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THE EFFECTS OF WASTE CLAY BRICK POWDER TO THE FRESH AND HARDENENT PROPERTIES OF SELF-COMPACTING CONCRETE

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Abstract. The study presents the waste clay brick powder WCBP effects on the fresh and hardened properties and performance in the self-compacting concrete (SCC). Different percentages (1%, 3%, 5%, and 7.5%) of cement weight were replaced with waste clay brick powder (WCBP) in SCC with maxim sieve sizes of 75µ and 80µ. For this research, two of self-compacting concrete mixes of design strength (45MPa and 50MPa) were prepared and tested. The tests that determined the fresh self-compacting concrete properties were: the slump flow, T50cm, V-funnel, and L-box. The mechanical properties of hardened SCC were: compressive strength test, splitting tensile strength, and the modulus of elasticity tests after 28 days.

In concrete mix of design strength 50MPa it was found that replacing (1%, 3%, and 5%) of cement content by clay brick powder of maxim size (80µ and 75µ) causes a increase more than design strength of 45MPA in the workability of SCC and the concrete hardened properties but using (7.5%) of the waste clay powder decreases the workability and properties of hardened concrete compared to the mixes without WCBP.

The increments of WCBP of maxim sieve of 80µ for SCC with design strength of 50MPa and 45MPa causes an increase more than WCBP of maxim sieve size of 75µ in the flowability with low viscosity And decreasing in velocity deformation time while decreasing the fresh SCC ability to flow through tight openings.

The preferable percentage of WCBP that improve the properties of self-compacted mixes (f_{cu}=45MPa, f_{cu}=50MPa) as shown in the test result was 5%.

1. Introductions:

Self-Compacting Concrete (SCC) is the new revolution that first made in Japan in 1988 which can flow without any to the coarse aggregate segregation and blockage between reinforcement bars, and compacted to every corners of the mold with its weight and without any vibration compaction. This type of concrete in its fresh state should have been a relatively low yield value to ensure high flowability, a reasonable viscosity to resist segregation and bleeding, and to maintain its homogeneity during transportation and placing [1].

With the development of the constructions, an amount of WCB has been produced from the demolition of aged buildings that changed into waste contributing to constructions garbage. The new concrete mixture contain the recycled demolition waste clay brick can be produced. Using this type of brick in construction develop eco-friendly concrete and encourage the concept of sustainable productions [2].

Zine Eddine Abib, et al (2013) investigates the effect of waste crushed brick on rheological and mechanical behavior of the mortar. The test results showed the use of crushed WCBP as a 5% of Portland cement in SCC helped to improves the strength (compression, tensile)[3].

Ali M Mansor, et. al (2016) investigates the effects of ground clay brick [GCB] as the cement substitute on fresh and hardened properties of the self-compacting concrete. Eleven replacement levels of [GCB] to Portland cement were tested, ranging from 0% to 50% of crushed and ground recycled clay brick(GCB) powder to a fineness of approximately 75µsubstitution instead of Portland cement improves the flowability of concrete and a reduction in segregation of mortar.

A significant relationship, between the compressive strength and splitting tensile strength has been noted. The required Water/Powder ratio has been increased with increment of the (GCB) content. The major reason for this was that the brick powder very high absorption. This in turn caused increases water absorption of concrete. For the workability tests it was observed that all mixes were within the specifications [4].

Wasan I. Khalil1 and et al (2017) studied the self- compacted concrete mortar and the Substitution of the clay brick waste as a volume replacement for coarse aggregates (25, 50, 75, and 100 percent), the results showed that flowability, filing ability, and passing ability of self-compacted concrete reinforced with steel decreases as the increases clay brick waste content. As the clay brick waste content of SCC increases, so does the segregation resistance. The use of clay brick waste aggregate reduces the density, compressive strength, splitting tensile strength, modulus of elasticity, flexural strength, and thermal conductivity of SCC. The percentage reduction in the above properties rises as the waste container. [5]

Oday A. Abdulrazzaq (2018) showed the properties of the SCC mortar in the fresh and hardening state and showed the effects of replacing Waste brick powder of percentages 5%, 10%, and 15% as a replacement for cement in SCC. In comparison with the mixture with no clay brick powder, it have been found that replacing 5% of cement increases the workability of SCC as well as the hardened properties for example :1-tensile strength, 2-compressive strength,3- modulus of elasticity. While its reduced at 10% , and 15% clay brick powder compared to a mix without clay brick powder [6].

Mohammed Si-Ahmed, et al (2020) showed the effects of adding waste ground brick WGB on self-compacting mortar SCM performance at fresh and hardened state. The experimental result shows that SCM can be obtain up to 25% of cement substitution by brick powders. The compressive strength was improved in long term for up to (15%) of cement substitution by brick powder. The absorption coefficient is increased the incorporation of waste brick powder (WGBP). The substitution of cement by (WGBP) up to 15% of brick powder increased compressive strength in the long term. [7]

2. Used materials

Iraqi Ordinary Portland Cement, which its properties conform to Iraqi Standards. No.5/1984 [8] has been used in the study. Table 1. shows properties of the cement used. Natural sand with a maxim aggregate size of (4.75mm), specific gravity of (2.4), and absorption (53%) was used. The physical properties and sieve analyses have complied with requirements of Iraqi Standard No.45/1984 [9]. The properties of coarse aggregate satisfied the requirement of Iraqi Standard No.45/ [9] with a nominal maxim size (20 mm), (2.57) specific gravity, and (2.5%) absorption. The grading of the (coarse, fine) aggregate using in this investigation is showed in Figure (1). The water used in self-compacted concrete was potable water. Also, the superplasticizer with a commercial mark of SikaViscoCrete_180GS® was used. The recommended dosage was in the range of (1-1.6%) by the weight of the binder. This type of admixture satisfies the requirements with ASTM C494/C494M-99a type F&G (ASTM C494, 2007) [10]. Waste clay brick powder was crushed, to have grading similar to that for cement as showed in Fig. (2). the physical and chemical properties of the clay brick wastes are shown in Table (1) [11].

Tables (1) Physical and chemical properties of the cement and clay brick powder (WCBP)

Compound composition	Physical and chemical properties	Cement	WCBP	Limit of IOS 5:1984
Sulfate	So3	2.2	0.89	<2.8
Iron Oxide	Fe2o3	5.8	2.34	--
Magnesia	Mgo	3.3	-----	<5
Silica	Sio2	21.03	43.34	--
Lime	C3A	2.98	------	--
	Cao	61.32	15.98	--
Loss of Ignition	L.O.I	2.2	2.32	<4
Fineness using Blaine air permeability apparatus (m^2/kg)		250.7		>230
Setting time using Vicat's instruments Initial (hrs: min.) Final (hrs : min)		 1:30hrs 4:17hrs		 >45 min <10 hrs
Compressive strength 3 days (MPa) 7 days (MPa)		 16 24		 >15 >23

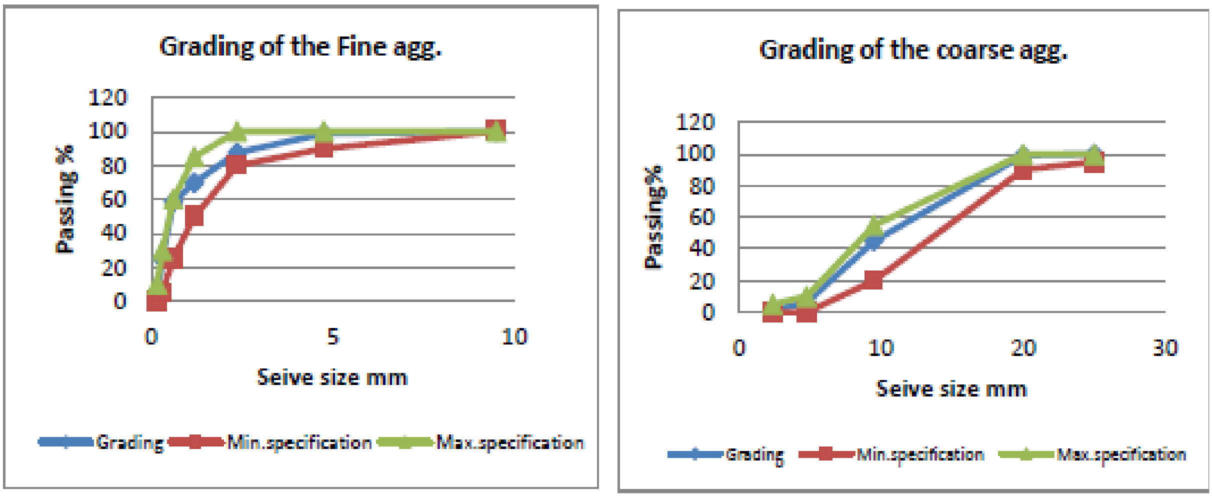

Figure (1): Grading of the coarse and fine aggregate.

Plate (1) Crushed wastes clay brick

3. Test program

Two mixes of SCC have been design in this study to achieve design strengths (45MPa, and 50MPa). This mixes adjusted to achieve EFNARC specifications. Table (2) showed the results of the concrete mix. Four percentages of WCBP have been used to investigate its effects to the behavior of the mortar, these percentages was (1%, 3%, 5%, and 7.5%) with maximum sieve size of 75µand 80µ. For each percentage were cast, about 9 cubes, 3 cylinders, and 3 prisms of concrete to be tested. The cube size of (150mm × 150mm ×150mm) was cast for the compressive test, cylinders of size (300mm × 100mm) for splitting tensile test, and prisms of (150mm ×150mm × 570mm) for the flexural strength test. Tables (2) and (3) show concrete mix components.

Table (2): Weights of the materials contest used for mix of (f_{cu} = 45MPa)

Materials content	SCC 0%	WCBP 1%	WCBP 3%	WCBP 5%	WCBP 7.5%
Cement(kg/m^3)	514	508.86	498.58	488.3	475.45
WCBP (kg/m^3)	0	5.14	15.42	25.7	38.55
W/C=33%(kg/m^3)	168.825	168.825	168.825	168.825	168.825
Sand (kg/m^3)	838	838	838	838	838
Gravel (kg/m^3)	838	838	838	838	838
SP/C =1% (kg/m^3)	5.14	5.14	5.14	5.14	5.14

Table (3): Weights of the materials contest used for mix of (f_{cu}= 50MPa)

Materials content	SCC 0%	WCBP 1%	WCBP 3%	WCBP 5%	WCBP 7.5%
Cement(kg/m^3)	450	445.5	436.5	427.5	416.25
WCBP (kg/m^3)	0	4.5	13.5	22.5	33.75
W/C=35%(kg/m^3)	158.625	158.625	158.625	158.625	158.625
Sand (kg/m^3)	874.15	874.15	874.15	874.15	874.15
Gravel (kg/m^3)	874.15	874.15	874.15	874.15	874.15
SP/C =1.3% (kg/m^3)	4.5	4.5	4.5	4.5	4.5

4. Making and curing of the test specimens

All molds have been coated with oil before casting the concrete mixes to prevent the escape of water out of mortar and to avoid adhesion with the mold's surface after hardening. The components of mortar have been mixed by laboratory mixer to become of uniform color, and then they casted in their molds and stored for 24hrs. Thereafter, then the specimens have been remove from the molds, then stored in a curing tank till the test day [13].

5. Experimental Tests

5.1Fresh Properties Tests of self compacting concrete

Fresh property of SCC has been test according to European Guidelines (EFNARE) [12].

Slump Flow

This test for evaluating flowability of SCC. The flow Observations should look for no separation of grout mix, no water should be at the edge or on the surface, and an even distribution of aggregate in the mortar. The equipment setup is shown in Plate (2).

V-Funnel Test

This test investigates material segregation resistance of SCC and viscosity. Where lowdown flow times indicate a lower viscosity of the mix. This test provides a qualitative assessment of SCC mix viscosity. The experimental setup shown in Plate (3).

L-Box test:

The method investigates the ability of fresh SCC passing through the gaps of steel bars and flowing within a defined flow distance. The blocking ratio (H2/H1) should be closer to one for better flow of SCC. The experimental setup is shown in Plate (4).

Plate (2): The Slump Flow Test

Plate. (3): V- Funnel Test

Fig. (4): L-Box Test

5.2 Hardened SCC Tests

The hardened phase of SCC, the test of compressive strengths was completed according to BS 1881[14], this is done by a universal hydraulic compression machine of capacity 2000kN, Plate (5). The splitting tensile strength test, as shown in Plate (6), was carried out on cylindrical specimens according to ASTM C496 [15]. The modulus of rupture test was carried out on concrete prismatic specimens to estimate the modulus of rupture under two-point loads according to ASTM C78 [16]as shown in Plate (7). Static Modulus of Elasticity, Plate (8), was determined at 28 day age according to ASTM C469 [17].

Plate (5): Compressive Strength Test

Plate (6): Splitting Tensile Strength Test

Plate (7): Splitting Tensile Strength Test

Plate (8): Static Modulus of Elasticity

6. The test result Discussion

6.1The Effect of fresh self compacted concrete with different content of WCBP on the workability

As the waste clay brick powder (WCBP) amount increases, in the SCC mixes of design strength 50MPa, as shown in Figure (2), it was found that replacing (1%, 3%, and 5%) in the cement content increase the flowability in slump flow test about (0.28%, 0.7%, 1.25%), and (0.08%, 0.24%, 0.42%), respectively. But causes a decreasing about (0.69%, and 1.4%), respectively, in the case of (7.5%) WCBP replacement.

While design strength of 45MPa, it was found that replacing (1%, 3%, and 5%) in cement content causes a slightly increase in flowability in SCC about (0.14%, 0.3%, and 0.42%) and (0.08%, 0.17%, and 0.3%). While decreasing at 7.5% about (0.7%, and 0.85%), respectively.

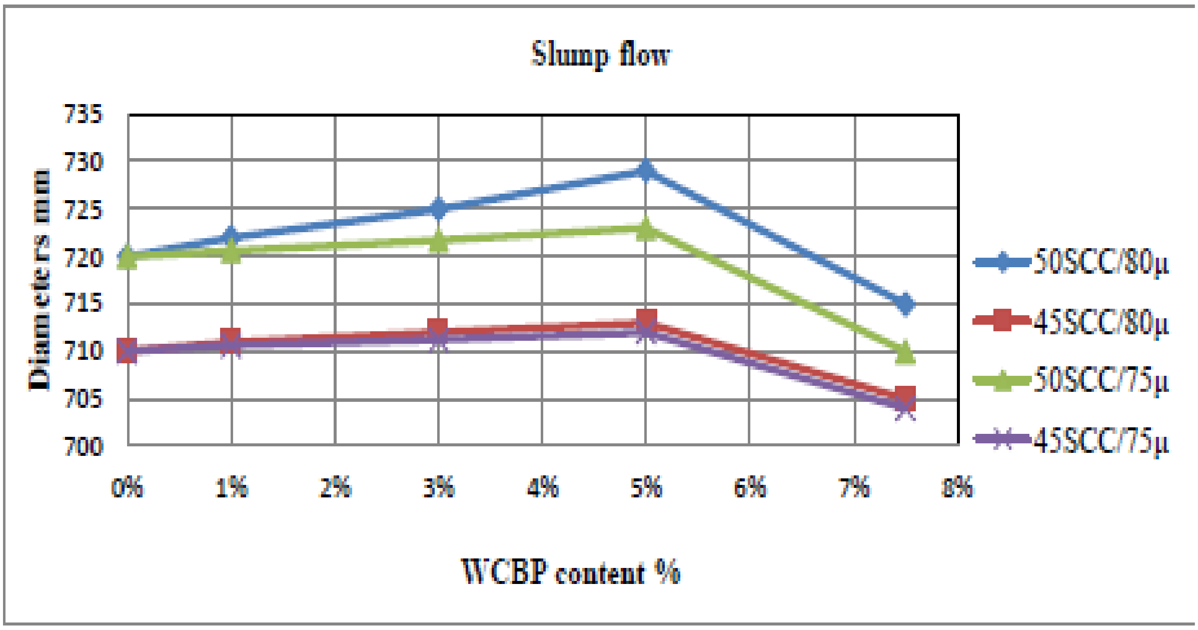

Figure (2) the slump flow of fresh concrete test results

The time required for the fresh concrete to flow is shown in Fig. (3). It was found that replacing (1%, 3%, and 5%) of WCBP in SCC with design strength of 50MPa decreases the flowability time about (4.9%, 15.3%, and16.4%), and (9.2%, 17.3 %, and 27.9%), respectively, while it increases at (7.5%) about (11.5%, and 7.5%), respectively.

And the replacing (1%, 3%, and 5%) of WCBP SCC with design strength of 45MPa decreases about (1.6%, 8.3%, and 14.1%), and (27.4%, 46.1%, and 55.1%), respectively, while increasing at 7.5% about (28.9%, and 5.62%), respectively.

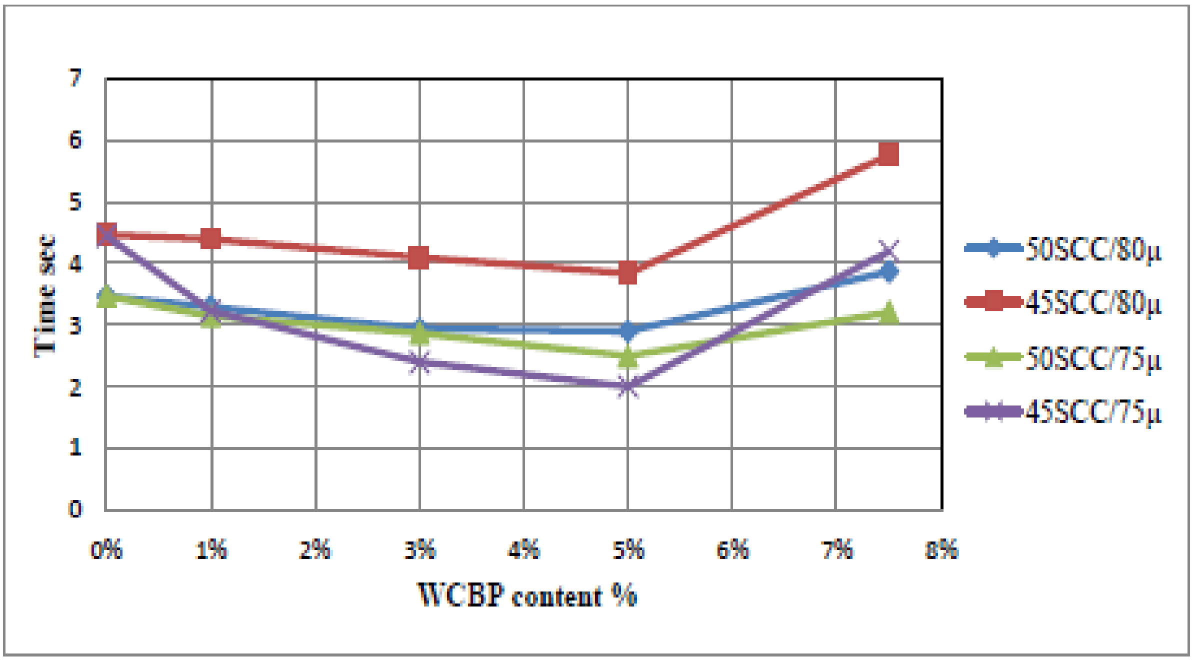

Figure (3) Test results of the slump flow time for fresh concrete

From the results of the V-funnel test, Fig. (4), the replacing (1%, 3%, and 5%) of WCBP with design strength of 50MPa causing a decreasing in the flow time about (22.1%, 38%, and 41.6%), and (29.7%, 41.2%, and46%), respectively, but it increases the flow time at (7.5%) about (38%, and 42%), respectively.

Also for SCC with design strength of 45MPa decreases about (19.4%, 26.1%, and 33%), and (1.6%, 10.4%, and 20.5%). while increasing at 7.5% about (9%, and 10.4%), respectively.

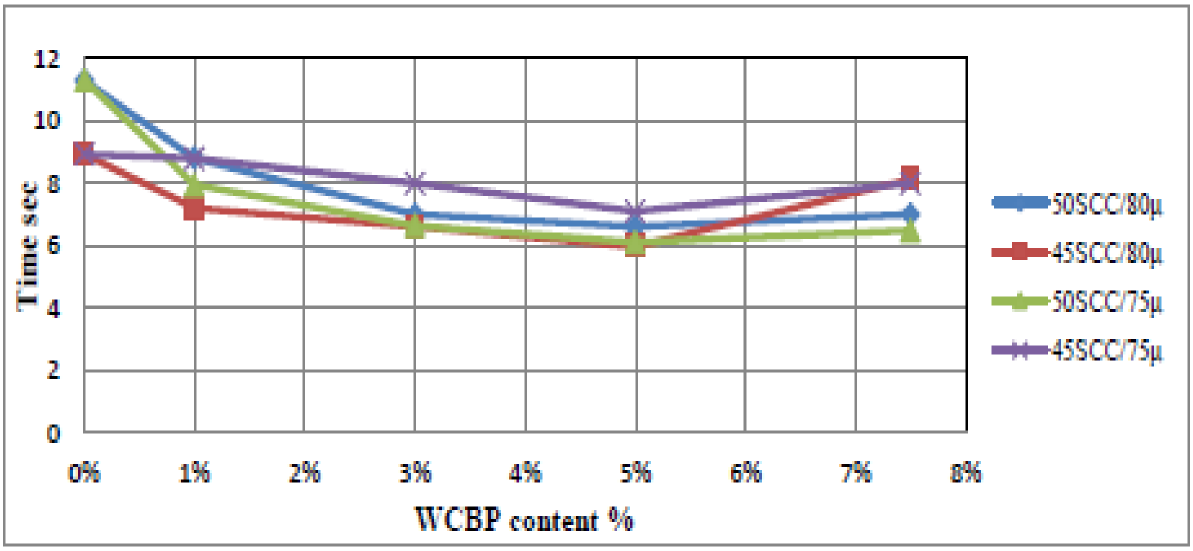

Figure (4) Test results of the V-funnel for fresh concrete

As shown in Fig. (5) it was found that replacing (1%, and 3%) of waste clay brick powder and design strength of 50MPa decreases the Passing Ability about (11%, and 10%), and (14%, and 20%), respectively, while increases at (5%, and 7.5%) of WCBP replacement about (1%, and 5%), and (13%, and 2%), respectively.

While the SCC of design strength of 45MPa it was found that replacing (1%, 3%, and 5%) of the cement content replacement with a maxim sieve size of 80µ, in SCC increases about (4.5%, 10.1%, and 12.4%), and decreasing at 7.5% about (7.9%), respectively.

And found that replacing (1%, 3%, and 5%) of WCBP with a maxim sieve size of 75µ in SCC decreases about (6.7%, 11.2%, and 5.6%), respectively. while increasing at 7.5% about (10.4%).

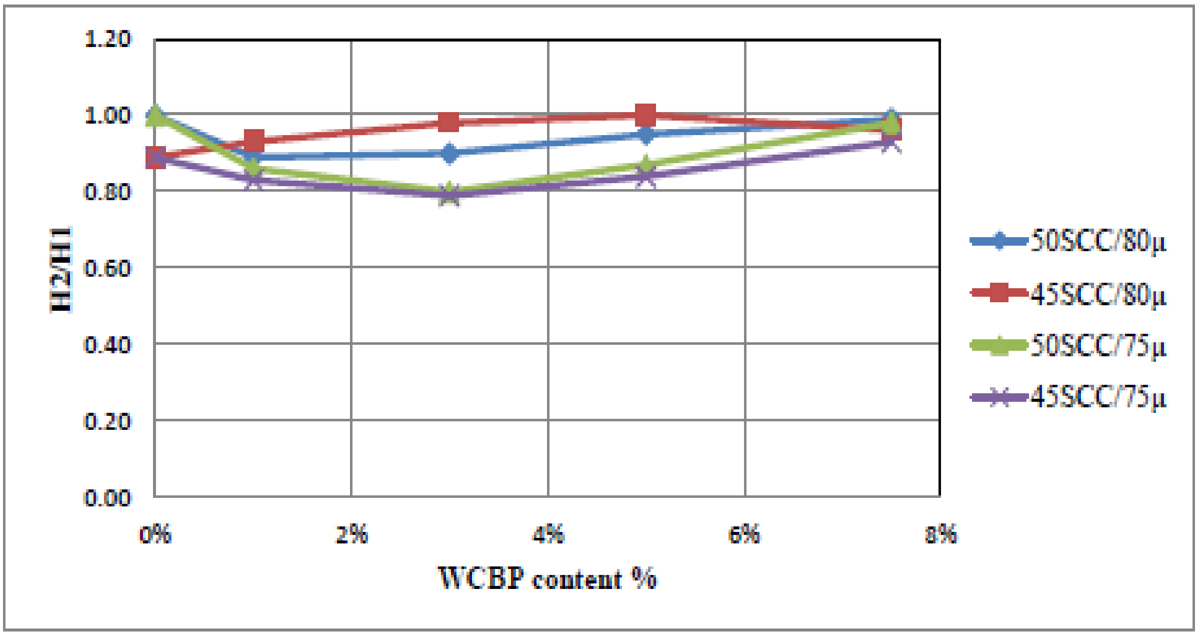

Figure (5) The L- Box test results of fresh concrete

6.2 Effect of fresh self compacted concrete with WCBP of different maxim sieve size on the workability

As shown in Fig. (2, 3, 4, and 5) It was found that while replacing (1%, 3%, 5%, and 7%) of WCBP of maxim sieve of 80µ for SCC with design strength of 50MPa causes an increase in the flowability with low viscosity than SCC with WCBP of maxim sieve size of 75µ about (0.2%, 0.46%, 0.83, and 0.71%). And decreasing in velocity deformation time about (4.3%, 2%, 11.5%, and 4%). while decreasing the ability of fresh SCC to flow through narrow openings about (3%, 10%, 12%, and 3%).

While it was found that replacing (1%, 3%, 5%, and 7%) of WCBP of maxim sieve of 80µ for design strength of 45MPa causes an increase in the flowability and low viscosity than SCC with WCBP of maxim sieve of 75µ about (0.06%, 0.2%, 0.12%, and 0.15%).

And decreasing in velocity deformation time about (17.8%, 15.7%, 12.5%, and 1.4%).while decreasing the SCC ability to flow through narrow openings about (3%, 10%, 12%, and 3%).

6.3 Effect of fresh concrete with WCBP and different design strength on the workability

As shown in Fig. (2, 3, 4, and 5) It was found that while the replacing (1%, 3%, 5%, and 7%) of WCBP of maxim sieve of 80µ for SCC with design strength of 50MPa causes an increase in the flowability more than SCC of design strength of 45MPa about (0.14%, 0.4%, 0.83%, and 0.01%)and decreasing inflow time about (3.3%, 7%, 2.3%, and 17.4%). And decreasing in velocity deformation time about (2.7%, 11.9%, 8.6%, and 29%). While decreasing the ability of fresh concrete to flow through narrow openings about (6.5%, 0.1%, 11.4%, and 2.9%).

While it was found that replacing (1%, 3%, 5%, and 7%) of WCBP of maxim sieve of 75µ for design strength of 50MPa causes an increase in the flowability more than SCC of design strength of 45MPa about (0%, 0.07%, 0.12%, and 0.55%). And decreasing inflow time about (18.2, 28.8, 27.2%, and 1.88). Decreasing in velocity deformation time about (28.1%, 30.8%, 25.5%, and 31.6%) while decreasing in the ability of fresh concrete to flow through narrow openings about (7.3%, 8.8%, 7.4%, and 8.4%).

6.4 Effect of hardened concrete with different WCBP content on the properties

Figure (6) and Figure (7) show the results between WCBP content and compressive strength for concrete mixes of designed strength (50MPa, and 45MPa) for maxim sieve size of 80 µ at (7, and 28) days. in the case of replacing (1%, 3%, and 5%) of the cement content replacement with a maxim sieve size of 80µ in SCC, it increased about (7.3%, 11%, and 17.9%), and (4.6%, 15%, and 18.6%) for 7 days and that the compressive strength of 50MPa, and 45MPa about (6.8%, 6.6%, and 9%), and(1.8%, 5.1%, and 11.2%) at ages of 28 days, respectively. In the case of WCBP replacement of (7.5%) caused a decrease of about (1%), and (0.3%) at ages of 7 days, respectively, and decreases about (5.3%), and (6.4%) at 28 days, respectively.

The results between WCBP content and compressive strength for mixes of designed compressive strength 50MPa and 45MPa for the size of 75µ. Designs strength 50MPa at 7, and 28 days decreased in the case of replacing (1%, 3%, 5%, and7.5%) of WCBP about (2.5%, 3.3%, 9.6%, and 12.6%) at 7 days, and (3.5, 7.6%, 13%, and 13%) for 28 days, respectively. While the results of the design strength of 45MPa at (7, and 28) days decreased in the case of replacing (1%, and 3%) of WCBP about (17.1%, and 27.7%) at7 days, and (10.5%, and 27.3%) at 28 days, respectively. and in the case of WCBP replacement of (5%, and 7.5%) increase the compressive strength at (7 days) about (12.5%, and 3%), and at 28 days increases about(17.1%, and 6.9%), respectively.

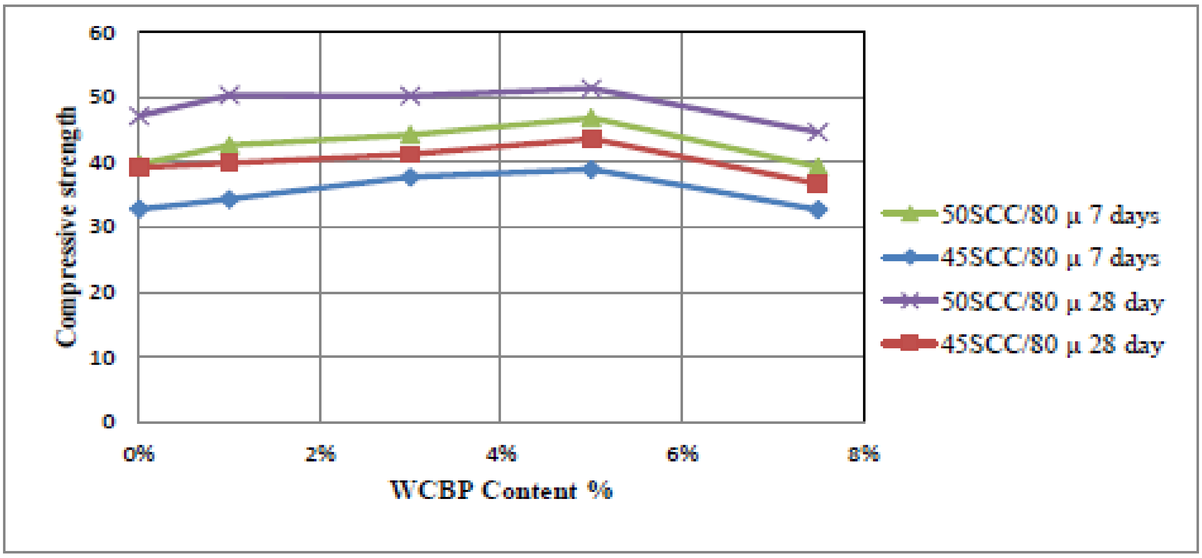

Figure (6) Relation between WCBP content and compressive strength for concrete of compressive strength 45MPa, and 35MPa with maxim sieve size of 80 µ at ages of(7, and 28) days

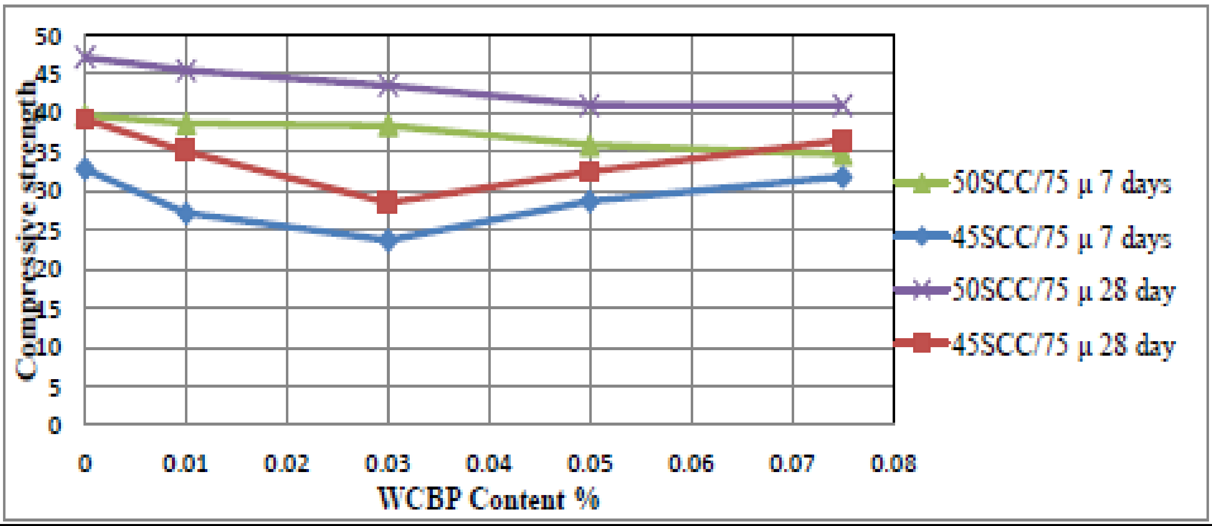

Figure (7) Relation between WCBP content and compressive strength for concrete of compressive strength45MPa, and 35MPa and maxim sieve size of 75 µ at ages of (7, and 28) days

Figure (8) shows modulus of rupture for mixes of designed compressive strengths fcu50MPa, and 45MPa with a maxim sieve size of 80 µ, and 75 µ. In the case of modulus of rupture of compressive strength 50MPa with a maxim sieve size of 80 µ, it is found that the replacement of (1%) of WCBP increases about (9.6%), while it decreased in the cases of (3%, 5%, and 7.5%) about (8.2%, 3.4%, and 21.2).in the case of the modulus of rupture for designed compressive strength 50MPa with a maxim sieve size of 75µ, it is found that the replacement of (1%3%, 5%, and 7.5%) of WCBP decreases about (4.2%, 10.1%, 19.6%, and 29.7%). While that the modulus of rupture for compressive strength of 45MPa and maxim sieve size of 80µ, and 75µ at age of 28 day, decreased in the case of replacing (1%, 3%, 5%,and 7.5%) of WCBP about (15.7%, 30.6%, 37.9%, and 41.2%), and(4%, 20.7%, 31.4%, and 33.9%), respectively.

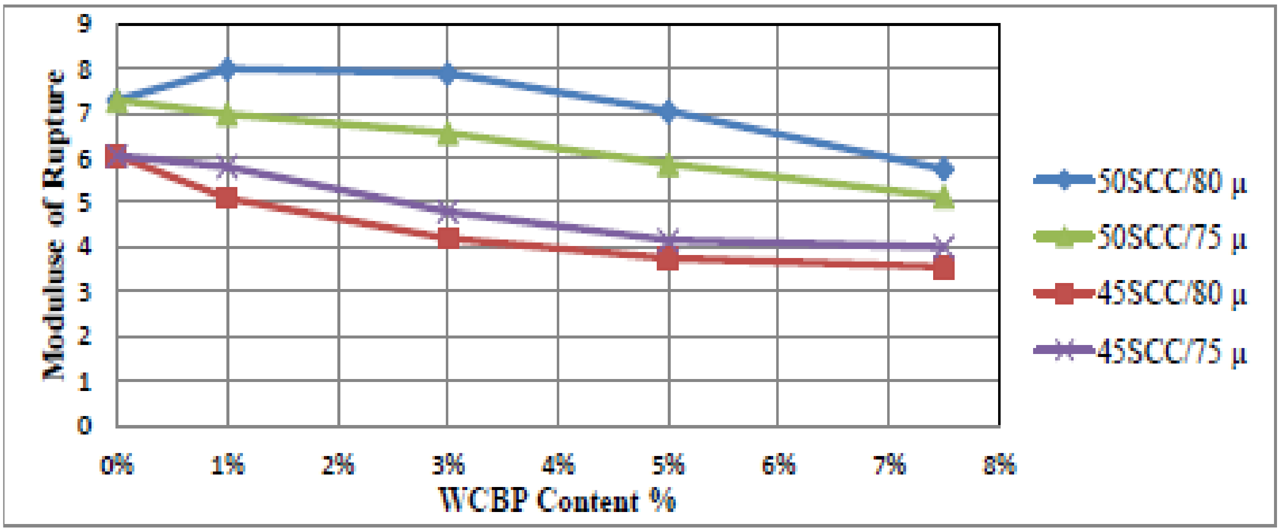

Figure (8) shows that the modulus of rupture of compressive strength 45MPa, and 35MPa with maxim sieve size of 80 µ, and 75 µ at age of 28 day

Also, splitting tensile strength compressive strength 50MPa with a maxim sieve size of 80 µ, and 75 µ at age of 28 days shown in Figure (9) increasing in case of replacement of (1%, 3%, and 5%) of WCBP about (3.6%, 6.8%, and 19.3%), and(1.8%, 25%, and 51.8%) respectively. while decreases at (7.5%) of WCBP replacement about (17.9%), and(50%), respectively. Also, splitting tensile strength compressive strength 45MPa with a maxim sieve size of 80 µ, and 75 µ at age of 28 days increasing in case of replacement of (1%, 3%, and 5%) of WCBP about (20.4%, 37%, and 57%), and(3.7%, 18.5%, and 31%) respectively. while decreases at (7.5%) of WCBP replacement about (40.7%), and (29.6%), respectively.

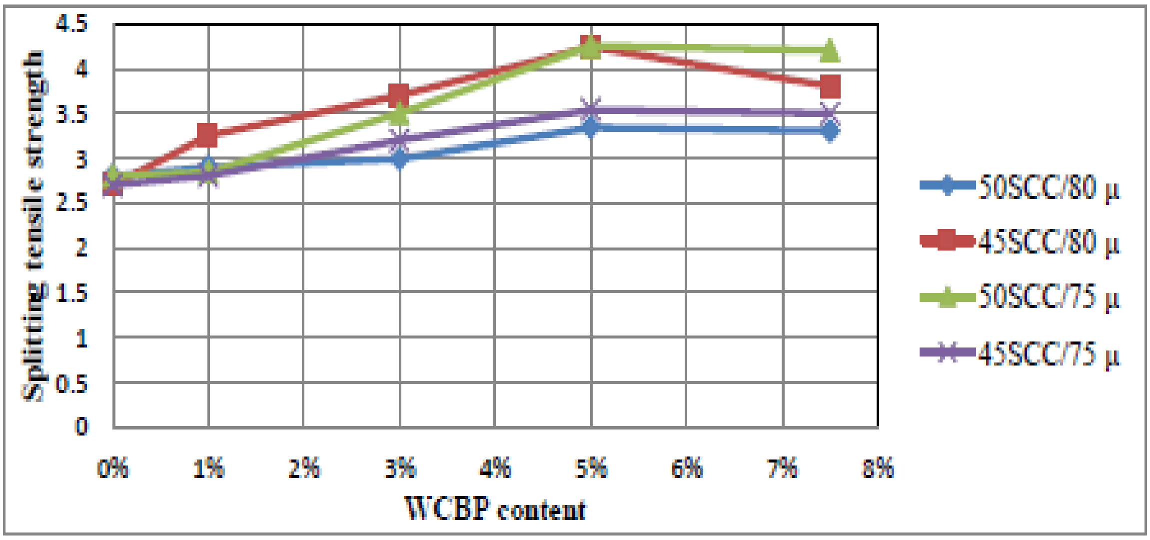

Figure (9) shows the splitting tensile strength and strength compressive strength 45MPa, and 35MPa with maxim sieve size of 80 µ, and 75 µ at age of 28 days.

Figure (10) the modulus of elasticity with design strength 50MPa, and 45MPa at age of 28 days. It was found that increased in the case of replacing (1%) of WCBP about (4.7%), and (35.7%) for 50MPa with a maxim sieve size of 80 µ, and 75 µ. And about (52.3%) for 45MPa with maxim sieve size of 80 µ.

While decreases at (3%, 5%, and 7.5%) of WCBP about (14.9%, 30.6%, and 32.3%), and (15%, 8.5%, and 18.7%) for 50MPa with maxim sieve size of 80 µ, and 75 µ, and (38.5%, 22.6%, and 20%) for 45MPa with maxim sieve size of 80µ.

While modulus of elasticity with compressive strength of 45 MPa and WCBP replacement with a maxim sieve size of 75µ there is no effect.

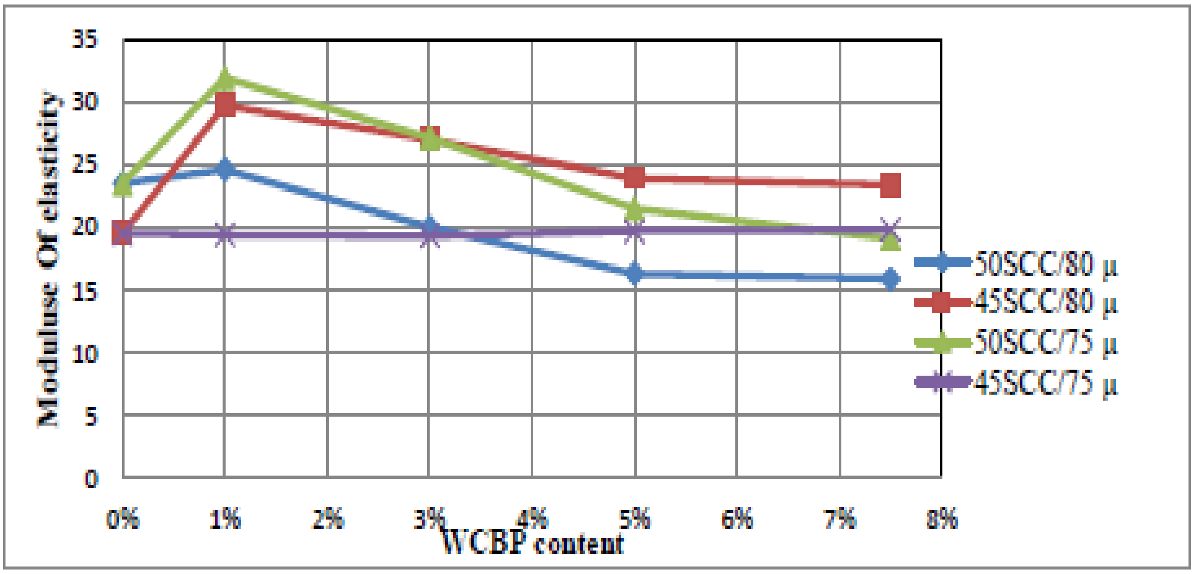

Figure (10) the modulus of elasticity and strength compressive strength 50MPa and 45MPa with a maxim sieve size of 80 µ, and 75µ at age of 28 days.

6.5The development of the compressive strength from 7 -28 days

Figure (6) and Figure (7) shows the results between WCBP content and designed strength of (50MPa and 45MPa) for maxim sieve size of 80 µ in the case of replacing (1%, 3%, 5%, and 7.5%) of WCBP develop from 7days to 28 day about (2.7%, 4%, 0.7%, and 0.7%) , and (5%, 1.5%, 2.2%, and 1.1%), respectively.

While the results between WCBP content and designed strength of (45MPa) for maxim sieve size of 75µ increased at replacing (1%, 3%, 5%, and 7.5%) of WCBP about (14.6%, 24.4%, 2.9%, and 9.6) at 7 days, and (7%, 19.7%, 4.1%, and 6.1%) at 28 days more than design strength of 50 MPa for same sieve size.

6.6Effect of hardened concrete with different maxim size of WCBP content on the properties

Fig.(7)While the results of designed strength of for maxim sieve size of 80 µ at ages of (7, and 28) days, is more than size 75 µ for design strength of (50MPa and 45MPa), for design strength of (50MPa)about (4.8%, 7.7%, 8.3%, and 11,6%) at 7 days and (3.3%, 1%, 4%, and 7.7%)at 28 day , for design strength of (45MPa) about (12.5%, 12.7%, 6.1%, and 2.7%) at 7 days, (8.7%, 22.2%, 5.9%, and 0.5%)at 28 day, respectively.

Fig (8) shows that the modulus of rupture for mixes of designed strengths 50MPa, with the size of 80 µ, and is more than the size of 75 µ about (5.4%, 1.9%, 16.2%, and 8.5%) at age of 28 days.

And designed strengths 45MPa with the size of 80 µ is more than the size of 75 µ about (11.7%, 9.9%, 6.5%, and 7.3) at age of 28 days.

As shown in Figure (9) splitting tensile strength of design strength 50MPa with a maxim sieve size of 80 µ, increase more than size 75 µ at age of 28 days about (1.8%, 18.2%, 32.5%, and 32.1),

And design strength 45MPa with a maxim sieve size of 80 µ, increase more than size 75 µ at age of 28 days about (16.7%, 18.5%, 26%, and 11.1%)

Figure (10) results of modulus of elasticity for compressive strength 50MPa, of maxim sieve of 80 µ are more than sieve size of 75 µ about (31%, 0.1%, 22.1%, and 13.6%).

6.7Effect of hardened concrete with WCBP content by different design strength on the properties

From Fig.(7)While the results of designed strength of (50MPa) for maxim sieve size of 80 µ, is more than design strength 45MPa about (0.5%, 4.4%, 8.9%, and 4.3%) at 7 days, and (2.8%, 9.9%, 7.4%, and 6.1%)at 28 days, respectively.

And for designed strength 50MPa for the size of 75µ at(7, & 28 days), is less than design strength of 45MPa about (1%, 4.3%, 3.4%, and 0.4), and (6.6%, 0.4%, 4.6, and 3.9%) since 7 days, respectively.

Fig.(8) shows that the modulus of rupture for mixes of designed strengths 50MPa, with the size of 80 µ, and is more design strength of 45MPa about (6.1%, 22.4%, 34.5%, and 20%) at 28 days.

This shows that modulus of rupture for mixes with designed strengths 50MPa, with the size of 75µ, and is more design strength of 45MPa about (0.2%, 10.6%, 11.8%, and 4.2%).

In Fig. (9) The splitting tensile strength of design strength 50MPa with a maxim sieve size of 80 µ, increase more than design strength of 45MPa at age of 28 days about (16.8%, 30.2%, 37.7%, and 22.8%)

Splitting tensile strength of design strength 50MPa with a maxim sieve size of 75 µ, increase more than design strength of 45MPa at age of 28 days about (1.9%, 6.5%, 20.8%, and 20.4%)

Figure (10) shown the modulus of elasticity for strength compressive strength 50MPa, of maxim sieve of 80 µ is more than compressive sieve of 45MPa about (47.6%, 23.6%, 8%, and 12.3%).

Since waste clay brick powder had the ability to absorb more water , and this will affect the W/C ratio, therefore the more adding of different percentages of WCBP will affect the compressive strength development.

7. Conclusion:

In this study, some of conclusion could be drawn as following;

1. The replacing of (1%, 3%, and 5%) with WCBP of maxim sieve size of 80µ, and 75µ in the mortar causes an increase with the flowability.
2. Concrete with high flowability capacity and very low flow time velocity tended to be very viscous and wouldn't take time to fill the formwork.
3. Small viscosity Concrete has a quick initial flow and then stop. While the high viscosity Concrete continued to creep an extended time.
4. Replacing (5%) with WCBP of maxim sieve size of 80µ with design strength of 50MPa, and 45MPa, increase the compressive strength.
5. Replacing (1%, 3%, 5%, and 7.5%) with WCBP of maxim sieve size of 75µ of design strength of 45MPa cause a decrease the compressive strength.
6. Replacing (1%, 3%, and 5%) with WCBP of maxim sieve size of 80µ, and 75µ of design strength of 50MPa, and 45MPa causes an increase in tensile strength at (28) days. While decreasing at (7.5%) with WCBP replacement.
7. Replacing (1%) of WCBP with maxim sieve size of 80 µ and 50MPa design strength causes an increase in modulus of rupture
8. Replacing (1%, 3%, 5%, and 7.5%) of WCBP with maxim sieve size of 80 µ and 45MPa, and maxim sieve size of 75µ and 50MPa, 45MPa design strength causes a decrease in modulus of rupture.
9. Replacing (1%) of WCBP with maxim sieve size of 80µ, and75µ and design strength of 50MPa, and 45MPa, causes an increase in modulus of elasticity. while decreasing at (5%, 3%, and 7.5%%) of WCBP replacement

10. The difference in particle size of (WCBP) will impact on its pozzolanic efficiency and mortar properties. The results shown that incensement of the grinding time, the particles of WCBP tend to be refined and spherical, which will increase the specific surface area and pozzolanic activity of WCBP. This is refers to that the WCBP of maxim sieve size of 80μ will had more effect on the properties of the SCC more than WCBP of 75μ.
11. The smaller the WCBP particle size, the fast the compressive strength of mortars grows. In addition to, the pore structures and hydration products results as well prove that: the WCBP with a smaller particle size will consumed more of calcium hydroxide to interact, and that would make the micro-structure denser and also obtain stronger compressive strength growth at later ages.

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