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EFFECT OF RECYCLED RUBBER TIRE LAYERS ON THERMAL INSULATION PROPERTIES OF CONCRETE BLOCKS

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ABSTRACT

Resent years have witnessed a massive change in the climate at the Middle East region where outside temperature could get up to 65 ˚C in some countries during summer. This change has led to excessive use of electricity in order to produce a comfortable indoor environment to live and work at. Since most of the buildings have been constructed in a way not considering thermal insulator construction materials where those materials usually have high initial cost and require skillful labor, this paper will present concrete blocks that are easy to handle, ecofriendly, and most important thermal resistant.

KEYWORDS: *Thermal insulation; Concrete blocks; Rubber tire layers.*

1. INTRODUCTION

Iraq is considered one of the countries where the dominant climate is hot, dry summers where the outside temperature could reach up to (65˚C) and very short winters. This kind of weather has forced increasing the consumption of electric power for cooling objectives to provide comfortable environment inside building keeping in mind that most of the houses and buildings were built using low thermal resisting materials such as hollow concrete blocks, solid concrete blocks, and clay bricks. It has been found that designing building with high thermal insulation properties would be more preferable economically and environmentally than using the current practice in the construction industry [1]. It is also known that the thermal conductivity of the rubber much less than the thermal connectivity of the concrete. So by using rubber tire layers in producing concrete blocks would decrease the thermal conductivity of the blocks and it is decrease as the number of layers in the block increase. Therefore, this study was aimed to produce concrete blocks with different rubber tire layers number and compare it with the current types of concrete blocks.

2. MATERIALS USED

2.1. Cement

Ordinary Portland cement manufactured in Iraq with trade mark of (lafarge) has been used throughout this research. It has been stored in airtight plastic containers to avoid exposure to atmospheric conditions table (1) show the physical properties of the cement and table (2) show its chemical composition.

Table (1) Physical properties of cement

Physical Properties	Test Results	Standards Specifications IQS 5/1984
Specific surface area, m^2/kg	490	>230
Initial setting time, hr:mm	1:25	>00:45
Final setting time, hr:mm	5:40	>15
Average compressive strength, MPa	32.1	>23

Table (2) Chemical properties of cement

Oxides Composition	Content %	Standards Specifications IQS 5/1984
CaO	59	-
SiO_2	18	-
Al_2O_3	6.3	-
Fe_2O_3	3.9	-
MgO	2.8	<5
SO_3	1.8	<2.8

2.2. Sand Normal river sand has been used as a fine aggregate with maximum particle size of 4.75mm. Table (3) shows the gradation of it.

Table (3) Gradation of fine aggregate

Sieve Size (mm)	Passing %	Standards Specifications IQS 45/1984
4.75	95	90-100
2.75	82.5	75-100
1.18	67	55-90
0.6	45.5	35-59
03	14	8-30
0.15	3	0-10
0.075	0.0	0-5

2.3. Gravel Gravel used throughout the work comprised of plane gravel with maximum size of 9.5mm with specific gravity of 2.6. Table (4) shows the gradation of it.

Table (4) Gradation of course aggregate

Sieve Size (mm)	Passing %	Standards Specifications IQS 45/1984
12.5	100	100
9.5	88	100-85
4.75	10	25-0
2.36	2.5	5-0

2.4. Rubber tire layers

The rubber layers used in this research as shown in the figure (1).

Figure (1) Rubber tire layers used in the research

2.5. Hollow concrete blocks

Hollow concrete blocks of size (40x20x20) cm were used for making walls.

3. PRODUCTION OF CONCRETE BLOCKS WITH THERMAL RESISTANCE

The production of thermal resisting concrete blocks included the concrete mix design for the blocks to obtain the required characteristics and material quantities. Table (5) shows the mixing proportions used to produce the thermal resisting blocks. The production phase also included molding, casting and curing of the concrete blocks. Figure (2) shows the casting stage

.

Table (5) Mixing proportions

w/c ratio	Mix Design cement	Fine Aggregate	Coarse Aggregate
0.5	1	3	6

Figure (2) Thermal resisting concrete blocks casting.

4. RESULTS AND DISCUSSION

4.1 Density

(40x20x15) cm blocks were used to determine the densities for three concrete specimens. The specimens kept in curing immediately after disjointed of molds for 28 days and then the specimen were weighted and the average densities were taken for each type of blocks. Table 6 shows the concrete blocks average densities.

Table (6) Concrete blocks densities

Concrete block type	Density (kg/m^3)
plain	2362
1 layer	2239
2 layer	2107
Hollow	1545

It can be seen that using rubber layers in concrete block will reduce the density. This is caused due to the fact that the density of the rubber is about half the density of the concrete. Therefore, using rubber in concrete block will decrease the total weight of it by 5.2 % for one layer and by 10.79% when using to layers.

4.2 Compressive Strength

The block tested by using compressive strength machine with capacity of (10,000 kN), the compressive strength test has been tested at loading rate of (3 MPa/s), the average of three blocks were recorded at 28 days as shown in figure (3).

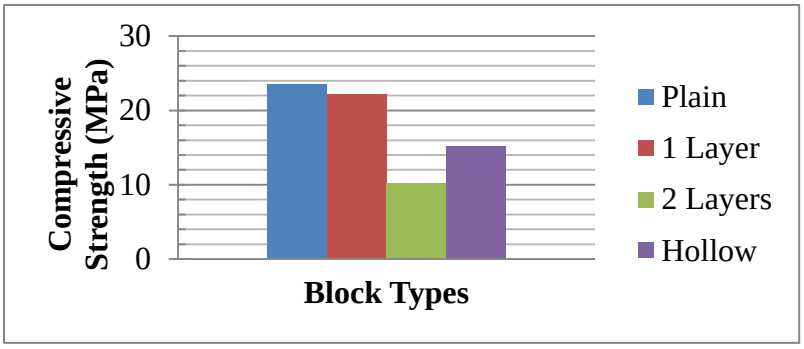

Figure (3) Effect of tire rubber plates content on compressive strength at 28-days.

It can be noticed in general that the compressive strength of concrete blocks decreases as the number of rubber layers increases which considered as a normal result. There was a decrease of .approximately 4.34%, and 60.87% in the compressive strength of blocks concrete containing one layer and two layers respectively.

4.3 Thermal insulation test

The thermal conductivity (k) is defined as quantity of heat transmitted through a unit thickness in a direction normal to a surface of unit area due to a unit temperature gradient under steady state conditions (6). Table 7 shows the thermal insulation test results. In this test, results showed that thermal insulation increases with the increasing of number of rubber layers increases. The *K* value has been dropped significantly by 43.63 % for one layer and by 77.27 % for two layers comparing with the plain solid concrete blocks.

Table (7) Thermal insulation properties of concrete blocks

Concrete block type	*K* (W/m˚C)
Plain	1.1
1 layer	0.62
2 layer	0.25
Hollow	1.6

5. CONCLUSIONS

This contribution focuses on the effects of rubber plates on the mechanical and physical properties of concrete blocks. On the basis of an experimental investigation, the following conclusions can be drawn when using rubber plates:

1) Helping the environment by reducing the rubber wastes.

2) Noticeable reducing of weight which could get up to 10.79% when using two rubber layers.

3) Insignificant decrease in compressive strength so the concrete still suitable for structural purposes.

4) The main purpose for this paper is to improve thermal insulation of the concrete blocks and with our results it is obvious that there is a huge achievement especially when we added 2 rubber layers where the thermal insulation value decreases by 77.27%.

To optimize the results, we recommend 1-layered concrete block for structural uses.

REFERENCES

1. *K.S. Al-Jabri, A.W. Hago, A.S. Al-Nuaimi, A.H. Al-Saidy. (2005), "Concrete blocks for thermal insulation in hot climate," Cement and Concrete Research 35, Elsevier, p.p:1472-1479.*
2. *Arin Yilmaz a, Nurhayat Degirmenci b. (2009), "Possibility of using waste tire rubber and fly ash with Portland cement as construction materials," Waste management 29(5), Elsevier, p.p:1541-1546.*
3. *Cao, W. (2007), "Study on properties of recycled tire rubber modified asphalt mixtures using dry process," Construction and Building Materials 21, Elsevier, p.p:1011–1015.*
4. *Siddique, R., Naik, T.R.(2004),"Properties of concrete containing scrap-tire rubber – an overview," Waste management 24,p.p: 563–569.*
5. *Sukontasukkul, P., Chaikaew, C. (2006), "Properties of concrete pedestrian block mixed with crumb rubber," Construction and Building Materials 20 (7), Elsevier, p.p:450–457.*
6. *Segre, N., Joekes, I. (2000), "Use of tire rubber particles as addition to cement paste," Cement and Concrete Research 30 (9), Elsevier, p.p: 1421–1425.*