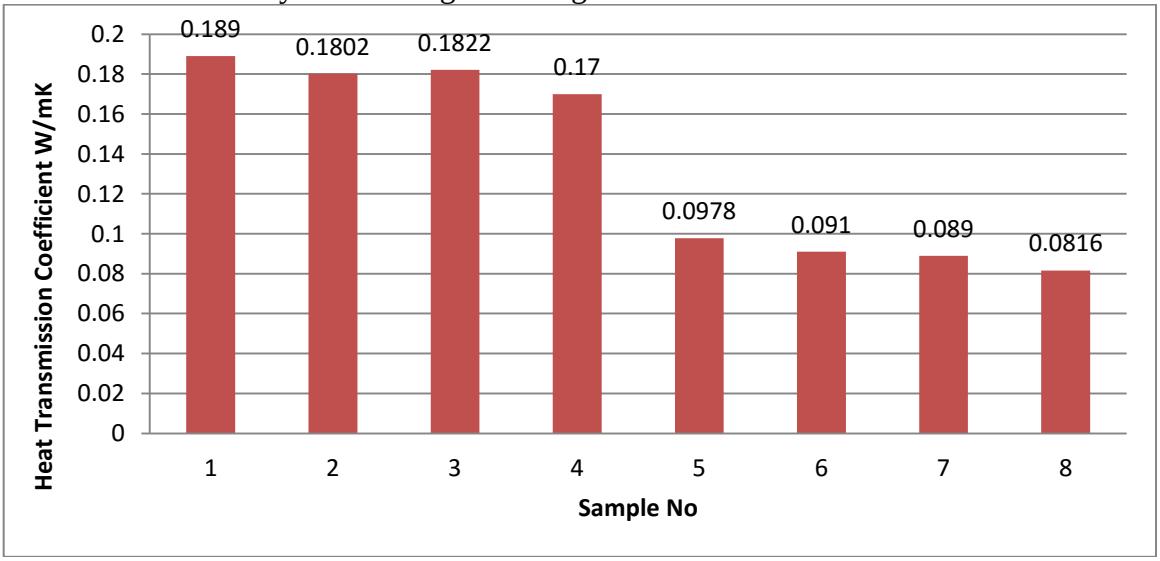

Figure 3. Chemical Additives as sodium hydroxide and aluminum powder anufactured using Thermal Conductivity of Insulation Materials

As air-entraining Admixtures Insulation Insulation Materials produced using the coefficients

Thermal conductivity values of figure 4 are given.

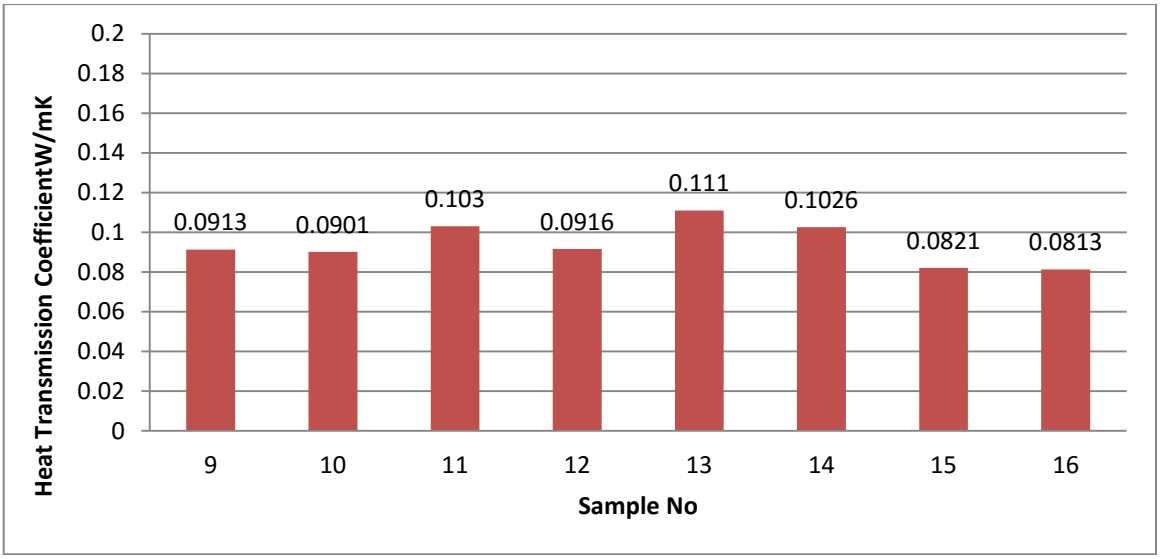

Figure 4. Chemical Additives as sodium hydroxide and aluminum powder manufactured using Thermal Conductivity of Insulation Materials

The samples produced in this study has been compared to sample A which has been produced without any admixture. To lessen the coefficient of the samples can be explained by the aim of producing more porous.

CONCLUSION

As the quantity of expanded perlite increases, specific bulk density decreases, the quantity of air in the beton increases and as a result of this, heat transmission coefficient decreases. To use lighter pumice, diatomite and vermiculite instead of calcite as filling coat has supported decreasing the weights of samples and providing heat transmission positively. Decreases in the heat transmission coefficient have been determined in the samples which use wastes of sugar factories rather than lime.

It has been provided to have more porpus samples by the use of sodium hydroxide and aluminium powder. Accordingly, the properties of insulation are made beter. At the end of the study, it has been seen that by using sodium hyroxide + aliminium powder and air entraining asmixture, perlite-based heat insulation material can be produced.

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