International Journal of Scientific Research in Civil Engineering
© 2019 IJSRCE | Volume 3 | Issue 4 | ISSN : 2456-6667

The Effect of Adding Types of Agricultural Residues on the Concrete Behaviour

Wael Shahadha Abdul Kareem, Hadi Salih Mijwal Aljumaily, Mohammed Nsaif Abbas
Environmental Engineering Department, College of Engineering, Mustansiriyah University, Baghdad, Iraq

ABSTRACT

Numerous of renowned conglomerates declared every year a new brands of classical chemical admixtures, but there was no one disclosed a new brand manufactured from a food waste, on another hand, due to the proliferation of wastes resulting from the foodstuff which is included within the environmental pollution framework. So this issue-study is to parade the ability of utilizing pomegranate leaves powder (PLP) as an admixture to magnify the compressive strength of Ordinary Portland Concrete (OPC), and to emerge the effect of these peels on the behavior and the properties of concrete. The ratio of (PLP/cement) was ranging between 0-1.0% by weight with mix proportion of (1:2:4) (cement:sand:gravel) by volume and a constant water to cement ratio (W/C) of 0.45. An evolve rate of 14.4% in concrete compressive strength was observed with increasing the ratio of PLP admixtures to 0.15%. Thus, the pomegranate leaves deem to be superb and efficient.

Keywords: Pomegranate Leaves Powder, Ordinary Portland Concrete, Water to Cement Ratio, Pomegranate Leaves Powder, Ordinary Portland Cement

I. INTRODUCTION

Many wars had major effects on the technologies that we use in our daily lives. Technology is neither good nor bad, nor is it neutral [1]. For the time being, technology in essence is a process of manipulating the business world for human purposes, depends not on the technology itself but on what humans choose to do with it. Due to rapid campaign in the construction of buildings led to increase the peremptory request for traditional building materials such as brick, cement, gravel and sand. Owing to the limited mechanical properties of these classical materials, so it has failed in the short plateau in addressing the growing and the renewable requirements demands of modern architectures techniques [2]. These limiting characteristic helm prospectors (especially for low-cost housing) to seek for a variety of new and innovative building admixtures to develop the conventional materials; have better features than its predecessors at the same time be effective and economical, low-cost, environmentally friendly and last longer ones. Innumerable studies have been conducted to improve the properties of concrete and composite materials, especially in the early nineties. However, polymeric, mineral and chemical admixtures [3] materials are expensive [4], the properties of the soft and hard concrete due to these materials are impressive [5]. Resorting to this method in the absence of other solutions to problems or to minimize the costs required to make the project more economically [6], and inflate the efficiency of the concrete. In fact, the environment endures from the accumulation of many types of pollutants directly and indirectly [7]. These pollutants lead to serious damage if left without treated such pollutants are agricultural pollutants. These admixtures are not considered (whatever the number) a solution for all types of problems faced by architects or implementers, but

gives a special method to improve some of concrete characteristics. As a result of the large increasing in inhabitants, people need to cultivate larger quantities of food which produce large amounts of waste [8]. This agricultural waste has utilized in several ways such as concrete admixtures. Pomegranate leaves is considered as one of the important agricultural residues in the world. In addition, it is deemed as an important source for adsorption of heavy metals due to its moderate surface area and other characteristic properties [9]. Thus it has been benefit to use the pomegranate leaves powder (PLP) in this research as an admixture for concrete and study their effects on concrete properties.

II. METHODS AND MATERIAL

Material Properties

Cement

Ordinary Portland Cement (OPC), (Type I) was used for all mixes. The chemical composition and physical properties of used cement are shown in Tables (1) and (2) respectively. The results conformed to the [Iraqi specifications No.5/1984].

Table1. Chemical composition and main compounds of cement used in this study

Oxide composition	Abbreviation	Content %	Limits of Iraqi specification No.5/1984
Lime	CaO	60.60	-
Silica	SiO_2	19.60	-
Alumina	Al_2O_3	5.52	-
Iron Oxide	Fe_2O_3	3.11	-
Sulfate	SO_3	2.27	≤ 2.8 %
Magnesia	MgO	1.80	≤ 5.0 %
Loss on ignition	L.O.I	1.60	≤ 4.0 %
Insoluble residue	I.R.	1.10	≤ 1.5 %
Lime saturation factor	L.S.F	0.93	0.66 - 1.02
Main Compounds (Bogue's equations)			
Tricalcium Aluminate	C_3A	9.37	-

Table 2. Physical properties of the cement used in this study*

Physical properties	Test Results	Limit of Iraq Specification No.5/1984
Specific surface area, (Blaine method), cm^2/g	2650	≥ 2300
Soundness (Le Chatelier Method)	1	≤ 10 mm
Setting time (vicat's apparatus) Initial setting, hrs: min	2:30	≥ 0:45
Final setting, hrs: min	4:10	≤ 10:0
Compressive strength		
3 days, MPa	17	≥ 15
7 days, MPa	23.7	≥ 23

* Chemical and physical tests were carried out in the National Center for Construction Laboratories and Researches (NCCLR).

Fine Aggregate

A natural rounded-shape particles and smooth texture sand of maximum size 4.75 mm is used as fine aggregate. The results point out that the fine aggregate grading and the sulfate content are within the Iraqi limits [Iraqi specification No.45/1984]. Sand grading and physical properties are shown in Tables (3) and (4) respectively.

Table 3. Grading of fine aggregate (sand)

Sieve Size(mm)	Cumulative Passing %	Limits of Iraqi Specification No.45/1984, zone 2
4.75	91	90 - 100
2.36	76	75 - 100
1.18	57	55 - 90
0.600	38	35 - 59
0.300	11	8 - 30
0.150	6	0 - 10

Table 4. Physical properties of fine aggregate*

Physical properties	Test results	Limits of Iraqi Specification No.45/1984
Specific gravity	2.7	-
Sulfate content	0.1	≤ 0.5%
Absorption	0.74%	-

*Tests for Chemical properties of fine aggregate were performed by the State Company for Inspection and Engineering Rehabilitation (SIER), Baghdad, Iraq.

Coarse Aggregate

A washed saturated dry surface crushed gravel was used for NSC. The grading and physical properties of the coarse aggregate are shown in Tables (5) and (6). The obtained results indicate that the coarse aggregate grading is within the requirement of the Iraqi standards [Iraqi specification No.45/1984].

Table 5. Grading of coarse aggregate

% Passing		
Sieve size	% Coarse Aggregate	Limits of Iraqi Specification No.45/1984
14 mm	100	100
10 mm	92	85 - 100
5 mm	12	0 - 25
pan	-	-

Table 6. Physical properties of fine aggregate*

Physical properties	Test results	Limits of Iraqi Specification No.45/1984
Specific gravity	2.6	-
Sulfate content	0.08%	0.1 max
Absorption	0.70%	-

*Tests for Chemical properties of fine aggregate were performed by the State Company for Inspection and Engineering Rehabilitation (SIER), Baghdad, Iraq.

Mixing Water

Ordinary tap water was used for mixing and curing for all the concrete specimens of this work. A constant water/cement ratio added for all samples of 0.45.

Admixtures

The admixture material used in this research is a pomegranate leaves which considered an inevitable result of *Punica granatum* fruit. The leaves used for this work was dried, grinded to get powder, the emitted product was dried again in an oven for two hours at 50°C to obtain a finely black divided ash,

The griddles sieved by 75μm BS standard size, and kept ready for analysis. Although the low concentration of harmful substances in Pomegranate leaves used in this study, which is almost be negligible, a treatment has been done to decrease it content in a fresh mix.

Experimental Program

A 48 concrete samples have been casted in 150 mm cubes steel molds; The ratio of (PLP/cement) was ranging between 0-1.0% by weight, with a conventional concrete mix proportion of (1:2:4) (cement:sand:gravel) by volume, and a constant rate of water to cement ratio (W/C) of 0.45.

Mixing, Casting, and Curing

A horizontal rotary concrete mixer capacity of 0.19 m^3 as shown in the Plate (1). To cast specimens of steel cylinders, cubes, and prisms molds. The molds were cleaned assembled and oiled. Pomegranate leaves powder was mixed together with cement, aggregate, until a homogeneous mixture was obtained. The measured quantity of water was then added on to the mixture. The mixture was further mixed until a paste of the required workability was obtained. After casting, the specimens are covered with nylon to prevent evaporation of water. After two days, the samples are removed from their molds and cured in water containers at a temperature of about (25°C) until the testing age of (28 days).

Compressive Strength Test

The hydraulic universal testing machine (MFL system) with ultimate load capacity of 3000 kN has been used to test the compressive strength in accordance with the standard procedure of (ASTM- C39/C39M-05) and (BS 1881-Part 116:1983).

Three samples of cube blocks were crushed at 28 days per each mix, as shown in the Plate (2), and the average value per each ratio of PPC has been compared with the value of NSC, as shown in the Table (7).

Plate 1. Rotary concrete mix used in this study

Table 7. Results values of compressive strength of concrete

No.	PLP/Cement Ratio %R	Type of Concrete	Average* Compressive Strength of Cube (MPa)	Compressive Strength increasing Ratio%
1	0	NSC**	28.11	----
2	0.001	PLP***	28.75	2.27677
3	0.05	PLP	29.20	3.877624
4	0.1	PLP	31.25	11.1704
5	**0.15**	**PLP**	**32.16**	**14.40768**
6	0.2	PLP	28.76	2.312344
7	0.25	PLP	24.51	-12.8068
8	0.3	PLP	22.18	-21.0957
9	0.35	PLP	20.66	-26.503
10	0.4	PLP	19.00	-32.4084
11	0.45	PLP	16.50	-41.302
12	0.5	PLP	15.09	-46.318
13	0.55	PLP	14.00	-50.1957
14	0.6	PLP	13.20	-53.0416
15	0.65	PLP	12.37	-55.9943
16	0.7	PLP	11.00	-60.868
17	0.75	PLP	9.17	-67.3782
18	0.8	PLP	7.50	-73.3191
19	0.85	PLP	4.25	-84.8808
20	0.9	PLP	4.00	-85.7702
21	0.95	PLP	3.21	-88.5806
22	1	PLP	1.38	-96.3074

*each value represents the average of 3 specimens tested values

**Normal Strength Concrete.

*** Pomegranate Peel Concrete

Plate 2. Test of compressive strength of concrete

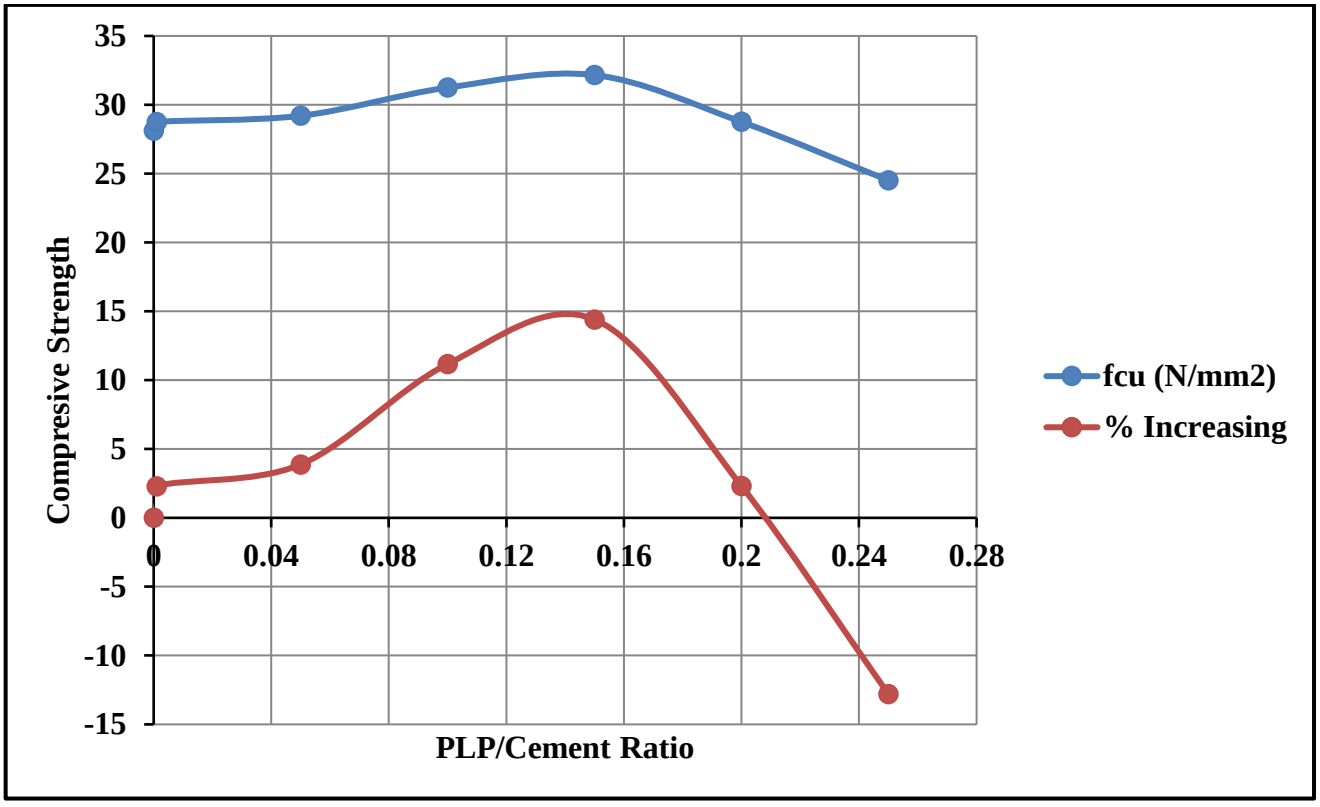

Figure 5. Relation between Compressive Strength and PLP/ cement ratio

The maximum values of average compressive strength of cube, gained when the pomegranate leaves/cement ratio is 15%, which considered as a perfect value of the pomegranate peel/cement ratio as an admixture.

III.CONCLUSION

1. Performance the compressive strength of the concrete using the natural materials of PLP. This study considered an eco-friendly method and decrease the aggravate of chemicals admixtures added to the concrete.
2. Adding 0.15% of (pomegranate peel/cement) to the normal strength fresh concrete mix proportion (1:2:4) and W/C ratio 0.45, will increase the compressive strength value by

14.40%. Since, each 100 g of pomegranate shell contains 162.1 mg of calcium [10]; it contributes additional formation of calcium gel that contributes to the strength development of the concrete because the C-S-H gel was produced. This gel filled the void between cement matrixes and causes the densification effect.

3. The maximum compressive strength of concrete presented with the ratio of 0.15% of the PLP/Cement added to the concrete. Increasing of the PLP/Cement ratio more than 0.15%, will decrease the compressive strength values, since the higher amount of (PLP/Cement) prevent binder (cement) to complete the chemical reaction.

IV. REFERENCES

[1]. Kranzberg, Melvin (July 1986). "Technology and History: "Kranzberg's Laws". Technology and Culture. 27 (3): 544–560..

[2]. ACI Committee E-701, American Concrete Institute, Chemical Admixtures for Concrete, January 2013, pp 13.

[3]. BS 1881-Part 102: 1983, “Slump Test, " British Standards Institute BSI, London.

[4]. Amani S. Al-Rawahi, Giles Edwards , Mohammed Al-Sibani , Ghanim Al-Thani , Ahmed S. Al-Harrasi and Mohammed Shafiur Rahman1,(2014) " Phenolic Constituents of Pomegranate Peels (Punica granatum L.) Cultivated in Oman", European Journal of Medicinal Plants, 4(3): 315-331, pp.317.

[5]. Amin Nooryan, Ang-604-11/5/2014"Types of Admixtures for Concrete", Islamic Azad University.

[6]. ASTM C494 / C494M-15a, Standard Specification for Chemical Admixtures for Concrete, ASTM International, West Conshohocken, PA, 2015, www.astm.org.

[7]. Chong, W., Changhui, Y., W., and Xincheng, P.,(2012) "Preparation of Ultra-High Performance Concrete with common technology and materials" , Journal of Cement and Concrete Composites, Vol. 34, 2012, pp. 538 –544.].

[8]. Environment Agency. (2000)"Risks of contaminated land to buildings, building materials and services", A literature review, R&D Technical Report P331, Environment Agency, Sweden.

[9]. Abbas, M. N. and Abbas, F. S. (2013). "The Predisposition of Iraqi Rice Husk to Remove Heavy Metals from Aqueous Solutions and Capitalized from Waste Residue." Research Journal of Applied Sciences, Engineering and Technology 6(22): 4237-4246, ISSN: 2040-7459.

[10]. Manal A. Sorour1 , Ayat E. Rizk2 , Dalia M. Elsheikh. (2014)" Drying of Pomgeranate Waste". International Journal of Advanced Technology in Engineering and Science. Volume No.02, Issue No. 10, October 2014. Page 271.

Cite this article as :