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Study On Strength Character and Mechanical Properties of Concrete with Partial Replacement of Fine Aggregate by Perlite

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Abstract

Except for compressive strength, those indices imply that perlite powder has an excessive pozzolanic impact and is an energetic mineral admixture (MA) for concrete. Structural lightweight aggregate concrete is a crucial and flexible material that gives various technical, financial, and environmental-improving and retaining benefits and is designed to be a dominant fabric in the new millennium. For the structural application of light-weight concrete, the density is frequently greater vital than the power. A reduced density for the equal strength level reduces the self-weight, basis length, and construction charges. Lightweight concrete is generally used to reduce the structure's dead weight and reduce the risk of an earthquake. In this have a look at, structural light-weight combination concrete became designed with the use of natural perlite aggregate so one can provide a bonus of lowering the lifeless weight of the structure and to obtain a more good value structural light-weight concrete through the usage of perlite powder as an alternative of the cement

I. INTRODUCTION

Concrete is used in almost every sort of construction. By tradition, concrete has been normally composed of cement, water, and aggregates (aggregates include each coarse and high-quality aggregate).

Although aggregates create up the bulk of the mixture, it's far the hardened cement paste that binds the aggregates collectively and contributes to concrete, with the aggregates serving in large part as low-cost fillers (although their power also is critical). Concrete isn't a homogeneous material, and its strength and structural residences may also vary significantly depending upon its ingredients and method of manufacture.

However, concrete is normally treated in design as a homogeneous material. To increase the tensile strength of concrete, steel reinforcements are used. Such a block of concrete is called Reinforced Cement Concrete,

Those ingredients must be precisely determined, nicely blended, cautiously placed, vibrated (no longer required in self-compacting concretes), and properly cured so that the preferred homes are received; They should also be inspected at everyday intervals and maintained properly until their meant lifestyles.

Even the cement at present being use has undergone a number of changes. Some concretes also being used, some tailored for their intended use, and many with improved properties.

As concrete technology has grown in parallel with the concrete design, it's miles impossible to describe all of the components, their chemistry, the special styles of concretes, and their houses in this chapter; hence, only a brief introduction is given about them, and interested readers should consult a book on concrete technology (many references are given at the end) for further details.

II. LITERATURE REVIEW

A. Dogan and Alkan, 2004; Harben and Bates, 1990: Perlite, obtained from pumice, contains 2–5% water and has a glassy shape of to vapor and causing the fabric to enlarge rhyolite or deictic magma. The economic product, generally exact as increased perlite, is produced by way of heating the cloth to760–1100 °C, thereby changing its indigenous water to 4 to 20 instances its unique extent at the same time as forming light-weight high-porosity aggregates (Dogan and Alkan, 2004; Harben and Bates, 1990). The heating process does not now exchange the perlite density (2.2–2.3 kg/m3); however, the bulk density decreases to 60–80to 35–50 cmol/kg, as a result of the multiplication of broken edges and amplified specific surface area from 1.2 to 2.3 m^2/g.

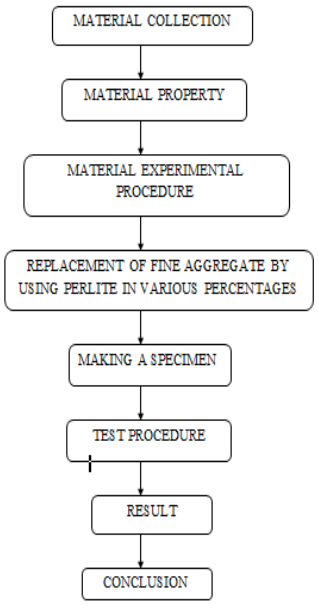
B. Topco and Isıkdag, 2007: Perlite is the mineral obsidian. Perlite Mineral deposits exist in many countries of the sector. However, the elevated product is most effective in international locations that have expanding industrial flowers (Topco and Isıkdag, 2007). The world reserves of perlite are anticipated as seven hundred million tons. In 2011, 1.7 million tons were produced, generally by using Greece (500.000 Mg), America (375.000 t), and Turkey (220.000 Mg); but, no information for China, the leading producer, became available (Bolen, 2011). Turkey’s 160.000 tons of likely perlite reserves are located in Menderes,

İzmir. Even though our united states of America have rich resources and perlite capacity, domestic demand may be very constrained, and the maximum of the produced perlite is imported.

C. Topco and Isıkdag, 2008:
Perlite is used in numerous areas, which includes construction materials, agriculture, clinical and chemical enterprise. Moreover, multiplied perlite mixture (EPA) has been used inside the constructional elements, including brick, plaster, pipe, wall, and ground block; but has not been industrially utilized in concrete yet. The EPA is a warm and sound insulator, and light-weight fabric ensures financial blessings in structures (Topco and Isıkdag, 2008). Many researchers have studied the function houses of the perlites and their use as production substances (Singh and Garg, 1991; Demirboga et al., 2001; Demirboga and Gul, 2003; Lanzon and Garcia-Ruiz, 2008; Sari et al., 2009; Sengul et al., 2011; Çelik, 2010). In those research,
especially using perlite as a thermal insulator in light-weight concrete and brick production was tested.

D. Meral (2004), Canadian Minerals Yearbook (1997): The increased perlite combination (EPA) has a huge range of makes use of, usually because of its homes of extremely low bulk density, excessive brightness, excessive absorption, low thermal and acoustic conductivity, and non-flammability. The absence of any obvious health danger is likewise increasing its utilization charge. Thanks to its thermal or acoustic insulation, light-weight, and hearth resistance, (EPA) is usually used in production packages, specifically concrete and mortar. EPA concrete provides sound deadening homes and is thermal insulating as nicely, depending on blend layout [Meral (2004), Canadian Minerals Yearbook (1997)].

III. METHODOLOGY



IV. MATERIALS COLLECTION

A. Concrete

Concrete is a composite material that includes a cement paste inside which numerous satisfactory and coarse aggregates are embedded. It incorporates a few amounts of entrapped air and may incorporate purposely-entrained air by means of the use of air-entraining admixtures. Numerous chemical admixtures and/or finely separated mineral admixtures are often used inside the concrete production to improve or modify its residences or reap extra cost-effective concrete.

B. Cement

Cement is a standard term that may practice in all binders. There is an extensive kind of cement types used to some extent in the construction and building industries or to resolve special issues. The chemical composition of these cement types may be pretty diverse; however, the greatest quantity of concrete used nowadays is made with Portland types of cement.

Description of test	**Test results obtained**	**Requirements of IS: 8112 1989**
Initial setting time	65 minutes	Min. 30minutes
Final setting time	270 minutes	Max. 600minutes
Fineness (specific surface by Blaine's air permeability test)	412.92 m^2/kg	Min.225 m^2/kg

Table 1 Test Result on Cement

Fig 1 Cement

C. Aggregate

Crushed granite mixture with a specific gravity of 2.77 and passing thru thr sieve casting specimens used 4.75 mm. Several investigations concluded that the maximum length of coarse mixture ought to be restrained in the composite's energy. Similar to

cement paste – mixture ratio, combination kind has an excellent impact on concrete dimensional stability.

Fig 2 Coarse Aggregate

D. Fine aggregate

The sand, which becomes regionally available and passing thru a 4.75mm IS sieve, is used. The particular gravity of exceptional aggregate becomes 2.60. For casting specimens, sand passing through IS Sieve 4.75 mm size is used. Topically available clean and dry sand, conforming IS 383 – 1970 grading zone 1 was used.

Fig 3 Fine Aggregate

E. Water

The water used for experiments turned into potable water. Water plays a major role in concrete. It chemically reacts with cement. It must be free from the organic count, and the pH value must be between 6 to 7.

F. Properties and uses of perlite

Perlite will become tender, as it's far a tumbler, at a temperature of 850-900°C. The trapped water inside the perlite escapes the structure and makes the material extend 7 - 15 instances of its unique quantity. The uncooked perlite density or the unexpanded perlite is around 1100 kg/m3 (1.1 g/cm3). The density of typically elevated perlite is 30 - 150kg/m3. Since perlite has a low density and is surprisingly cost-effective, it's far used commercially in the following ways:

Fig 4 Perlite

Parameter	Data
Color	Gray, white, black
Softening point	800 - 1000 °C
Melting point	1.315 - 1.390 °C
pH	6.6 - 8.0
Specific heat	0.2 kcal/kg°C
Maximum free moisture	0.5 percent

Table 2 Physical Properties of Perlite

V. MIX DESIGN

MIX PROPORTION

Cement (kg)/ m^3	**FA (kg)/ m^3**	**CA (kg)/ m^3**	**Water (kg)/ m^3**	**Super plasticizer**
547.37	656.42	1141.99	191.58	2% of cement content

REPLACEMENT OF FINE AGGREGATE PERLITE

S.No	**Percentage**	**Fine Aggregate (kg/m^3)**	**Perlite (kg/m^3)**
1	5	623.599	32.821
2	10	590.778	65.642
3	15	556.957	98.463

VI. TESTING PROCEDURE

A. Compressive strength of concrete

Out of various tests apply to the concrete, that is the maximum essential that gives approximately all of the concrete character. The compressive energy of concrete depends on many elements: water-cement ratio, cement electricity, first-rate of concrete material, and quality manage at some point of manufacturing of concrete.

B. Splitting tensile strength test

The tensile strength of concrete is one of the simple and crucial properties. Splitting the tensile power test on the concrete cylinder is a method to decide the concrete's tensile strength.

C. Water absorption test

The 100x50 mm dia specimen cylinder after casting specimens had been then oven-dried for twenty-four hours at the temperature110°C until the mass became steady and again weighed. This weight became mentioned because of the dry weight (W_1) of the cylinder. After that, the specimen was changed into kept in hot water at 85°c for 3.5 hours. Then this weight became stated as the wet weight (W2) of the cylinder.

VII. TEST RESULT

A. Compression strength

Mix Design	Curing Days	15%		35%		50%	
		LOAD (KN)	Compressive Strength (N/mm$^{2)}$	LOAD (KN)	Compressive Strength (N/mm$^{2)}$	LOAD (KN)	Compressive Strength (N/mm^2)
M40	7	596.25	26.5	575.1	25.56	526.5	23.4
	14	911.25	40.5	819.9	36.44	732.6	31.5
	28	1012.5	45	967.5	43	933.75	39.5

Table 3 Compression Test Result

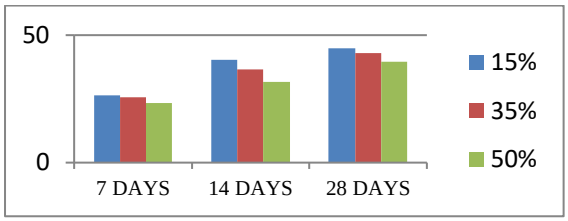


Fig 5 Compressive Test Result Comparison

B. Split tensile strength

Mix Design	Curing Days	15%		35%		50%	
		Load (kn)	Split strength (n/mm$^{2)}$	Load (kn)	Split strength (n/mm$^{2)}$	Load (kn)	Split strength (n/mm$^{2)}$
M40	7	254.46	3.6	251.64	3.56	238.92	3.38
	14	307.48	4.35	296.88	4.20	277.1	3.92
	28	331.56	4.69	317.38	4.49	303.24	4.29

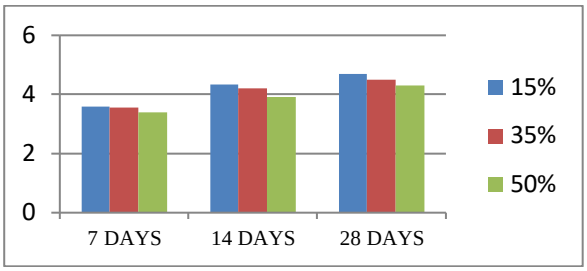


Fig 6 Split Tensile Test Comparison

C. Water absorption test

Sample No	Dry Weight Of Specimen (W1)	Wet Weight Of Specimen(W2)	% Water Absorption
Sample 1	1.072	1.08	0.74
Sample 2	1.073	1.079	0.55
Sample 3	1.075	1.081	0.56

Table 4 Water Absorption Test Result

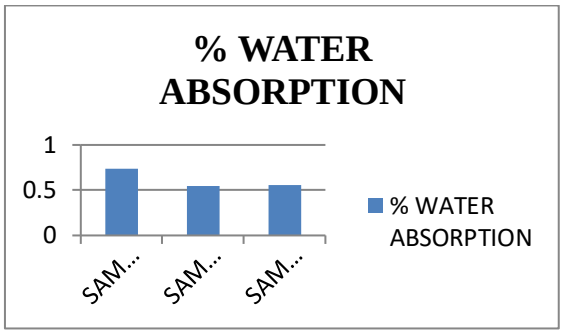


Fig 7 Water Absorption Test Comparisons

VIII. CONCLUSION

The results show that the perlite waste can be considered as an option siliceous source to reduce the consumption of sand used as aggregate in concrete. Results conducted on samples made with water-cement ratio of 0.55 and 0.35 shows a significant pozzolanic performance on the perlite attention. The positive effect of perlite is 0/35 times more on the compressive strength.

These test results have shown an increase of about 50% in the design containing 15% perlite and compressive strength, similar to the control design containing 15% perlite at the age of 28 days. The

sample quality evaluation was done through destructive tests, and ultrasonic velocity measurement also showed favorable properties of concrete containing 15% of perlite. It's miles worth noting that disposal and use of waste products, which include perlite waste, is difficult because of the trouble of dusting in its remedy within the dry state and the creation of waste on the wet level grinding quartz sand allows removing that hassle. The usage of perlite waste to replace sand.

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