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Original Research Article

Study of Coarse Aggregate Characteristics on Strength Properties of High Performance Concrete Using Chemical Admixtures

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Abstract

Shape and grading of aggregates can influence concrete workability. The volumes of water for well graded and poorly graded vary along with cementations materials are commonly increased to adjust. The basic purpose of this paper is to show that by properly selection of aggregates and changing mixture proportions, the proportion of cementations materials provided for workability can be minimized while achieving suitable workability and strength properties. In this research study of strength properties of high Performance concrete is achieved by using diverse characteristics of aggregate and the results obtained from laboratory testing of concrete having varying aggregate characteristics. By the purpose of this work, two types of coarse aggregates have been used. The fine aggregate is normal sand obtained from a locally available (BHOLARI /JAMSHORO AREA Latitude: 25.317. Longitude: 68.217 AND 25.416868, longitude is 68.274307. Jamshoro, Pakistan) initial laboratory investigation was conducted to obtain the suitability of using the aggregates for construction work. The various tests conducted include sieve analysis, bulk density, and specific gravity. ASTM mix design was adopted for this work and mix compositions were calculated by absolute volume method. For each and every type of coarse aggregate 25 numbers cubes (150x150x150mm) were cast to allow the compressive strength to be monitored at. 56 days. Test result reveals that concrete made from a type aggregate has higher compressive strength.
Keywords: Concrete, Compressive strength, effect of coarse & fine Aggregate, Alccofine.

INTRODUCTION

Shape and grading of aggregates can significantly influence concrete workability. Poorly shaped and poorly graded aggregates tgenerally show a lower packing density than well shaped and well graded aggregates, as a result more paste being required to fill the voids between aggregates. As the more paste volume needed to fill the voids is reduced, the fluidity of the paste must be increased to maintain a given workability level. As, poorly shaped aggregates show increased inter particle friction, resulting in reduced workability. The concrete mixtures having poorly shaped and poorly graded aggregates often require higher water and cementations materials requirements than those with well shaped and well graded aggregates to maintain the same workability. The right selection of aggregates can minimize the increased water and cementations materials contents needed to ensure adequate workability.

The compressive strength of concrete is generally dependent on the water to cement ratio, degree of compaction, ratio of cement to aggregate, bond between mortar and aggregate, and grading, shape, strength and size of the aggregate. Concrete can be classified as a multi-phase composite material made up of three phases; namely the mortar, mortar/aggregate interface, and the coarse aggregate phase. The coarse aggregate in normal concrete are taken from rock fragments characterised by high strength. Therefore, the aggregate interface is not a limiting factor governing the strength requirement standards. The caause of failure is manifested by crack growth in the concrete. For normal concrete the crack growth is mainly near the cement paste or at the aggregate/cement paste interfacial zone. The strength of concrete at the interfacial zone mostly depends on the integrity of the cement paste and the nature of the coarse aggregate.

The resultant effect of two different types of coarse aggregate coarse aggregate on the mechanical properties of high-performance concrete was investigated. The end result of the study reveals that the strength, stiffness, and fracture energy of concrete for a given water/cement ratio depend on the type of aggregate The result of cement and particle size distribution of coarse aggregate on the compressive

strength of concrete have been investigated [1]. The main property compressive strength, stiffness, and fracture energy of concrete for a given water/cement ratio (W/C) depend on the type of aggregate, especially for high-strength concrete. It is advised that high-strength concrete with lower brittleness can be made by selecting high-strength aggregate with low brittleness [2]. The type of coarse aggregate also affects the modulus of elasticity of concrete. Weaker aggregates go to produce a more ductile concrete than stronger aggregates do [3].

Three different types of coarse aggregates were mixed in four different proportions for concrete production. The Plasticizers and Super plasticizers were used in some mixes to reduce the water to cement ratio. The result of their work showed that the mixture with a ternary combination of granular fraction with a maximum size of 25mm, with no admixtures have shown the highest compressive strength. The lower water to cement ratio, the binary granular system produced the highest compressive strength. The result of this paper reveals the research undertaken to investigate the effect of two different types of coarse aggregate on the compressive strength of normal concrete.

MATERIALS

Cement

Ordinary Portland cement (OPC)-55 grades (Pakland Cement) widely available in all over Pakistan has been used in investigation. The cement was tested according to ASTM C150 / C150M – 18. The cement Properties are given in Table 1.

Table-1: Properties of OPC - 55 Grade Used

SR.	Properties		Value	As per
No.	Specific gravity		3.0	ASTM C-150
1	Normal consistency		32%	3.15
2	Initial setting time		35	30% - 34%
3	Final setting time		455	>30
4	Fineness (%passing 90 IS sieve)		4%	<600
5	Soundness (mm)		1.5	<10%
6	Compressive strength	3 day	40	<10
7		7 day	41	>27
		28 day	58	>37
II.II	Coarse Aggregate			>53

Two different types of coarse aggregates from two different sources were used. The Sieve analysis is given in Figure 1. And Figure 3.and Its Properties are given in Table 2.

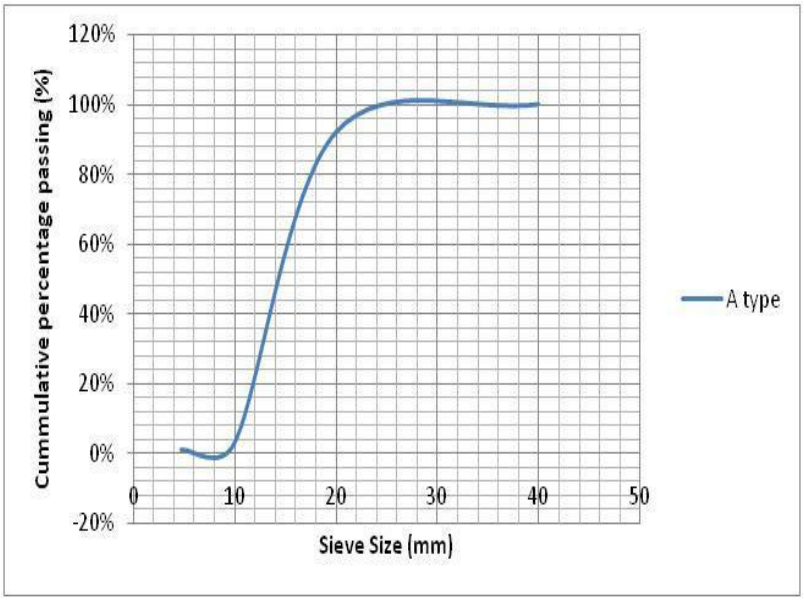

Fig-1: Sieve analysis for a type Coarse aggregate

Fig-2: Picture of coarse and fine aggregates used in experimental work

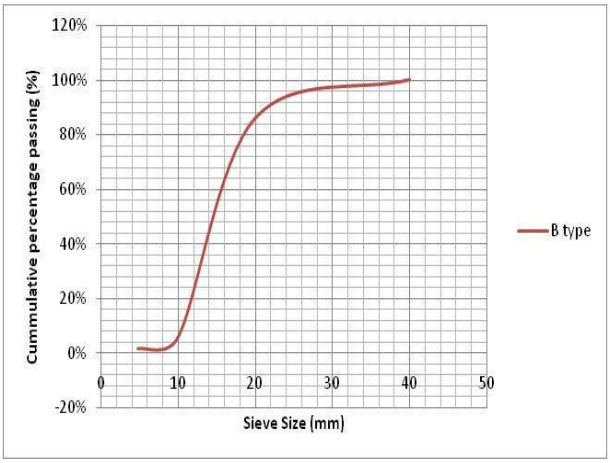

Fig-3: Sieve analysis for B type coarse aggregate

Fine Aggregate

Natural sand as per ASTM C-33-93-2000 was used. Locally available River sand having bulk density 1865 kg/m3 was used The properties of fine aggregate are shown in Table 2.

Table-2: Physical properties of aggregates

Aggregate type	Dry density (kg/m^3)	specific gravity	Surface Moisture (%)	Water Absorption (%)	Loss on Abrasion (%)
A Type Course.	1827	2.8	0	2.20	22.9
B Type Course.	1655	2.82	0.4	3.16	30.41
Sand	2.66 (F.M.)	2.65	0.6	0.8	--

Alccofine

ALCCOFINE 1203 is a particularly processed product based on slag of high glass content with high reactivity obtained through the process of controlled granulation. ALCCOFINE 1203 use in project conforming to ASTM C989-99. Physical & Chemical Properties of Alccofine is given in Table 3.

Table-3: Physical & Chemical Properties of Alccofine

Fineness (cm2/gm)	Specific Gravity	Bulk Density (Kg/m3)	Particle Size Distribution		
			d10	d50	d90
>12000	2.8	780-900	1.5 micron	5 micron	8 micron
Chemical Properties:					
C_aO	SO_3	SiO_2	AL_2O_3	Fe_2O_3	M_gO
62-64%	2-2.5 %	20-23 %	5-5.5 %	3.8-4.5 %	0.8-1.5 %

Super plasticizer

This investigation contains super plasticizer-GLENIUM SKY 784 is based on second generation polycarboxylic ether polymers, developed using Nano technology. Chemical Admixture GLENIUM SKY 784 is conforming to ASTM C-494 TYPE D was used to improve the workability of concrete. The properties of super plasticizer are given as under in Table 4.

Table-4: Properties of super plasticizer

Parameter	Specification	Results
	(as per IS 9103)	
Physical state	Light brown liquid	Light brown liquid
Chemical name of	Polycarboxylate	Polycarboxylate
active ingredient	polymers	Polymers
Relative density at 25 c	1.1±0.01	1.103
ph	Min 6	6.52
Chloride ion content (%)	Max 0.2	0.0018
Dry material content	34±5(%)	33.14

Experimentalwork

Concrete cubes of 150 X 150 X 150 mm dimension were cast for compressive strength. The compressive strength after 56 days of water curing was tested. For this, five specimens were tested and the mean value of these measurements is reported. Coarse aggregate contain 10 mm and 20 mm of 40% and 60% respectively.

Table-5: Mix proportions for different mixes (For one cubic meter of concrete)

	Mix designation	W/B ratio	Cement (Kg)	Fly-Ash (Kg)	Alccofine (Kg)	Coarse Aggregate (Kg)	Sand (Kg)	Water (litres)
Type A Coarse Aggregate	M1	0.28	406.75	112.42	38	1175	635	156
	M2	0.30	380.6	105	36.5	1187	663	156
	M3	0.35	328.45	88.71	31.5	1206	722	157
	M4	0.40	285.52	79.5	27.57	1235	786	157
	M5	0.50	278.59	75.6	27.81	1253	847	191.5
	M1	0.28	405.71	113.42	39.2	1184	642	156
	M2	0.30	377.6	106	36.45	1195	669	156
	M3	0.35	326.45	89.75	31.45	1202	735	157
	M4	0.40	287.52	78.51	27.48	1226	793	157
	M5	0.50	278.59	76.65	26.89	1243	855	191.5

RESULTS AND DISCUSSIONS

The results of compressive strength have been presented in Table 6. The C S test was carried out conforming to ASTM C150 / C150M – 18 to obtain compressive strength of concrete at the age of 56 days. The Compression Testing Machine was used to test the cubes (CTM) of capacity 2000KN. Strength is near 28. 62 N/mm2 and 62.50 N/mm2 at 56 days. The heighest value of compressive strength is observed In the Type a Coarse Aggregate. The significant improvement was observed in the compressive strength of concrete because of the Physical properties of Type a Coarse Aggregate and Compatibility.

Table-6: Compressive Strength (N/mm^2) of Concrete Mixes

W/B ratio	Type A C oarse Aggregate	Type B Coarse Aggregat e
0.28	65.50	58.28
0.30	55.68	52.33
0.35	50.70	48.30
0.40	47.56	45.26
0.50	35.58	30.62

Table-7: Slump Value and Slump Flow

	Slump h eight in mm		Slump flow in diamete r.	
W/B ratio	Type A Coarse Aggregate	Type B Coarse Aggregate	Type A Coarse Aggregate	Type B Coarse Aggreg ate
0.28	-	-	581	579
0.30	-	-	615	601
0.35	-	-	655	635
0.40	92	86	-	-
0.50	100	96	-	-

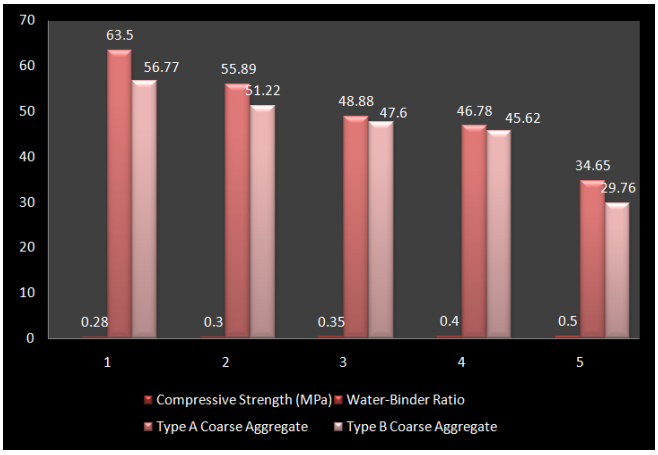

Fig-4: Showing effect t of Aggregate on compressive strengt

Fig-5: Picture showing stock pile of coarse and fine aggregates

CONCLUSIONS

The results of the research described in this paper reveal that aggregates can play an important role in the cement content of concrete mixtures. Specifically, the following conclusions can be assumed:

- Aggregate type shows effect on the compressive strength of normal concrete.
- Type a Coarse Aggregate compares to type B Coarse Aggregate has highest compressive strength.

It is clear from the above investigation, that, Poor Graded and Light weight and Pours Aggregate give Poor compressive strength.

REFERENCES

1. Domone, P. L. (2007). A review of the hardened mechanical properties of self-compacting concrete. *Cement and concrete composites*, *29*(1), 1-12.
2. Aïtcin, P. C., & Mehta, P. K. (1990). Effect of coarse aggregate characteristics on mechanical properties of high-strength concrete. *Materials Journal*, *87*(2), 103-107.
3. Ayub, T., Khan, S. U., & Memon, F. A. (2014). Mechanical characteristics of hardened concrete with different mineral admixtures: a review. *The Scientific World Journal*. *2014*.