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The Improving of the solid block concrete thermal behavior by using the powder particles of Eucalyptus camaldulensis bark

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Abstract. Eucalyptus has been widely planted in the world. In the last century, the genus eucalypts became an important multipurpose source in many industrial applications after removal the bark as a wood working waste. Concrete block are much known used in building. The objective of this paper to improve the constructional thermal behavior of solid block concrete which used instead of bricks in building construction by adding the powder particles (*average diameter is 1-5 µm*) of eucalyptus Camaldulensis bark (*Plates type*) during concrete formation, to obtain a block concrete with low weight, enhanced thermal and mechanical properties reached to decrease electric energy need to operate air-conditioner systems. Researchers found that the perfect added is (*7.5 g*) for construction testing while the perfect quantity is (*5 g*) for thermal testing with decrease the mass density.

1. Introduction

Concrete blocks made by mixing sand and gravel with cement as a binder substance (*contain inorganic materials like alumina, silica, lime, iron oxide, and magnesium oxide*). It is widely used in Iraq and other countries in construction.

Iraq locates in north sub-tropical zone within the moderate northern region, similar to that of semi-desert climate, the number of the clear days is 240 days/year, the annual average of sun brightness within limits 9 hours/day, while the brightness average during summer season arrives at 15 hours/day, the environment air temperature arrives (*in shadow*) to 50 ^{o}C (*centigrade degree*), the average of radiation 900 w/m^2 (*watt/ square meter*) in summer, and 340 w/m^2 in winter [1], so that the building exposed to thermal effects for long periods, the constructional blocks used in the building walls make to decrement and lag the time of heat waves quantity, therefore, the environment cause in change degree of building space heat and rises it about requested standard level that need to preservation on it (*26.5 ^{o}C*) [2], which means the direct consumption of the electrical energy from the employment air conditioner unities in the building will be connected in dominant to the transmitted heat quantity from the environment across walls of the building, so the heat quantity of the environment that effect on the building through the walls will be between 50-80% (*depending on building height and constructive size*) from the total environmental impact on the building [3], therefore, the consumed electric power for air conditioning purposes will be in limiting 60%, from the total consumed energy of Baghdad city in summer-2015[4]. So, it requires applications for reduced energy consumption for conditioning purposes without taking from the thermal comfort level inside of the building, because the currently executed walls and since several contracts depends on the brick in most areas of Iraq, the ratio of the construction in the brick arrived at 83% in Iraq generality and 98% in Baghdad [1], the value of heat transfer coefficient for the wall within limits 1.514 W/m^2.K (*watt/ square meter kelvin*), on consideration presence of finishing external layer of cement and covered the finishing interior layer by gypsum plaster, and the wall weight within limits 288 kg/m^2 (*kilogram/square meter*) [5]. The product of the bricks is accompanied with contraction of the agricultural lands [6], therefore, requires as for producing constructional blocks in high level of technological technics and likewise requires investment of a big money, like thermoston and light concrete (*ASO and Al-Yassin Companies*) [5, 7, 8], while the second direction is the focus on the present of local materials [5], with reduction quantity of each of the density and the thermal conductivity like solid concrete and hollow concrete, therefore, several researches achieved depends on the limestone [9], or solid concrete[10], to construct twofold bark walls/un bearing, development the constructive woods by establishment of un bearing walls/un traditionalism [11], and improvement of the physical properties for the including cement in industry of the concrete blocks by use a limestone powder [12], Zeolitic rock a lone [13], glass fibers [14] to produce a light constructional blocks, using a rich residue agricultural in silicate material [15], producing of twofold bark boards from the residues of wooden industry [16, 17], using bamboo sticks after mixing it with cement material [18], specification of the better ratio to mix the cement with wood rests for reinforcement of the resulting boards [10, 19, 20, 21], and used juniper bark as aggregate substitute in concrete (*at ratio 25, 50, 75, 100 % by volume*) [22].

Eucalyptus is a fast growing, medium-sized to tall tree attaining 20-50 m (*meter*) in height and up to 2 m in diameter and strongly occupied a wide range of the world. The species grows under a wide range of climatic/soil conditions from warm to hot, sub humid to humid and for different types from soil. In the last century, the genus eucalypts became an important multipurpose source and used in many industrial applications after removal the bark as a wood working waste.

This study used the bark (*Plates type*) powder of eucalyptus camaldulensis trees to benefit from it (*after removal the bark as a wood working waste*) by mixing with the concrete in preparing block stages for studying the thermal, mechanical properties and the constructive behavior for specification of effective range for constructive use.

2. Materials and Methods

For the purpose of complete search goal in possibility to improvement of the thermal and constructive performance for the concrete blocks which uses for construction of the walls, number of cubic constructional blocks was complete with dimensions (*150×150×150 mm* (*millimeter*)) for compression strength examinations accreditation to (*British Specifications 1881 part 5 1983*) and (*100×100×500 mm*) for modules of rupture by used (*E.L.E International/ 2007–U.K/ADR 2000-Standard Machine*) device and choice the mixing ratio of (*1:2:4 by volume*), with fixation of water ratio used in mixing (*0.5*), and accreditation of the (*British Specifications 1992/882 BS*) [23]. At formation mix, it is used a Portland cement accreditation to (*Iraqi Specifications m.q.a.5 1984*), Karbala area sand (*graduated limits showed in Table 1*) as smooth aggregation and Salah Alden area stones (*graduated limits showed in Table 2*) as rough aggregation, after materials washing and drying relate to the advance gradual examinations to be sure identical mixing for the British specifications.

The industrialized samples for the thermal examinations purposes was in dimensions (*200×100×200 mm*), and *Table 3* clarified the examinations results. It is used a powder of eucalyptus camaldulensis trees bark (*Plates type*), that it's widespread agriculture in a lot of areas of Iraq and grinding of this bark to granules in size of (*1-5 μm* (*micrometer*)), (*the measuring done on microscopic micrometer device/laboratory of the physics/the college of science/University of Baghdad*). Eucalyptus bark powder used as a gravimetric ratio from the include water in the concrete blocks formation in a ratio 2, 4 , 6, 8 and 10%, with continuation mixing at ratio addition by used an electrical stirrer for good guarantee distribution of the contents within concrete mix, and after that pouring of the concrete in a cubic molds that prepared for this purpose, and the block left to dry, storing of the cubic molds in very damp atmosphere, lifting the cubes of the molds after complete hardening of the mass and leaves it in the damp atmosphere for 24 hours, moved it to a standard atmosphere (*40 ^oC- 40% relative of humidity*) and leaved in it for 7 days, after that the samples reservation in a good ventilation store at temperature (*24 ^oC*), and cool it at a room temperature to complete a compression strength examination.

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Table 1. The graduated limits of the smooth aggregation in the construction mixture at the search

Sieve diameter mm	*Percentage accumulation on the sieve %*	*Percentage passing sieve*	
		Search measurements	*specification BS:882/1992*
10	0	100	100
5	5	95	(89-100)
2.36	12.85	82.15	(60-100)
1.18	15.85	66.3	(30-100)
0.6	21.73	44.55	(15-100)
0.3	29.95	14.6	(5-70)
0.15	11.05	3.55	(0-15)

Table 2. The graduated limits of the rough aggregation in the construction mixture at the search

Sieve diameter mm	*Percentage accumulation on the sieve %*	*Percentage passing sieve*	
		Search measurements	*specification BS:882/1992*
37	0	100	100
20	0	100	100
9.5	22	(70-78)	(50-85)
4.75	66	(6-10)	(0-10)

Table 3. The results of construction examinations of the samples

Study samples		*Slump mm*	*Mass density Kg/m^3*	*Compression strength N/mm^2*	*Absorbability %*	*Tensile strength N/mm^2*	*Modules of rupture N/mm^2*
The reference mixture		13	2350	24.2	1.2	2.18	3.75
The changeable ratio of construction	2%	13	2175	24.1	1.2	2.15	3.71
	4%	13	2157	23.9	1.2	2.14	3.70
	6%	13	2134	23.7	1.2	2.14	3.68
	8%	14	2111	21.5	1.2	2.13	3.18
	10%	14	2088	21.2	1.2	2.10	3.14

The experimental room is constructed with dimensions (*1×1×2 m, as shown in Figure 1*) locates on the third floor of residential building in Baghdad city (*latitude 33.2^o north*), and exposed to the surrounding environment, all room walls and ceiling are insulated by polystyrene sheets (*200 mm thickness*) except the testing wall (*1×2 m*) which oriented to the east, testing wall is movable part for adding modifications purpose, and build by the prepared concrete blocks with covering by gypsum plaster (*test wall, clarified detail in the Figure 2*).

It is used a rubber waddings around contact area between test wall and room to make the air calm inside of the room. It is used 1 T.R. (*Ton refrigeration*) window air conditioner to keep save the room temperature at 26.5 ^{o}C. The external finishing surrounding area for the test room is grey concrete tiles (*800×800×40 mm*).

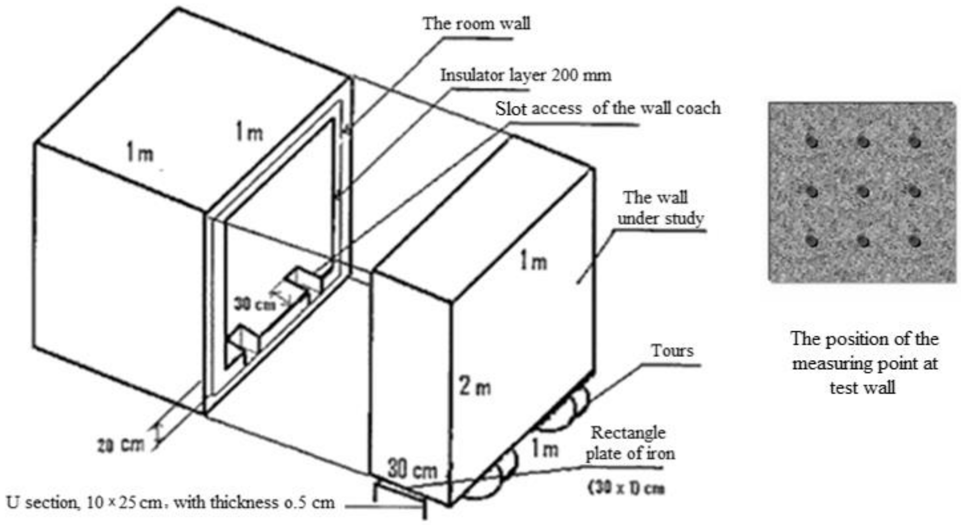

Figure 1. Schematic illustration the details of room test

The quantity of consumed electric power is measured by electric power device in kWh. The natural convection coefficient of heat transfer (h) for the inter surface of the test room to room is calculated from relationship-1 [24].

$$(1) h = 1.31(\Delta t)^{1/3}$$

Where Δt is the difference in temperatures between the external testing wall of the room, and the standard temperature of the air (*that design inside of the room*), therefore, the transmitted heat quantity (Q) (which the environment perceived on the room space) calculated from relationship-2.

$$(2) Q_{con} = h.A.\Delta t$$

The temperature of the test wall surfaces is measured by (*Intelligent auto digital thermometer*) device in kWh unit. The study of specify error (*uncertainly analysis*) is depended on the Holmen equation [25], so it's found that error ratio does not exceed of 3.2% from the max value for the heat transmitted quantity across the wall.

3. Results and Discussion

To reduction of the dependency on the brick as constructive material and substituted it by use of the solid concrete blocks, essential attempt applied to improve the thermal and constructive behavior for it, with suitable in suits and ferocity of the climate in Iraq, a bark powder of eucalyptus trees was used as addition material to the mixture. *Table 3* clarify the results of the constructive examinations for the prepared mixing blocks (*the blocks contain a powder addition*) to the reference mixture, which calculated for each square meter from the wall during the whole summer season, the transmitted thermal behavior for all concrete blocks under study clarifying in the *Figures 3, 4, 5*, while *Figures 6, 7, 8, 9, 10* clarify the comparison results and below the discussion of changeable search.

3.1. Powder quantity of the added bark.

Because of the small prepared measuring samples (*200×100×200 mm*), it's used a powder of eucalyptus trees bark at 25 g in 100 g of water, and taking 2% from this mixture (*2.5 g of first mixing*) and increase in all stages at 2%, so the added mass to the water was 2.5, 5, 7.5 , 10 and 12.5 g, with reduction of the prepared water to mix in the same of the addition weight to remain the ratio of water fixed without changes, it is used continuation mixing for good guarantee distribution of these particles inside the concrete blocks and to eliminate the aerial bubble if it found.

3.2. Thermal Period test of the samples.

The transmitted thermal behavior is measured during 21 hours/day from every month, months of the summer in 2016 is the May, June, July, August and September, the thermal behavior is clarified in the

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Figures 3, 4 and 5 for July month only. Constructional walls which are used to study the thermal behavior are clarified in *Figure 2*.

(1) A Wall established from 100 mm of concrete blocks with two rows to complete the whole wall thickness at 200 mm (*Wall-1*). (2) A wall is formed from 100 mm of concrete blocks with an aerial gap at thickness 50 mm, and concrete blocks of thickness 100 mm and covered the finishing interior layer by gypsum at thickness 25 mm (*Wall-2*). (3) A wall is formed from 100 mm concrete blocks with a thermal insulator at thickness 50 mm (*micro fiberglass*) with concrete blocks thickness at 100 mm and covered the finishing interior layer by gypsum at thickness 25 mm (*Wall-3*), with a change of the concrete blocks in all mentioned forms above depending five times on the addition ratio.

(2) The temperature of the test wall surfaces is measured for wall 1-3 in two positions:

A. The wall surface temperature direct to environment (*To*).
B. The wall surface temperature direct to environment (*Ti*).

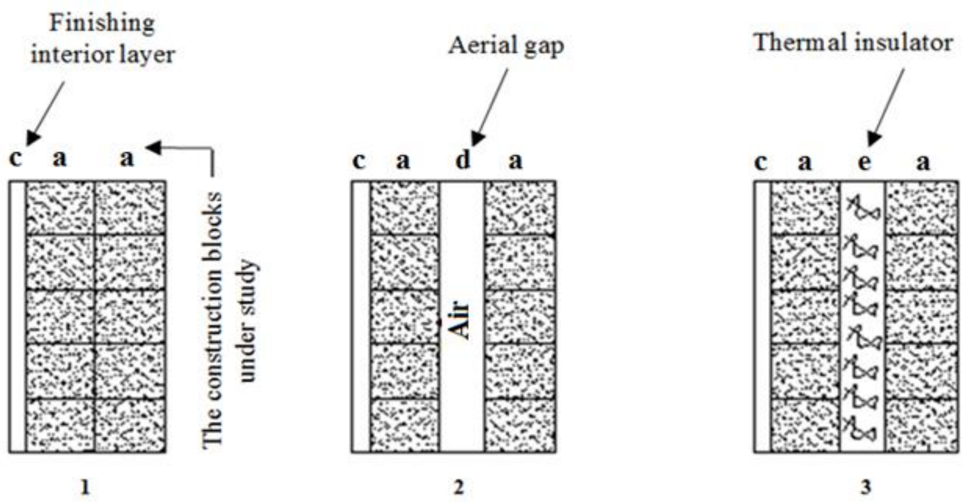
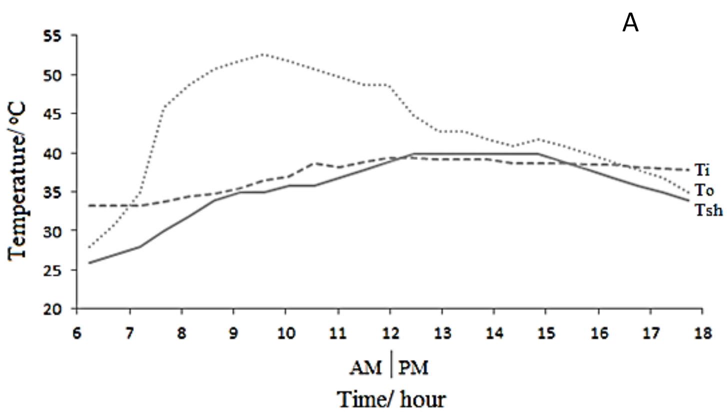
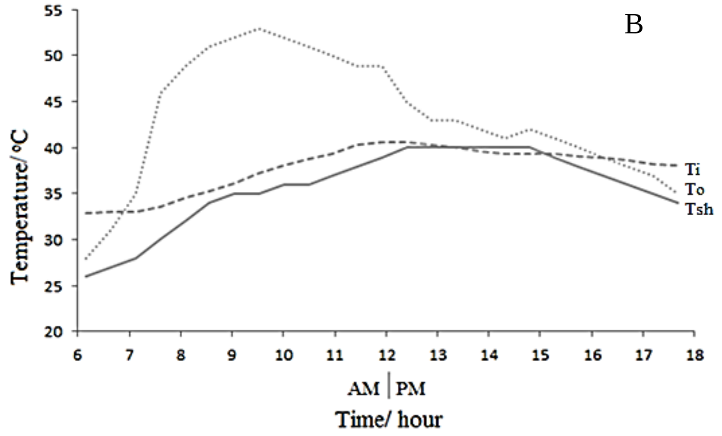


Figure 2. Schematic illustration the details of test walls represented the samples of the construction blocks arrangements under study: 1-directly, 2- at aerial gap, 3- at thermal insulator.





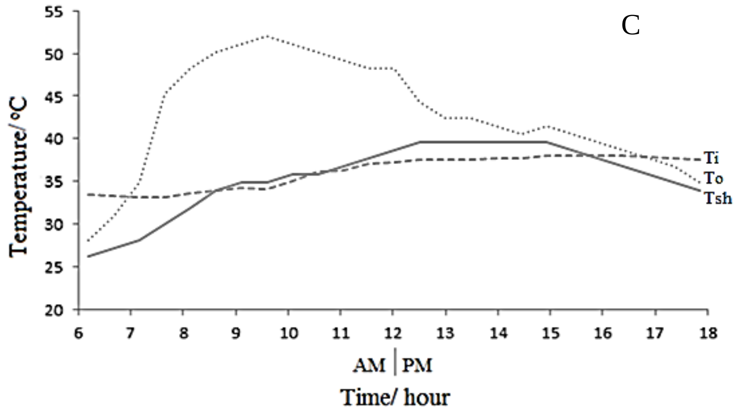
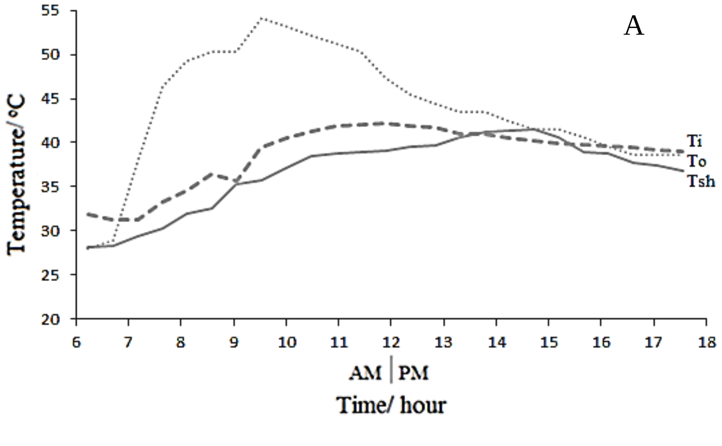
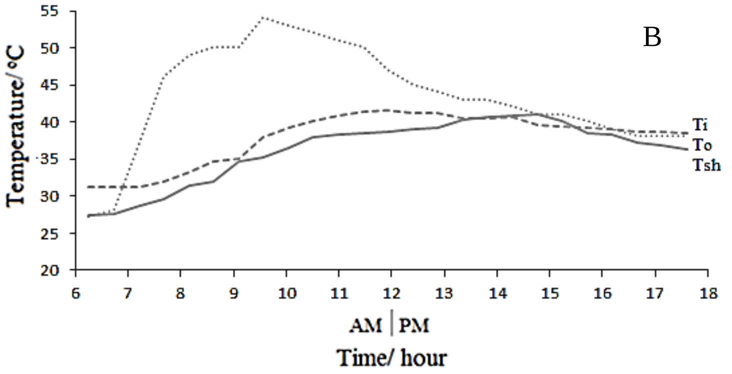


Figure 3. The thermal behavior for the concrete blocks under study on the wall directly (wall-1) at addition ratio 2% (A), 4% (B) and 6% (C) consecutively, throw one day in summer-2016.
Air enviroment temperature (Tsh).
The wall surface temperature direct to enviroment (To).
The wall surface temperature direct to enviroment (Ti).





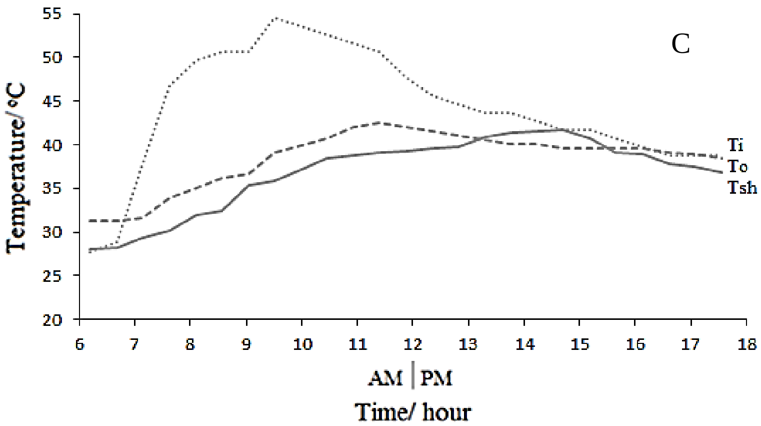
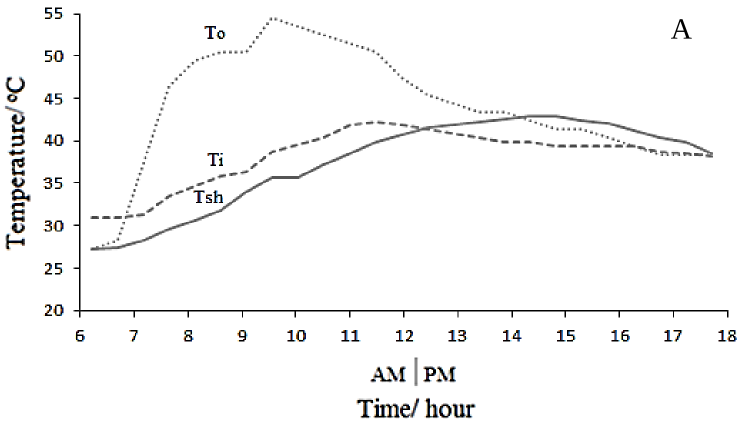


Figure 4. The heat behavior for the concrete blocks under study at aerialgap (wall-2) with addition ratio 2% (A), 4% (B) and 6% (C) consecutively, throw one day in summer-2016.
Air enviroment temperature (Tsh).
The wall surface temperature direct to enviroment (To).
The wall surface temperature direct to enviroment (Ti).



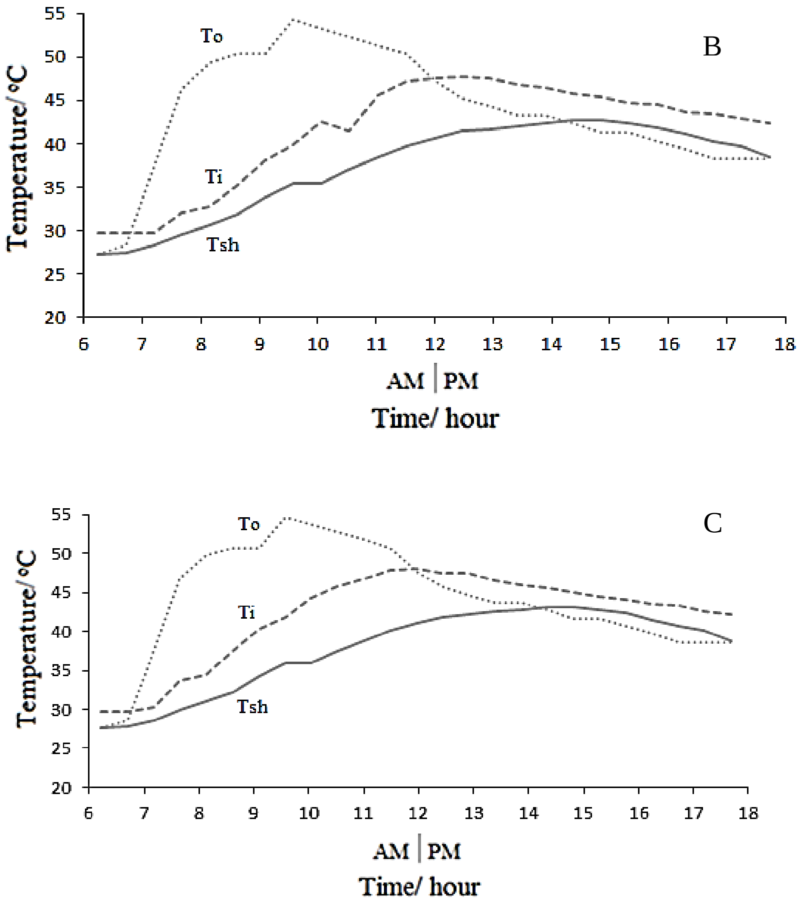


Figure 5. The heat behavior for the concrete blocks under study with back thermal insulator (wall-3), at addition ratio, 2% (A), 4% (B) and 6% (C) consecutively, throw one day in summer-2016.
Air enviroment temperature (Tsh).
The wall surface temperature direct to enviroment (To).
The wall surface temperature direct to enviroment (Ti).

3.3. Density of the concrete examples

One of the priority from our search is decreased the density for the concrete blocks by reduction the wall calm weight during the area unit and the results clarified in the *Table 3* refer that density of the solid concrete (*the reference mixture*) 2350 kg/m^3 (*kilo gram/cubic meter*), the complete weight for the wall will be 500 kg/m^2, while the density quantity of concrete blocks decrease at addition of powder and water mixture (*at 2% equal to 2.5 g*) to it, and became 2175 kg/m^3, (*the percentage of reduction mass density is 7.5%*). The complete weight for the wall will be 465 kg/m^2, and at presence 4% of added materials (equal to 5 g from the powder) the density will be 2157 kg/m^3 (*the percentage of mass density reduction is 8.2%*), the whole weight of the wall 461 kg/m^2, 2134 kg/m^2, and the total weight for the wall 456 kg/m^2, when a powder quantity added is 6%, equal to 7.5 g (*9.2 %*), the density arrives at 2088 kg/m^3, and the complete weight for the wall 447 kg/m^2, when a powder quantity added is 10%, equal to 12.5 g (*the percentage of reduction mass density is 11.15%*), so it clear that addition of the bark powder to mixture will decreased the wall weight in limits (*7-10.6 %*) for each square meter depending on the addition ratio, the reason accustoms that the material is wood (*the mass density 980 kg/m^2*), added to that it saturated by water-molecules and at drying water molecules moved to the adjacent cement molecules, so the wood particles will be decreased in size and formed in more dominant gaps worked on reduction weight of the block.

3.4. The physical properties for the concrete blocks

3.4.1. Compression strength

It is noticed from *Table 3* that compression strength values decreased relative at reference mixing to become 24.1, 23.9, 23.8 N/mm^2, decreasing ratio 24.10, 1.30, 1.90 % relative to reference mixing, at addition 2, 4, 6 % of bark powder respectively, but at addition 8% of powder the compression strength became 21.5 N/mm^2, decreasing ratio 11.20% relative to reference mixing, following by an addition 10% of powder the compression strength became 24.1 N/mm^2, decreasing ratio 24.10% relative to reference mixing, this mean that collapse of compression strength happened at addition 8 and 10%. The reason due to the gaps formed that result from moved of water molecules to the adjacent cement molecules.

3.4.2. Tensile strength

The concrete blocks recorded a tensile strength at 2.15, 2.14, 2.14 N/mm^2, decreasing ratio 1.40, 1.84, 1.84% relative to reference mixing, at addition 2, 4, 6% of bark powder respectively, but at addition 8 and 10% of powder the tensile strength became 2.13 and 1.10 N/mm^2, decreasing ratio 2.30 and 3.67% in sequence relative to reference mixing.

3.4.3. Modules of rupture

The modules of rupture showed decreasing in values relative to reference mixing at addition 2, 4, 6% to become 3.71, 3.70, 3.68 N/mm^2, while a collapse happened at addition 8 and 10% to record a 3.18 and 3.14 N/mm^2 respectively.

3.5. A Possibility use of the blocks in the construction of carrying walls

Through investigation of the constructive examinations results for the concrete blocks properties under study (*the mass density, the compression and the tensile*) and at comparison it with the (*British Specifications 1992/882 BS*) [11] which conditioned in the materials that the density of construction carrying walls increased about 1848 kg/m^3, and compression strength does not decrease about 17 N/m^3 ,therefore, it is cleared that all concrete blocks under study was be succeeded in the test and it is possible to use for carrying walls construction.

3.6. The thermal behavior for the concrete blocks

The transmitted thermal behavior for the concrete blocks under study in one day clarifying in the *Figures 3, 4 and 5,* for the measurements of samples during summer season/2016, and the average surface temperature (*internal-external*) are showed in *Figures 6,7*.

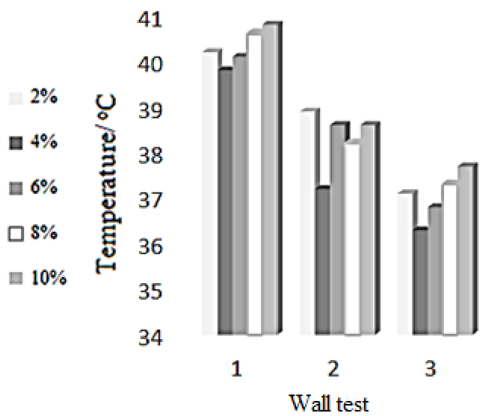


Figure 6. The average temperature of the external wall surface for the three walls: 1-directly, 2-at aerial gap, 3- at thermal insulator for all addition ratios (2-10%).

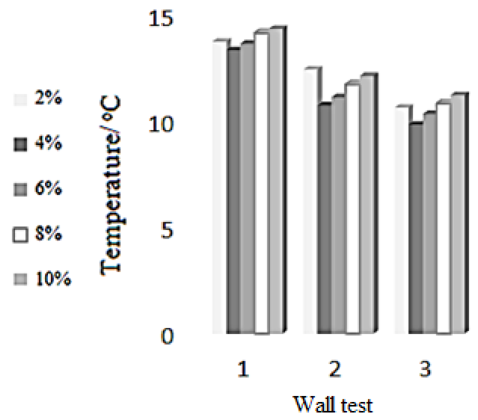


Figure 7. The internal wall surface temperatures for the three walls: 1-directly, 2-at aerial gap, 3- at thermal insulator for all addition ratios (2-10%).

3.6.1. The surface temperature of the concrete blocks

The difference in internal-external wall (*two concrete block surfaces*) temperatures of the concrete blocks/known as the reference mixture was 4.7 °C but when used the concrete blocks under study it is found that average difference temperature became 6.5, 6.9, 6.6, 6.1 and 5.9 °C, consecutively, as shown in *Figure 8*, which means the difference in internal-external wall temperatures of the block, that the bark of eucalyptus tree added to it may increase as comparative to the reference mixture, so it is found that difference temperature at compared in some of the mixings with addition and the reference mixture was 1.8, 2.2, 1.9, 1.4 and 1.2 °C, to the attributed addition 2,4, 6, 8 and 10%, consecutively.

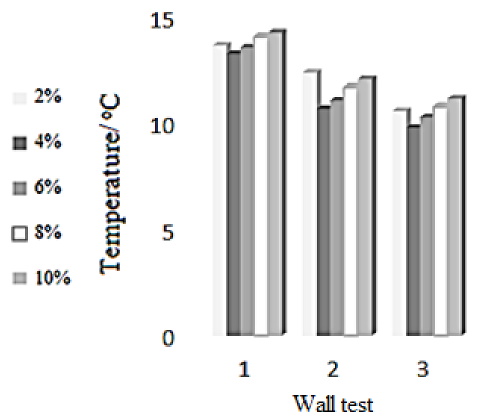


Figure 8. Internal external wall temperatures difference for the three walls: 1-directly, 2-at aerial gap, 3- at thermal insulator for all addition ratios (2-10%).

The bigger certain reduction is noticed at mixing of the addition 4% and after that the difference decreases but it remains superior from the average at comparative to the reference mixture, the researchers believes that increase ratio of added bark powder of eucalyptus tree will operating bridge link of this molecules inside the concrete mixture and thus, the heat will move during it inside of the block, therefore quantity of the transmitted heat will increase and decreases with it certain difference temperatures, as general the addition of bark powder of the tree to mix concrete will decrease of the total thermal transmitted for the formative concrete because of the thermal conduction for tree bark is lower than concrete , therefore, the average difference in internal-external wall temperatures will increase for resistant increase and the greater value ratio will be at 4%.

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3.6.2. The consumed electrical energy for the conditioning purposes

The reduction of the temperatures for the internal surface of the concrete blocks leads to reduce the temperatures difference in this surface and air conditioner unit of the designed room temperature and thus reduction of the requested cooling capacity for the space and this will be lead to reduction of working period of the air conditioner during hours/day and thus will be reduced the consumption of the total energy, and this clears through the data in *Table 3*, where the requested cooling load of solid concrete blocks/the reference mixture was 28.08 T.R/m^2, and consumed electric power 62.62 kWh/m^2, at use granules powder of eucalyptus bark with a ratio of 2, 4, 6, 8 and 10%, the requested cooling loads are 23.813, 22.9, 23.583, 24.750 and 25.215 T.R/m^2, consecutively, while the consumed energy quantity for the conditioning purposes for the same sequence became 53.11, 51.07, 52.60, 55.2 and 56.23 kWh/m^2, which means the difference in consumed electrical energy will be 9.51 kWh/m^2, at comparative between the reference concrete blocks and the blocks with an addition 2% and this difference increased to 11.55 kWh/m^2, at resistant between the solid concrete blocks/the reference mixture and the concrete blocks with an addition 4%. The difference of the saving will decrease after that to 10.02, 7.42 and 6.39 kWh/m^2, at comparative between the consumption reference mixture and the blocks with the addition 6, 8 and 10% consecutively, and so it is found that all the additions ratio will decrease from the heat quantity that trans throw it and so thus the consumed electrical energy quantity will decrease for purpose of saving standard temperature at comparative with the consumed electrical loads through the use of the reference mixture but the better saving is at the ratio 4% and the percentage for the saving will be within limits 18.5% and this is clarified in *Figure 9, 10*.

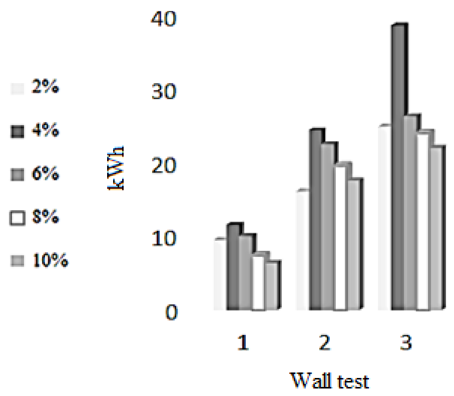

Figure 9. The electric energy saving for the three walls: 1-directly, 2-at aerial gap, 3- at thermal insulator for all addition ratios (2-10%).

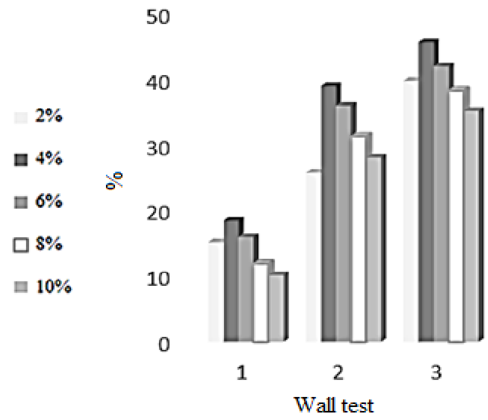

Figure 10. The percentage of decreasing amount of the electric energy for the three walls: 1-directly, 2-at aerial gap, 3- at thermal insulator for all addition ratios (2-10%).

3.7. Impact presence of aerial gap behind the concrete blocks

The presence of aerial gap with thickness 50 mm division the concrete blocks (*as clarified in Figure 2*), it is effected on an increase of the thermal resistance quantity that obstructs road passing of the thermal wave, which the environment perceived by it, but it not be locked gap because of porous building materials, so it makes open gap relatively for the environment always, therefore temperature of the wall surface opposite for the room will decrease, example it is found that the concrete blocks with the addition 2% and in case of the normal wall (*Figure 2*), will save 40.2 ^oC which means the reduction in temperature quantity of two surfaces will be 6.5 ^oC, but in presence of the gap the temperature of the surface will become 38.9 ^oC, the reduction differences on its surface will be 7.8 ^oC and this will be reversed on reduction of the temperature differences between the opposite surface of the wall to the room and the air temperature of the design room, which it was 13.7 ^oC and becomes 12.4 ^oC, and this will be reversed on the reduction of the requested conditioning load from 23.813 to 20.851 T.R/m^2, and decrease of the consumed electrical energy from 53.11 to 46.50 kWh/m^2, at a comparison with the consumed quantity of the electrical energy for the concrete blocks/ the reference mixture, which was with 62.62 kWh/m^2, the transient of the saver energy quantity is 16.12 kWh, and the certain saving ratio is 25%, while the reduction ratio for the normal wall was 2% (9.5 kWh/m^2). The saving difference will be 9.51 kWh/m^2, and the percentage for the reduction 15.2, but at comparative between the concrete blocks with the addition 2%, confirm directly, and in presence of the aerial gap, it is found that presence of gap may decrease the consumption from 53.11 to 46.50 kWh/m^2, so increased in the saving quantity as much as 6.61 kWh/m^2, and this is also for the rest ratio, where the surface temperature was 37.2, 37.6, 38.2 and 38.6 ^oC, for the rest addition ratio 4, 6, 8 and 10% consecutively, this will be reversed on a reduction of the electrical consumption (*Figure 9,10*).

3.8. The effect of presence the thermal insulating behind the concrete blocks

Because of porous building materials, it is not possible obtaining locked gap , therefore, the assistance was complete in thermal insulating to occupy the all thickness of the gap (*50 mm*) as showed in *Figure 2* and in reason decrease of the thermal conduction for insulating (0.025 W/m.K (*watt/ meter kelvin*)) will be increased of the thermal resistance for the constructive segment for the wall, and this will be resulting from decrease of the thermal wave, which the environment effected on it and the decreasing quantity will be bigger and so it is found that the wall surface temperature of the opposite to the room was decreased to 37.1 ^oC (*in normal case 40.2 ^oC and 38.9 ^oC at presence of aerial gap*), which means the difference in internal-external wall temperatures become 9.6 ^oC (*in normal case 6.5 ^oC and 7.8 ^oC at presence of aerial gap*), the reduction of difference temperatures between wall surface and the room becomes 10.6 ^oC (*in normal case 13.7 ^oC and 12.4 ^oC at presence of aerial gap*), so the requested cooling load quantity decreased to 16.92 T.R/m^2, with decreased the consumed electric energy quantity for saving the thermal comfort to 37.73 kWh/m^2. The decreased of the consumed quantity in the electrical energy for purpose of saving 37.73 kWh/m^2, (*in normal case 53.11 kWh/m^2 and 46.50 kWh/m^2 at presence of aerial gap*) and this will be reversed on quantity of the saving in the energy at comparative with the concrete blocks/the reference mixture and quantity of the saving was 24.9 kWh/m^2, the ratio of saving 39.8%, while the quantity of energy available at insulating use didn't be 15.39 kWh/m^2, at comparative in the saving quantity at use of the insulating or in the presence of the gap, so the saving was within limits 8.78 kWh/m^2, and this is for the rest mixing ratio where the certain saving was 28.6, 26.30, 24 and 22.01 kWh/m^2, for the other addition ratio 4, 6, 8 and 10% consecutively.

4. Conclusions

(*A*) It is possible to constructive the carrying walls from the concrete blocks which a powder bark of eucalyptus trees added to it. (*B*) A little decreasing of physical properties value at addition of eucalyptus trees bark powder to concrete mixing at comparative with the reference mixing and the better ratio is 6% (*7.5 g*) from the powder. (*C*) Decreasing the density of the concrete blocks with addition of eucalyptus bark powder which leads to decrease the weight of the wall for each square meter and reduction the dead load. (*D*) Decreasing the temperature of the concrete blocks surface that facing to the environment so this reverse on reducing of the heat quantity passing throw it and as a result reduction the requested electrical energy to operate air conditioner (*the better addition ratio is 4%, addition quantity is 5.0 g*).

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