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Experimental Studies on Mechanical Properties of Light Weight Expanded Clay Aggregates and Silica Fume

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Abstract:The use of lightweight aggregate concrete in construction has been steadily rising over the last decade. These aggregates may be either natural or manufactured from natural materials or from industrial by-products. The most widely used artificial LWAC are manufactured from expanded clay, expanded glass, sintered ash etc. These aggregates vary in their composition, density, surface texture, porosity and water absorption capacity. The Light weight Expanded clay aggregates are one of most used aggregate now-a-day .Majorly its reduces 30% of dead load to the structure. The usage of the cement now a days is very high so by replacing it with the silica fume which is a by product of the silica metal. These silica fume are finer than the cement. The purpose of this study to investigate the Light Weight Expanded Clay particles & silica fume as a partial replacement of Aggregates & cement in concrete with different percentages which could be the alternatives to conventional material constituents.

Keywords: LECA, SILLICA FUME

1. Introduction

Recently, with the speedy development of high rise buildings, floating marine platforms, larger sized and long span concrete structures, light-weight concrete (LWC) has been a promising fashionable construction material.

The concrete whose density is relatively but that of traditional standard concrete is termed as light-weight weight concrete. In comparison with standard concrete, LWC shows some excellent characteristics such as lower density, higher specific strength, better thermal insulation and greater energy absorption which can be obtained by replacing commonplace mixture completely or part by light-weight mixture (LWA). Due to that we are going to use LECA (light weight clay aggregate) & Silica fume which are a partial replacement of coarse aggregate & cement. The silica fume is added in the replacement of cement in different proportions of 5%, 10 %, 15%, 20%, 25%.The LECA is added in the replacement of coarse aggregate in different proportions of 5%, 10 %, 15%, 20%. After that by making Silica Fume constant at 15% different proportion of LECA are added then tested.

1.1 LECA

LECA is an acronym term or (light weight expanded clay aggregate) which is produced in rotary kiln at about 1200oC. The production of light-weight enlarged clay mixture (LECA) becomes a lot of common since the stuff is clay thatis overabundant everywhere the globe.

LECA is named as Brazilian lightweight aggregate and Azerit in Brazil and Azerbaijan, respectively. The production and use of LECA isn't wide in Turkey partially as a result of the natural light-weight mixturesources ar offered and partially as a result of the employment of light-weight structural parts in constructions is not common.

1.2 Silica Fume

Silica fume may be a by product of manufacturing atomic number 14 metal or ferrosilicon alloys. One of the foremost useful uses for silicon dioxide fume is in concrete. Because of its chemical and physical properties, it's a awfully reactive pozzolan.

Concrete containing silicon dioxide fume will have terribly high strength and might be terribly sturdy. Silica fume is out there from suppliers of concrete admixtures and, when specified, is simply added during concrete production.Placing, finishing, and natural process silica-fume concrete need special attention on the a part of the concrete contractor.

2.Test results:

Compressive strength of concrete & split strength of concrete The variation of cube strength and split tensile strength for different percentages of LECA & SF are shown in graph below:

Table 1.1 Compressive strength of Concrete with different proportions of Silica fume

Compressive strength KN/mm2		
Percentages	7 days	28days
Nominal mix	28.9	38.9
5% SF	28.12	42.2
10% SF	30.47	44.6
15% SF	32.13	46
20% SF	29.62	43
25% SF	27.29	39.1

Table 1.2 Compressive strength of Concrete with different propositions of LECA

Compressive strength KN/mm2		
PERCENTAGES	7 days	28 days
0%	28.9	38.9
5%	27.2	36.25
10%	25.6	33.2
15%	20.2	29.7
20%	17.9	25.9

Table 1.3 Compressive strength of Concrete with 15% SF & different proportions LECA

Compressive strength N/mm2		
Percentages	7 days	28days
Nominal mix	28.9	38.9
15%SF+5%LECA	26.2	38.2
15%SF+10%LECA	25.2	36
15%SF+15%LECA	17.46	25
15%SF+20%LECA	13.29	19

Table 1.4 Split tensile strength of Concrete with different proportions of Silica fume

Percentages	Split tensile strength KN/mm2
Nominal mix	2.4
5% SF	2.41
10% SF	2.42
15% SF	2.5
20% SF	2.49
25% SF	2.4

Table 1.5 Split tensile strength of Concrete with different propositions of LECA

PERCENTAGES	SPLIT TENSILE STRENGTH N/mm2
0%	2.4
5%	2.38
10%	2.37
15%	2.2
20%	2.16

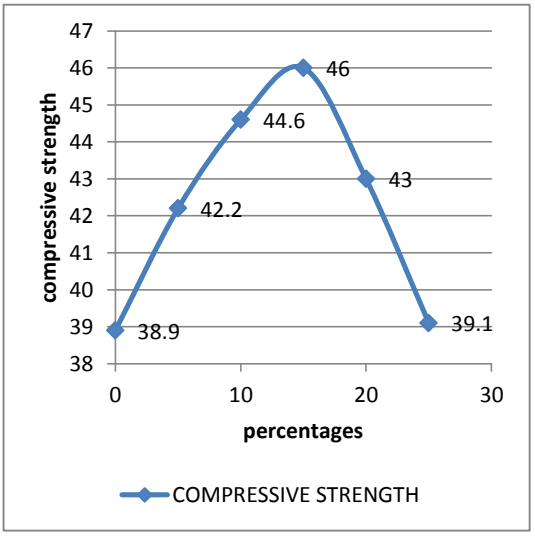

Chart -1 Compressive strength of Concrete with different proportions of SF

Table 1.6 Split tensile strength of Concrete with 15% SF & different proportions LECA

percentages	Split tensile strength 0KN/mm2
Nominal mix	2.4
15%SF+5%LECA	2.7
15%SF+10%LECA	2.55
15%SF+15%LECA	2.3
15%SF+20%LECA	1.96

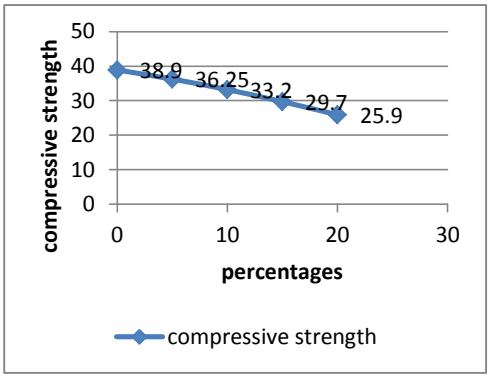

Chart -2 Compressive strength of Concrete with different propositions of LECA

Table 1.7 Weights of LECA with 15% silica fume

Proportion	Weight of cube Kg	Weight of cylinder kg
Nominal	8.95	13.6
15%SF	8.8	13.5
15%SF+5%LECA	8.48	13.28
15%SF+10%LECA	8.4	12.7
15%SF+15%LECA	8.1	12.2
15%SF+20%LECA	7.88	12.1

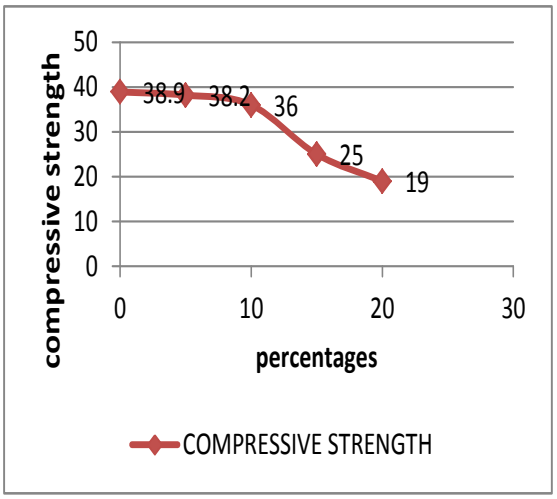

Chart -3 Compressive strength of Concrete with 15% SF & different proportions LECA

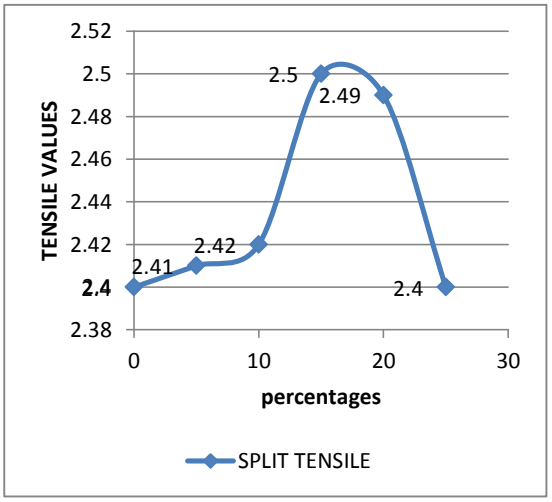

Chart -4 Split tensile strength of Concrete with different proportions of SF

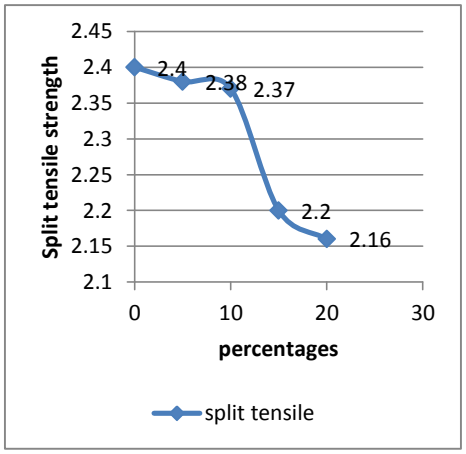

Chart -5 Split tensile strength of Concrete with different propositions of sLECA

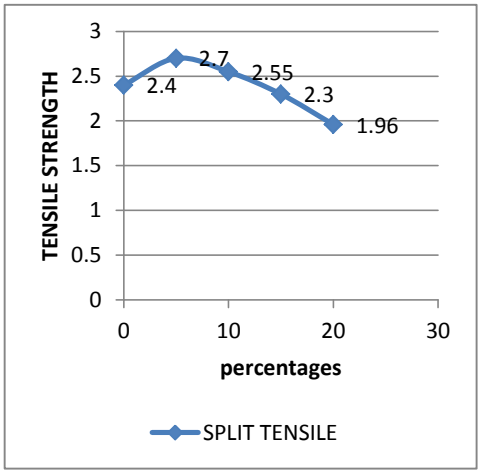

Chart -6 Split tensile strength of Concrete with 15% SF & different proportions LECA

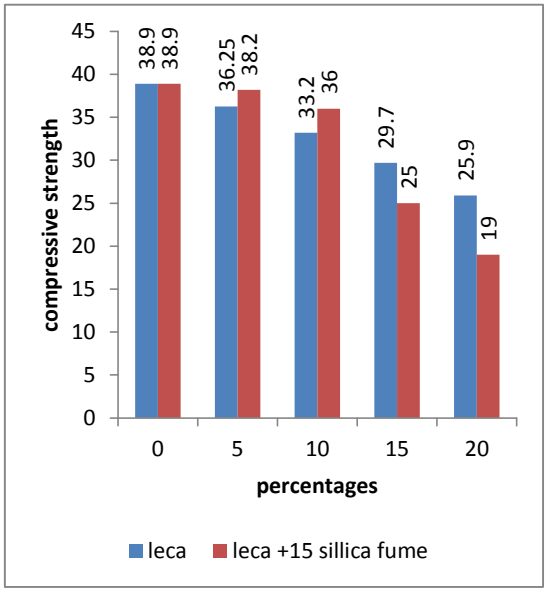

Chart -7 Compressive strength of concrete with different proportions LECA and different proportions of LECA with 15% silica fume

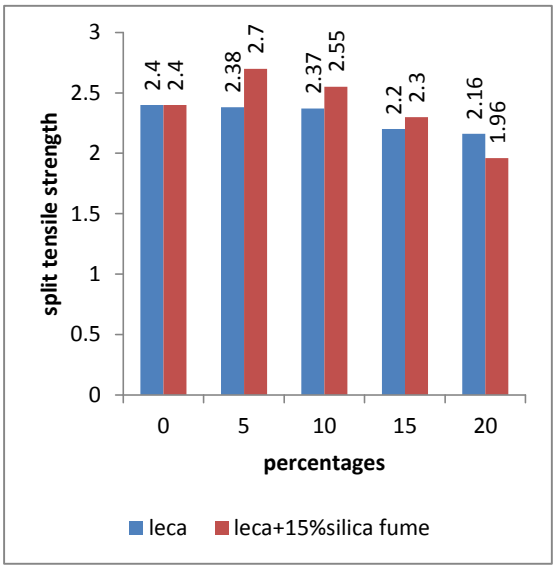

Chart -8 Split Tensile Strength concrete with different proportions LECA and different proportions of LECA with 15% silica fume

3. CONCLUSIONS

From the above observation of graph and it is observed that with increase of SILLICA FUME content that is at 5%,10%,15%,20%,25% increases the compressive strength and split tensile strength of concrete up to 15%. the compressive strength gradually increses to 9.5% at the 15% SF and compression strength decreses beyond 15%. The optimum percentage of silica fume replacement is 15% from our experimental results

When LECA is added to the concrete by replacing it with the coarse aggregate then the different proportions like 5%,10%,15%,20% then the compressive strength & split tensile strength is decreases gradually.

When LECA is also added to the 15% SF in different content of 5%10%,15%,20%, then the compression and the split tensile strength decreases. When 15% of silica fume is added with 5% LECA concrete compressive strength reached to the target mean strength.

It has showed that with increase of LECA increases the workability but when SF is used then the workability is decreased.

We found that coarse aggregate replaced by LECA of 5% & cement replace by 15% of Silica Fume showed better results in compressive strength, split tensile strength. The observation made and conclusions drawn from this study are based on the experimental test results of this research. The conclusions are as follows:

1. The compressive strength increased with increase of percentages of silicafume
2. Split tensile strength gradually increases of silica fume
3. The compressive strength decreased with increase of percentages of LECA
4. Split tensile strength gradually decreases of LECA
5. The workability of the LECA increases with percentage increase
6. The workability of the silica fume decreases with percentage increase

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