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UTILIZATION OF GRANITE POWDER IN CEMENT MORTAR

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ABSTRACT:

The world is struggling with the problem of solid waste disposal. Such materials are causing pollution and damages related to it. The industry of dimensional granite stone has contributed to the development of major environmental problems due to waste generation at different stages of mining and processing operations. The complete process involved with granite starting from mining till the finished product contributes to around 60-80% of the worked masses of the mineral mined, the sludge generated being estimated over 30% of the volume of the sawn block. For dealing with the problem of waste generated by the granite production industry, studies are being conducted for the incorporation of granite sludge as partial or complete replacement of aggregates in cement concrete. This paper elaborates on the study conducted to test the compressive strength, flexural strength, pull-off strength, abrasion resistance, drying shrinkage, air and water permeability, rapid chloride permeability, alkalinity and resistance to sulphate attack in concrete specimen.

INRODUCTION:

The problem of solid waste disposal is a major global concern. The damages that it has been causing to the environment are drastic. Solid waste is produced mainly from industrial processing, mining and agriculture, and is disposed inefficiently. The waste produced during mining, processing and finishing of rocks such as granite, marble, sandstone, etc., constitutes a large quantum of the total solid waste.

Granite is a type of felsic intrusive igneous rock that is granular and phaneritic in nature. They have a coarse grained structure of such a holocrystalline rock. It consists of at least 20% quartz and up to 65% alkali feldspar by volume. This rock is widely distributed throughout the continental crust. Due to its wide availability, granite has become a popular stone in construction and beautification of domestic and industrial buildings. It is also used in sculptures and other decorative items. Such growth in the demand of granite has caused an increase the mining and processing of granite, increasing the amount of waste being generated by this industry. Granite waste being a light powdered material, is easily distributed over large areas by wind, causing greater damage to the environment, causing land damage and damage to the health of the people working at and living in or near the area of the site of mining or the area where the waste is disposed. The complete and proper disposal of this waste is not possible, and the only way to minimize the damages caused by it is its complete utilization.

Granite powder is granite fines, generated in the processing and finishing of granite stone, suspended in water. With the increase in the quantity of waste generated in this industry, coupled with the acute shortage of dumping sites, and sharp increase in transportation and dumping costs, the quality of environment has seriously deteriorated. This waste, although with no proper method of disposal, has a potential for usage as partial or complete replacement of aggregates in cement mortar, or can be used as a cement substitute in concrete, as implicated by the concept of green concrete.

Rare researchers experimented the contribution of granite powder in concrete mix as a replacement of sand or cement.

Abukersh, S. and Fairfield, C., 2011 experimented on red Granite dust (RGD) for properness as a replacement for up to 30% by mass of the cement content of concrete made with recycled coarse aggregates. The results showed that natural aggregate concretes produced with RGD at 30% cement replacement had strengths either comparable to, or better than, equivalent control mixes. Concrete mixes containing 30% RGD showed good workability, better than expected mechanical properties and excellent surface finish.

Felixkala T and Partheeban P (2010) examined the possibility of using granite powder as replacement of

sand along with partial replacement of cement with fly ash, silica fume and blast furnace slag. They reported that granite powder of marginal quantity as partial replacement to sand had beneficial effect on the mechanical properties such as compressive strength, split tensile strength and modulus of elasticity. They also reported that the values of plastic and drying shrinkage of concrete with granite powder were less than those of ordinary concrete specimens.

T. Ramos et al studied the effect of granitic sludge from a quarry as a partial cement replacement material in mortar in terms of strength and durability, so as to envisage its use in concrete. [1] The granite rock sludge was analyzed as cementreplacement for strength and durability testing, for alkali-silica reaction expansion (ASR) and chloride attack. From the analysis it is found that there is marginal workability and strength loss for up to 10% cement replacement. It is alsofound that there is improvement of reduction in ASR expansion and improvement in chloride resistance.

Oyekan G.L and Kamiyo O.M (2008) carried out research work on performance of hollow sandcrete blocks which contains cement, sharp sand and granite powder in varying propositions to determine their structural and hydrothermal properties results of tests indicated that inclusion of granite fines in sand cement matrix has a positive effect on the compressive strength of blocks with 15% as optimum value of granite fines content.

MATERIAL PROPERTIES AND PREPARATION OF TEST SPECIMENS:

TABLE 1. Properties of Cement

S. No.	Properties	Value
1	OPC	Grade 43
2	Specific gravity	3.10
3	Normal Consistency	30.5%
4	Initial setting time	135min
5	Final setting time	200 min

TABLE 2.Properties of Natural river sand

S. No.	Properties	Value
1.	Zone	II
2.	void content	34%
3.	specific gravity	2.57
4.	free surface moisture	1%
5.	fineness modulus	2.735

TABLE 3.Properties of Granite Powder

S. No.	Properties	Value
1.	Porosity	Very low
2.	specific gravity	2.5
3.	free surface moisture	1%
4.	Density	2600kg/m3

the chemical analysis for granite waste samples was carried out in order to identify their chemical characteristics.

TABLE 4. Chemical composition of granite powder

Main Constituents	Weight %
SiO2	59.58
TiO2	0.37
Al2O3	13.01
Fe2O3	9.77
MnO	0.17
MgO	0.29
CaO	3.8
Na2O	5.92
K2O	4.76
P2O5	0.07
SO3	0.33
Ci	0.09
LOI	1.56

LABORATORY TESTING PROGRAME:

TABLE 5. Mix detail of Specimen

Sr. No.	% of placement	Cement in gm.	Sand in g	Granite powder in grams
1	0	1320	3960	0
2	2.5	1320	3861	99
3	5	1320	3762	198
4	7.5	1320	3663	297
5	10	1320	3564	396
6	12.5	1320	3465	495
7	15	1320	3366	594
8	17.5	1320	3267	693
9	20	1320	3168	792

COMPRESSIVE STRENGTH:

This test is carried out to determine the compressive strength of mortar. Three cube of mortar of size 70.6 mm was casted and After 24 hr. of casting the cube was placed for curing. After 28 days compressive strength was tested by using compression testing machine at the uniform rate of loading 35N/mm2.

ABRASION TEST:

For measuring the resistance to wear the abrasion test was done. It was performed on 28 days cured mortar cubes size of 5000 mm2, which are oven dried at 18 0 C for 24 h, Standard abrasive powder as used, and a load of 600 N was applied on the specimen as the surface area exposed to wear was 100 cm2.

WATER ABSORPTION TEST:

Dry sample was kept in water for 48hr and the water absorb by sample was measured in terms of percentage by weight.

RESULT AND DISSCUSSION:

As per laboratory test performance the replacement of granite powder with sand in mortar, from the graph we can see that up to 7.5% replacement the value of water absorption is minimum and further increase in granite powder percentage up to 20% gives better result than control mix.

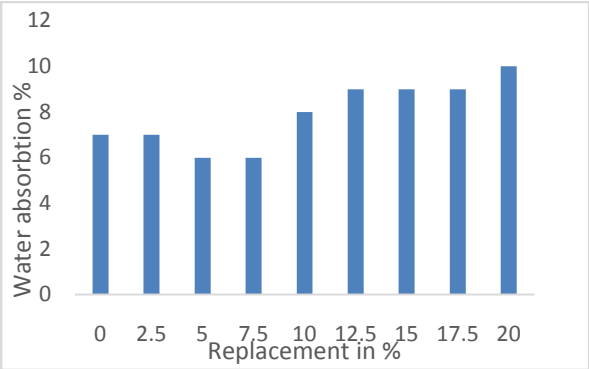

Fig 1. Water absorption strength variation with different proportion of granite.

TABLE 6. Result of Water absorption test

S. No.	Replacement % (specimen mark)	Water absorption in %
1	0	7
2	2.5	7
3	5	6
4	7.5	6
5	10	8
6	12.5	9
7	15	9
8	17.5	9
9	20	10

COMPRESSIVE STRENGTH:

After 28 days curing the 3 sample are tested and average compressive strength of 5000mm2 cube was shown in fig.2, and it is clear from graph that till 5% replacement there is no effect on strength as compare to control mix. Further increase in granite powder replacement up to 20% compressive strength kept on decreasing.

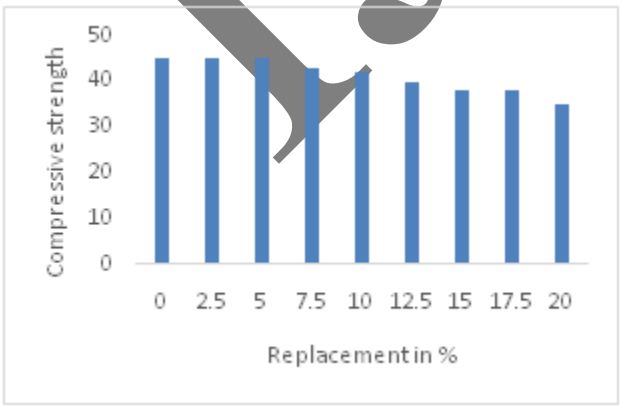

Fig 2. Compressive strength variation with different proportion of granite.

TABLE 7. Result of Compressive strength

S. No.	Replacement % (specimen mark)	Compressive strength in Mpa
1	0	45
2	2.5	45
3	5	45
4	7.5	43
5	10	42
6	12.5	40
7	15	38
8	17.5	38
9	20	35

ABRASION TEST:

After conducting abrasion test on 100mm cube the result shows that the replacement up to 5% gives same result like control mix, further increment of replacement gives higher abrasion value which is constant up to 15% and on further increment of replacement the abrasion value gets higher.

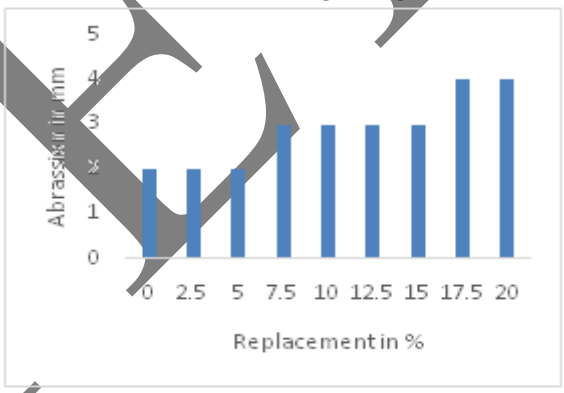

Fig 3. Abrassion variation with different proportion of granite.

TABLE 8. Result of Abrasion test

S. No.	Replacement % (specimen mark)	Abrasion in mm
1	0	2
2	2.5	2
3	5	2
4	7.5	3
5	10	3
6	12.5	3
7	15	3
8	17.5	4
9	20	4

CONCLUSION:

Based on the experimental investigation concerning the compressive strength, abrasion resistance value and water absorption of the cement mortar, the following observation were made regarding the partially replacement of sand with the granite powder. The specimen with 0% granite powder was taken as control mix. The following conclusion drawn is that by replacing 5% of sand, granite powder gives same

strength and durability to the cement mortar as the control mix.

REFERENCES:

1) Blessen Skariah Thomas a, Alok Damare b, R.C. Gupta,"*Strength and durability characteristics of copper tailing concrete*", Construction and Building Materials 48(2013)894-900.
2) Garas G. L., Allam M. E. and Bakhoum E. S., *Studies undertaken to incorporate granite waste in green concrete production*", ARPN journal of engineering and applied sciences vol.9,September 2014.
3) Y. Yaswanth Kumar1*, C.M. Vivek Vardhan1, A. Anitha*," Use of granite waste as partial substitute to cement concrete*", Y. Yaswanth Kumar et al. Int. Journal of Engineering Research and Applications ISSN: 2248-9622, Vol.5, Issue4, and (Part-6) April2015.
4) Dr. T. Felix Kala, *Effect of granite powder on strength properties of concrete",* International journal of engineering and science vol.2, Issue 12 (May 2013).
5) Mr. B. Senthil1, S.Selvarani2, M.Saranya2, D. Suganya2, P. R. Suganya," *Study of partial replacement of sand with waste material from attur granite and quarry dust industries*", National conference on research advances in communication, computation, electrical science and structures (NCRACCESS-2015).