EXPERIMENTAL INVESTIGATION OF CONCRETE BY USING CHARCOAL AS AN ADMIXTURE

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ABSTRACT: *In construction industry and in urban areas, many concrete structures like building bridges and roads are razed after a period of time into their service life for purpose of replacement and also due to natural disasters like earthquakes, cyclones and human causes like war and bombing of buildings causes and structural failures. As a result, large amount of demolished concrete is generated as waste. Most of the demolished waste is disposed of by dumping it as land fill or for reclaiming land. But the cost of transportation and the shortage of dumping grounds make disposal of major problems. Also, due to increasing urbanization the natural resources are depleting. It is becoming increasingly difficult to obtain good quality aggregate at reasonable prize. The increase in cost is mainly due to the cost transportation cost and few quarries. Considering the present situation, the best solution would be to reuse the demolished concrete. Our project deals with an experimental investigation of concrete by using charcoal as admixture in different percentages like 2%,3%, 4%,5%and 6% on the strength*

Key words: concrete, charcoal, compression test, flexural test, tensile test

INTRODUCTION

The aim of designing a structure is to fulfill its intended purpose during its intended lifetime adequate serviceability in terms of stiffness, durability, and economy. Safety implies that the like hood of partial or total collapse of the structure is acceptably low not only under the normal expected loads but also under abnormal but portable overloads such as due to earthquake or extreme wind. Collapse may occur due to various possibilities such as exceeding the load bearing capacity, overturning, sliding, buckling, fatigue fracture, etc. Serviceability implies satisfactory performance of the structure under service loads, without discomfort to the user due to excessive deflection, cracking, vibration, etc. other considerations under the preview of Serviceability are durability, impermeability, acoustic and thermal insulation etc. Conservation of natural resources and preservation of environment is the essence of any development. Nature has a way of clearing off some of mess by process of biodegradation, but not certain products have come up which are non-biodegradable. One way of reducing such wastes is the process of adding admixture and this is a solution in many areas. Rapid growth in population and urbanization are pushing the growth in construction, especially in the developing countries and old buildings are being demolished to be replaced with new ones. One of the problems arising from continuous technological and industrial development is the disposal of waste materials. Following this process in discriminately leads to two basic problems on the one had there is an urgent need to fruitfully construction debris, which is often simply thrown away have used has been filling materials, without considering the environment need of the problems .on the other hand ,the industry is facing with the non-availability of good quality aggregates with reasonable distances and deforestation from the thoughtless mining for aggregates from quarries. Research in different countries has suggested the possibility of using the charcoal as an admixture in concrete. Charcoal can be getting from burning of wood this is also one type of waste it can be use in concrete as an admixture.

MATERIAL

CEMENT

Ordinary Portland of 43 grade is used. Cement is an important building material. The cement used was fresh i.e., used within 3 months of manufacture.

PROPERTIES	VALUES
Compressive strength	43Mpa
Fineness	10%
Initial setting time	28min
Final setting time	2-3hours
Standard consistency	29%
Specific gravity	3.15

FINE AGGREGATE

The less amount of clay and slit. The Hire from silt, clay, salts and organic materials and it was clean and dry.

S No	Property	Values
1.	Specific gravity	2.67
2.	Fineness modulus	2.72

COARSE AGGREGATE

The coarse aggregate used passes in 19 mm sieve. It is well graded (should of different particle size and maximum dry packing density and minimum voids) and cubical in shape.

Coarse aggregate	Values
Size	20mm
Bulk density	1674kg/m^3
Fineness modules	6.23
Specific gravity	2.61
Water absorption	0.55%

WATER

Ordinary drinking water available in the construction laboratory was used for casting all specimens of this investigation. It reads chemically with cement and brings about setting and hardening of cement. It lubricates the mix and compact property. Potable water, free from impurities such as oil, alkalis, acids, salts, sugar, and organic materials were used. The quality of water was found to satisfy the requirement if IS456-2000

CHARCOAL ADMIXTURE:

Charcoal is the dark grey residue consisting of carbon, and any remaining ash, obtained by removing water and other volatile constituents from animal and vegetation substances. Charcoal is usually produced by slow pyrolysis, the heating of wood or other substances in the absence of oxygen.

Methodology

CONCRETE MIX

Grade of concrete selected is M30 (1:1.02:2.26) and water content adopted is 0.38. The mix proportion was designed in accordance with IS (456-2000) for good degree of quality control and moderate exposure condition. The controlled mixes were prepared by using natural sand as fine aggregate and for comparison 100 percent crusher sand was used in companion mixes.

Charcoal properties`	Values
Specific gravity	0.38
Water absorption in %	10%

PREPARATION OF TEST SPECIMEN

Concrete is mixed in roller type mixing machine. Care is taken to see that the concrete is properly placed beneath and along the sides of the mold with help of trowel and vibrating table. The following specimens are cast to study the mechanical properties of conventional and replaced concrete. 9No's of cube of size 150*150*150mm 3 No's per each mix for 7 and 28 days and each percentage of charcoal (0%,2%,3%,4%,5%and 6%) 9 No's of cylinder of size 150mm diameter & 300mm height 3 No's per each mix for 28 days and each percentage of charcoal (0%,2%,3%,4%,5%and 6%)

CASTING AND CURING

The mold specification, preparation of mold the method of casting and curing are discussed in following.

S.No	Specimen	Size (mm)
1	Cube	150x150x150
2	Beam	100x100x500
3	Cylinder	150dia. & 300 height

CASTING AND CURING OF SPECIMEN

- Concrete using grade M30 (1:1.02:2.26) with water cement ratio 0.38 were used.
- Cubes, beams, and cylinders (7&28days) were prepared by using charcoal as

Admixture

COMPACTION OF CONCRETE

Compaction of concrete is the process adopted for expelling the entrapped air from the concrete. The concrete was placed in the molds after the mixing. The concrete filled molds are kept on the vibration table for compaction. The concrete was compacted both through table vibrator as well as through hand compaction. The specimen was finished smooth and taken out of the vibrating table.

CURING OF SPECIMEN

The test specimen was De- mold after 24hours of casting. The De-mold specimen was immersed in the curing tank and stored in place free from vibration and at a temperature of 27°C. The molds could cure for 7 and 28 days.

TESTING AND ANALYSIS OF SPECIMEN

CUBE COMPRESSION TEST

The cubes of size 150x150x150mm are placed in the machine such that load is applied on the opposite side of the cubes as casted. Align carefully and load is applied, till the specimen breaks. The formula used for calculation Compressive Strength= total failure load / area of the cube

SPLIT TENSILE TEST

The test is carried out by placing cylinder specimen of dimension 150mm diameter and 300mm length, horizontally between the loading surface of compression testing machine and the load is applied until failure of the cylinder along the vertical diameter. The failure load of the specimen is noted. The failure load of tensile strength of cylinder is calculated by using the formula Tensile strength= 2P / 3.14 DL

Where, P- Failure load of the specimen, D-Diameter of the specimen, L-Length of specimen

FLEXURAL TEST: The test is carried out to find the flexural strength of the prism of dimension 100 x 100 x 500 mm. The prism is then placed in the machine in such manner that the load is applied to the uppermost surface as cast in the mold. Two points loading adopted on an effective span of 400 mm while testing the prism. The load is applied until the failure of the prism. By using the failure load of prism Flexural strength = PL/bd^2

Where, P – failure load of the prism, L- length of the prism, b-breadth of the prism, d-depth of the prism

Results and discussions: The test results of compressive strength show the consistent increase in the overall strength of concrete prepared by using charcoal as admixture. By adding of the charcoal, the corrosion can be reduced. And this charcoal has well fire-resistant properties so it can reduce the fire damages in concrete. This charcoal admixture slightly increasing the strength of concrete rather than the conventional concrete. We can use this charcoal admixture up to 4% for strength. The result is shown in the graphs below.

s.no	% of charcoal adding	Compressive strength Mpa (28days)
1	0%	31.7
2	2%	32.1
3	3%	33.3
4	4%	34.0
5	5%	33.5

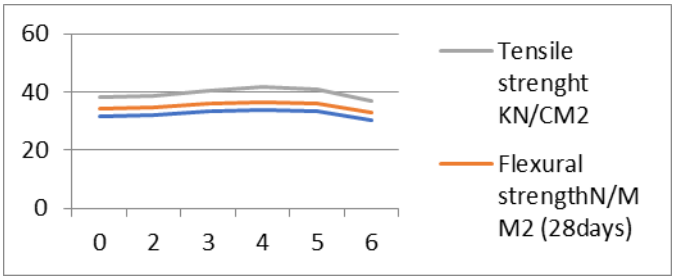
Compression strength

S.no	% of charcoal adding	Split Tensile KN/cm² (28days)
1	0%	2.45
2	2%	2.48
3	3%	2.51
4	4%	2.63
5	5%	2.55

S.no	% of adding	Flexural strength MM² (28days)
1	0%	4.13
2	2%	4.26
3	3%	4.44
4	4%	5.02
5	5%	4.82
6	6%	4.32

Split tensile strength

Flexural strength



Graphical representation of tensile, compression, flexural strength

CONCLUSION

Based on this experimental investigation the behavior of charcoal concrete and concrete was concluded. The additions of charcoal in concrete at 0 %, 2%, 3% 4%,5% and 6% by weight of total material has not given any additional mechanical properties of concrete. Usually concrete with admixtures perform better durability properties, but with the admixing of charcoal is found to be only slightly marginal improvement as compared to the conventional concrete. An experimental study was carried out to investigate the properties of concrete with charcoal admixture. The charcoal admixture used in this investigation is of free cost since it is the waste obtained from the wood burning place. It can be concluded that 4% replacement of charcoal as admixture gives the maximum compressive strength, tensile strength, flexural strength. The percentage of charcoal adding can be increased up to 4% and their characteristics can be studied and use in the concrete construction works. The charcoal admixture can be used in various grades of concrete and various percentages. There is scope for doing further investigation to increase the strength by analyzing durability properties. Further this experiment can be extended to the field conditions, real time condition also. It is obtained from only from burning wastes, so we can use this very low cost for further uses.

References

- IS: 383-1970, "specification for coarse and fine aggregate from natural sources for concrete", Bureau of Indian standards, New Delhi.
- J. W.; Li, R. (2001) "A Novel Strategy for CO2 Sequestration and Clean Air Protection," Proceedings of First National Conference on Carbon Sequestration, Washington, DC, May 14)17, 2001.
- J. W.; Li, R. (1998) "Method for Reducing CO2, CO, NOx, and SOx Emissions," 1998 Oak Ridge National Laboratory Invention Disclosure, ERID 0631; 2002 U.S. Patent No. US 6,447,437 B1.
- Lee, J. W., and R. Li (2002). "Integration of Coal-Fired Energy Systems with CO2 Sequestration through NH4HCO3 Production," Energy Convers. Manage.