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Utilization of Granite Slurry as Partial Replacement of Cement and Sand for Manufacturing Hand Made Tile

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ABSTRACT: Granite is a valuable dimensional and decorative stone that consisting light-colored coarse or medium grained plutonic igneous rock which is rich in feldspar and quartz. Granite found in Rajasthan is of almost all geological periods from Precambrian to tertiary time scales. It is spread mainly over Jodhpur, Pali, Sirohi, Barmer, Jalore, Jhunjhunu, and Ajmer. Large deposits of slurry waste get accumulated during quarry and processing unit of stone waste. Since these deposits creates a lot of environmental issue and their disposal is quite acute. In order to create a sustainable way by using waste material, an initiative is taken to use of granite slurry obtained from Rajasthan and further mix with the cement mortar and tile store reduce thereby the rely on natural resources.

Investigations are done in order to study the effect the granite slurry in cement mortar and further more in tiles also. Granite slurry is partially replaced with sand and cement in various proportions with different ratios. Cement, slurry and sand are taken in ratios of 1:0.5:3, 1:1:3, 1:1.5:3 and 1:2:3 by weight and by volume both. Various tests are performed in order to know the properties of cement mortar mix with granite slurry and on tile mixed with granite slurry such as compressive strength, flexural strength, water-absorption and scanning electron microscope (SEM).

KEYWORDS: Slurry, Sustainable, SEM, Compressive Strength, Flexural Strength, Abrasion, Water Absorption.

I. INTRODUCTION

One of the basic needs of the human is shelter. With the evolution of human the need for shelter is increasing rapidly. Now the era has come where we want modern housing facilities and with the progress in construction phase it is necessary to opt for better housing facilities. But if we consider the human resources is decreasing day by day and the way for sustainable growth of the construction industry is needed.

As we can observe that large amount of slurry waste gets deposited at every place where the stone industry is there. A large amount of slurry and their disposal is acute. This leads to the environmental imbalance. Many problems get arises by the deposition of these slurry in the open land i.e. aquifer flow get clotted, respiratory problems for humans get arises, it affect the soil fertility where it get dumped and many more. Thus it is very necessary to use this slurry in construction industry so as to produce a sustainable way which helps in the betterment of the society and maintain the ecology balance. A step is made towards achieving better results than the conventional mortar by utilizing granite slurry in cement mortar.

In this thesis, a preliminary test was performed on granite slurry generated in Rajasthan. This slurry is replaced in different ratios by cement and sand in various proportions. Cement, slurry and sand are taken in ratios of 1:0.5:3, 1:1:3, 1:1.5:3 and 1:2:3 by weight and by volume both as well as analysing the workability by flow table test, compressive and flexural strength, water-absorption of cement mortar and finding out the optimum replacement level of the slurry.

Paper is organized as follows. Section II describes automatic text detection using morphological operations, connected component analysis and set of selection or rejection criteria. The flow diagram represents the step of the algorithm. After detection of text, how text region is filled using an inpainting technique that is given in Section III. Section IV presents experimental results showing results of images tested. Finally, Section V presents conclusion.

II. RELATED WORK

Durability of concrete mixes with granite powder and waste glass powder at different proportions analysed by Kishan Lal Jain et al. [1]. Glass powder as 5%, 10%, 15%, 20% and 25%, whereas granite powder as 10%, 20%, 30%, 40% and 50%,



were added in the concrete mixes as a partial replacement of cement and sand, Concrete having 15% Glass powder and 30% Granite Powder as replacement of cement and sand respectively had notable improvement in durability. Granite Sawing Waste (GSW) in Poly Propylene fibre (PP) reinforced self compacting concrete along with Fly Ash is used to form a new concrete mix by K. Aarathi et al. [2]. Their results have shown that the shrinkage value of Self Compacting Concrete (SCC) is reduced by using Granite Sawing Waste and Poly Propylene fibre. Acid attack and chloride penetration resistance are improved. Pradeep et al. [3]. Concluded that replacement of natural sand is possible in concrete by dimensional waste manufactured sand, a problem of alkali-silica reaction may be there it is seen during this project on the use of dimensional stone waste. Granite cutting waste substituted by Sarbjeet Singh[4]. In Modified concrete exhibits increased resistance to carbonation, acid attack, exposure to elevated temperature and chloride ion penetration at optimum replacement level of 25% weight was nil at all durations of exposure to Magnesium sulphate solution. This specimen exhibited more intensity and peak area for hydration products - C S H and ettringite as compared to the control specimen. Replacement of fine aggregates by Granite cutting waste and marble slurry in the manufacturing of concrete by Sarbjeet Singh[5]. Optimum replacement percentage for Granite cutting waste and Marble slurry concrete were 25% and 15% respectively. Durability aspects of cement mortar using granite stone dust which is replaced by cement in different percentage level 20%, 25%, 30%, 35% or 40%.by weight of cement done by S. Vishnu Shankar et al. [6]. 30% replacement level given the better results. Granite stone dust used by Hamza et al.,2013 [7] in concrete blocks and conclude that it improves the property of concrete blocks up to 10% substitution.

III. METHODOLOGY

After doing a study on the conventional mix proportion (1:3) with the replacement of sand with Granite slurry and getting good results regarding compressive and flexure strength, it comes into mind to make some new proportions which will be suitable for different works as per the requirement.

The new proportions by weight are

- Mix proportion(1:0.5:3) i.e.(cement:Graniteslurry:sand)
- Mix proportion(1:1:3) i.e.(cement:Graniteslurry:sand)
- Mix proportion(1:1.5:3) i.e.(cement:Graniteslurry:sand)
- Mix proportion(1:2:3) i.e.(cement:Graniteslurry:sand)

And also the new proportions by volume are

- Mix proportion(1:0.5:3) i.e.(cement:Graniteslurry:sand)
- Mix proportion(1:1:3) i.e.(cement:Graniteslurry:sand)
- Mix proportion(1:1.5:3) i.e.(cement:Graniteslurry:sand)
- Mix proportion(1:2:3) i.e.(cement:Graniteslurry:sand)

S. No	Proportion	Cement (In grams)	Sand (In grams)	Granite Slurry (In grams)
1	1:3	55.0	187.0	0
2	1:0.5:3	50.0	170.0	25.0
3	1:1:3	45.8	155.6	45.8
4	1:1.5:3	42.1	143.2	63.2
5	1:2:3	39.1	133.0	78.2

Table 1. Ingredients required for the 1 cube specimen of size 50x50x50mm is given below for different proportions



S.No	Proportion	Cement (In grams)	Sand (In grams)	Granite Slurry (In grams)
1	1:3	113.2	384.8	0
2	1:0.5:3	102.4	348.2	51.2
3	1:1:3	93.7	318.6	93.7
4	1:1.5:3	86.2	293.1	129.3
5	1:2:3	80.1	272.4	160.2

Table 2. Ingredients required for the 1 beam specimen of size 40x40x160 mm is given below for different proportions

Preparation of handmade tile

Following steps were followed to prepare specimens.

- Prepare coloured cement with the help of pigment colour
- Prepare mix of cement and sand at appropriate ratio
- The mould is inserted in base. The mould is basically a metal section for design purpose.
- Then the coloured cement is pour into the mould and the mould is taken out from the base. It is the first layer of tile.
- A second layer of cement mix with some amount of marble powder is poured into the mould.
- The third layer of cement and sand is poured into the mould
- The steel cap is placed on top of the mould and it is inserted in the hydraulic press and pressure is applied on it about 150 kg/cm².
- After all the process the tile is put in water tank for curing.

IV. EXPERIMENTAL RESULTS

Material test:

Before using the material in any mix, the testing for the chemical and physical property of materials is done as per Indian standards.

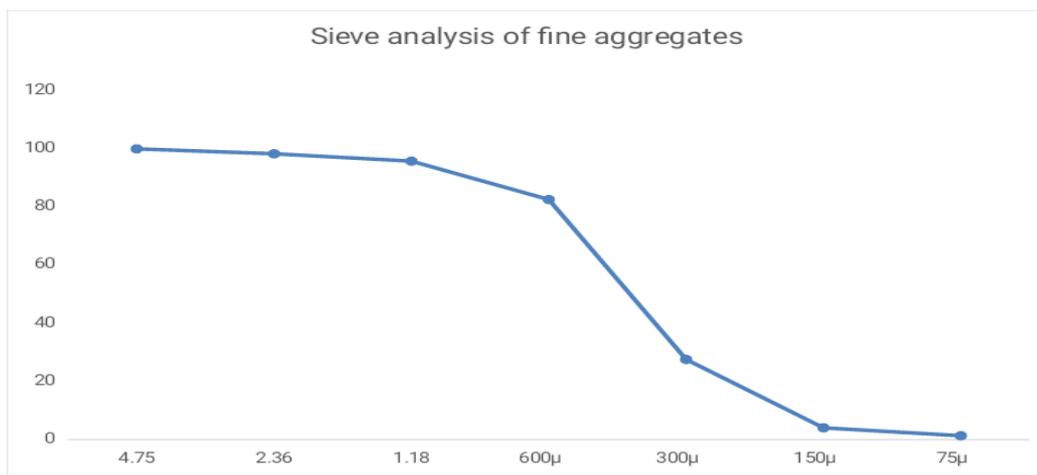


Fig.1 grain size distribution curve (size of sieve v/s % passing)



	fine aggregates	Granite slurry	Units
Weight of sample and container	2.73	2.6	Kg
Weight of container	1.57	1.57	Kg
Weight of sample	1.16	1.03	Kg
Volume of container	0.000707	0.000707	Cu m
Uncompact bulk density	1635	1450	Kg /cu m

Table 3. Bulk density of fine aggregates and Granite slurry

Bulk density of cement and sand are taken as 1440 kg/m³ and 1635 kg/m³ respectively.

Result of different tests for the Mortar (1:3) (By volume)

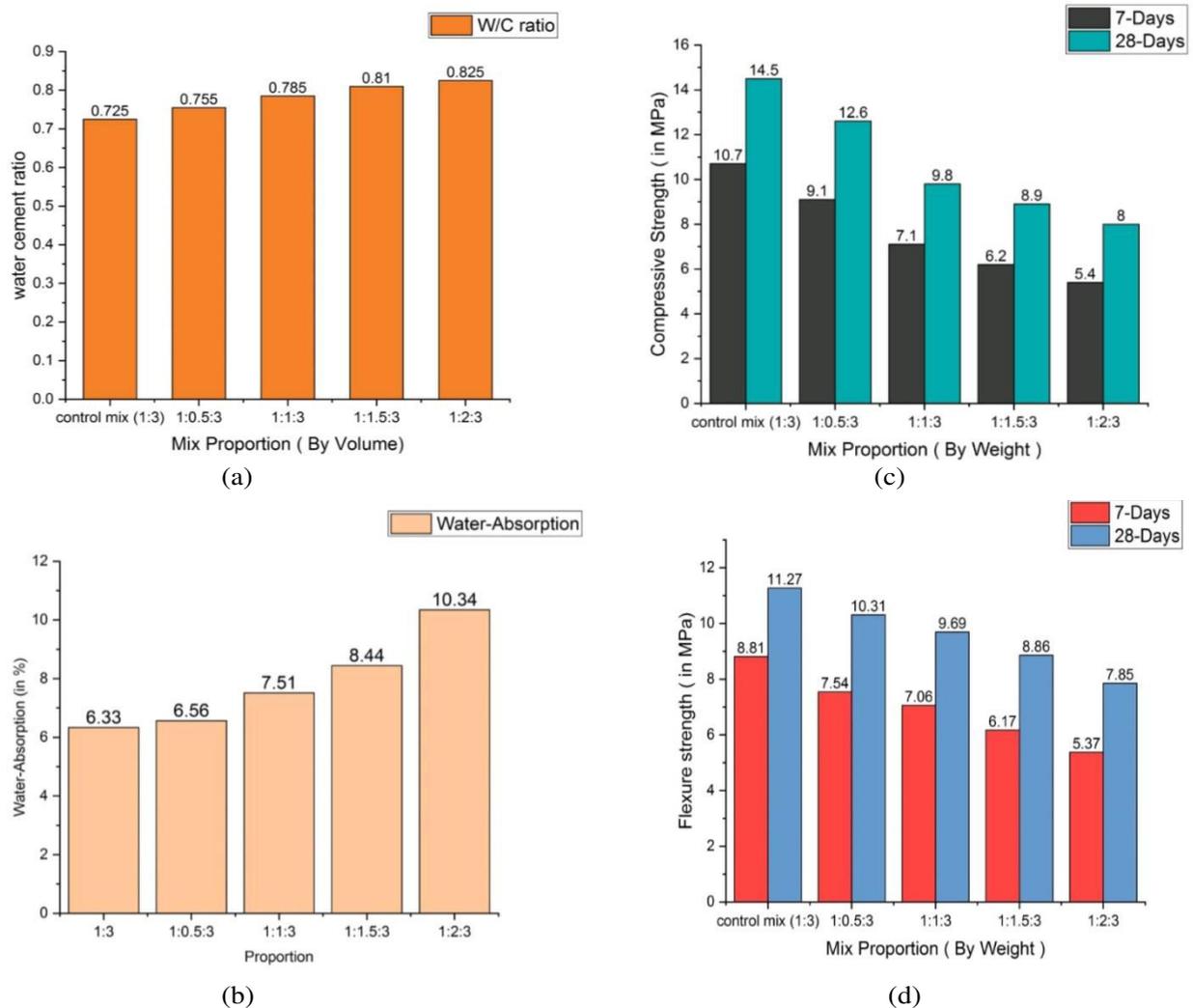
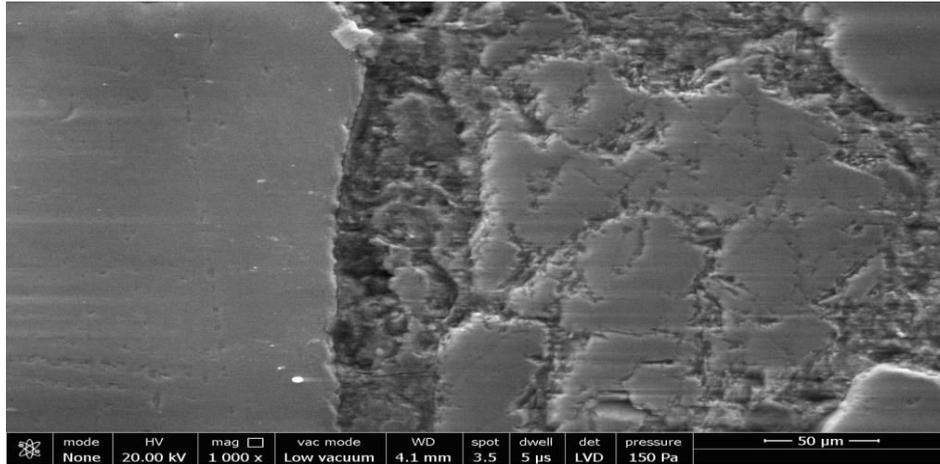


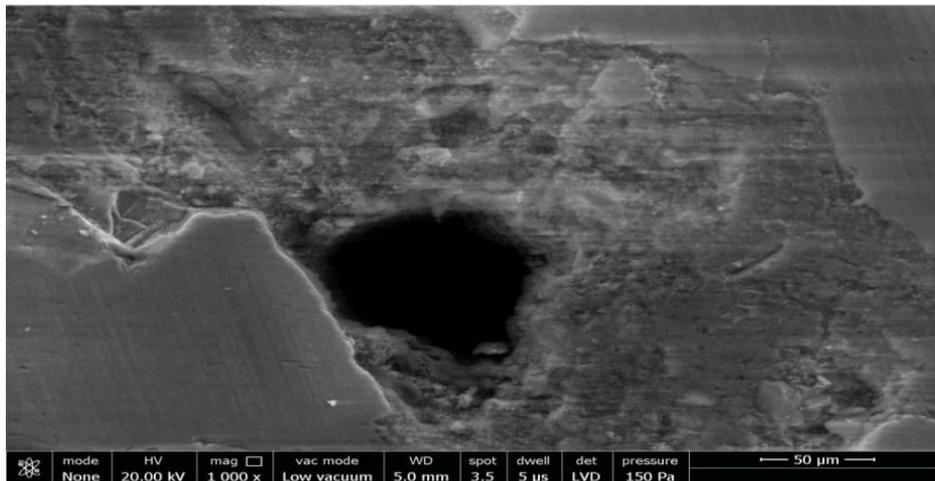
Fig. 2. Test results for different proportions (a) Bar chart showing water cement ratios (b) Bar chart showing water absorptions (c) Bar chart showing compressive strengths (d) Bar chart showing flexural strengths.



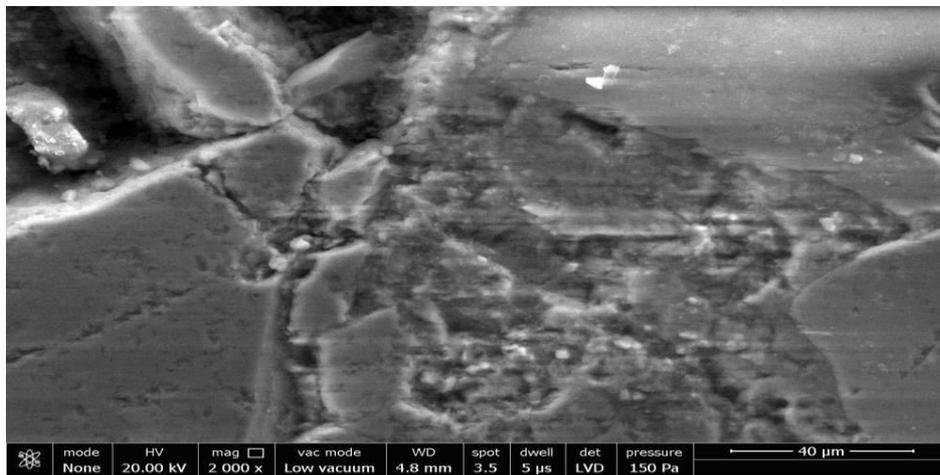
SEM (Scanning Electron Microscopy) Test images:



(a)



(b)



(c)

Fig. 3. SEM (Scanning Electron Microscopy) Test images For different proportions (a) SEM image of specimen in proportion mortar 1:0.5:3 (b) SEM image of specimen in proportion mortar 1:0.5:3 (c) SEM image of specimen in proportion mortar 1:1:3



Result of different tests for the Mortar (1:3) (By weight):

Proportion	Water Cement Ratio
Control mix (1:3)	0.665
1:0.5:3	0.69
1:1:3	0.71
1:1.5:3	0.735
1:2:3	0.75

Table 4. Different proportions and corresponding water cement ratios

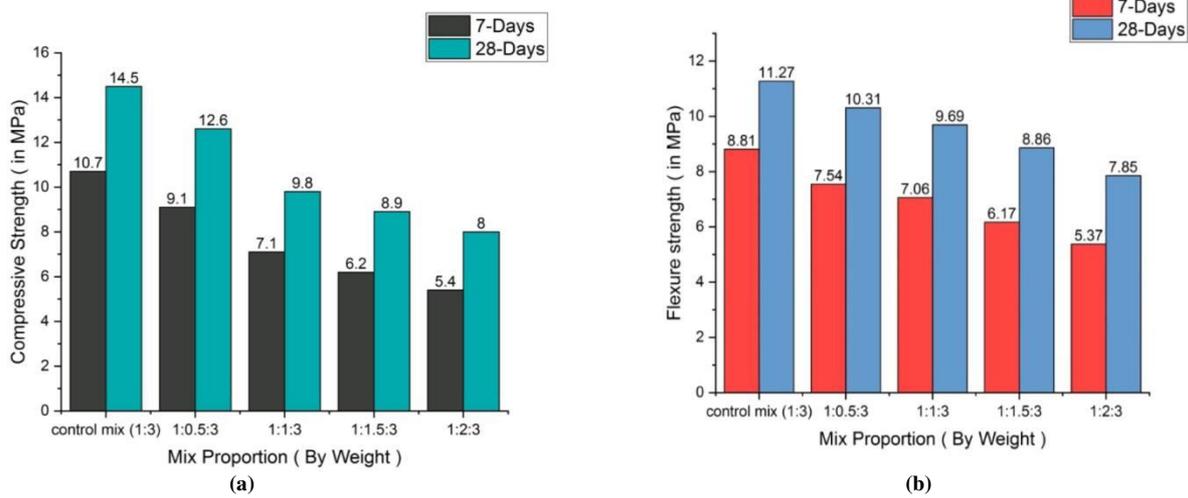


Fig. 4. (a) Different proportions and their compressive strength (b) Different replacements and their flexural strength

Result of different tests for the Handmade Tile :

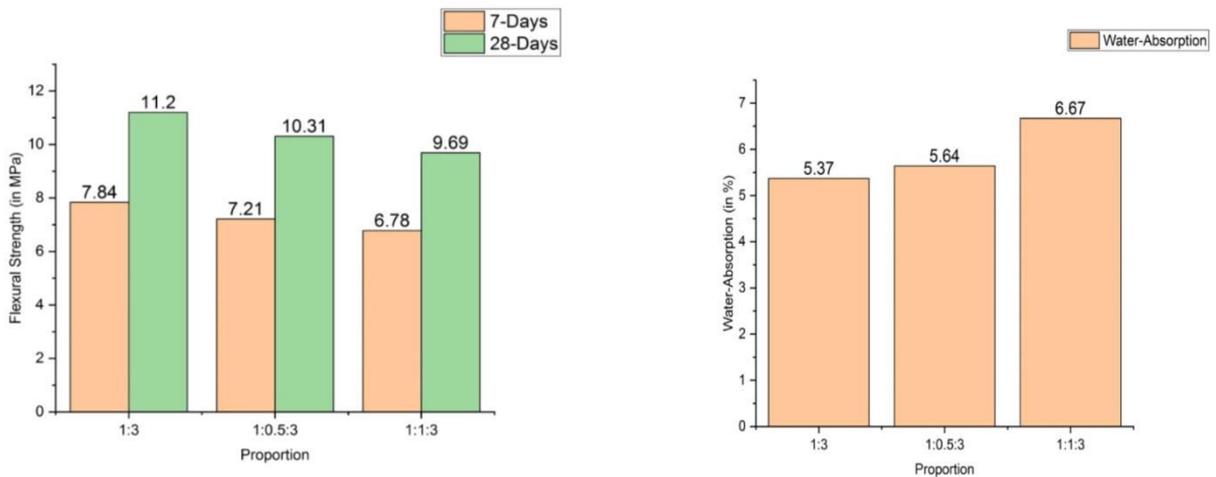


Fig. 5. (a) Different proportions and their Flexural strength (b) Different proportions and their water absorption

VI. CONCLUSION AND FUTURE SCOPE

The following conclusions were obtained from the above study-

- The compressive strength and the flexural strength of the modified ratios i.e. 1:0.5:3, 1:1:3, 1:1.5:3 and 1:2:3 are lower than the conventional 1:3 cement mortar. But still the compressive and flexural strength of the modified ratio 1:0.5:3 is within the permissible limit.
- The water absorption of the modified ratios i.e. 1:0.5:3, 1:1:3, 1:1.5:3 and 1:2:3 are gradually increasing as compared to the conventional 1:3 cement mortar. But the water absorption of ratio 1:0.5:3 is within the permissible limit.
- We are making the use of granite slurry; this makes the construction economical and environment friendly.
- Making use of granite slurry in the 3rd layer of the handmade tile reduces its initial cost.

Scope for Future

- If we will make granite slurry replaced with sand instead of cement and sand both, than the result of compression and flexural strength may be better than the conventional cement mortar.
- We can bring granite slurry in different construction products of modern sustainable highway constructions.
- We can enhance this research on durability of cement mortar replaced with granite slurry.

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