EFFECTIVE UTILIZATION OF GRANITE POWDER AS REPLACEMENT OF MARBLE POWDER IN MARBLE BRICK

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ABSTRACT

The most basic building material for construction of houses is the conventional brick. The rapid growth in today's construction industry has obliged the civil engineers in searching for more efficient and durable alternatives far beyond the limitations of the conventional brick production. By incorporating Granite powder in Marble brick, compressive strength can be improved. Reduces the construction cost, maintenance cost. Also reduce the temperature up to 4^0 C. Since marble and Granite consist of silica and lime, availability of silica in granite is more. The strength of Granite powder brick is relatively more as compare to marble powder brick. The Marble powder has been replaced by Granite powder accordingly in the range of 20%, 40%, 60% and 80% by weight. The waste generated from the industries cause environmental problems. Hence the reuse of this waste material can be emphasized. To produce low cost brick, to reduce disposal and pollution problems due to the use of waste.

Keywords: *Marble Powder1, Granite Powder2, Brick3*

INTRODUCTION

Rajasthan is the major centre of the marble, Granite industry in the country. More than 1,500 marble mines are operating in the Aravallis in Rajasthan, Rajasthan boasts almost two-thirds of India's mineable marble reserves, and it is responsible for around 85% of the country's total marble production. Indeed, the entire stretch of the Aravallis in lower Rajasthan is a waste depository of marble. Rajasamand, Ramganj Mandi, Jhalawar, Udaipur, Kota and Banswara districts contribute over half the state's marble output. The marble reserves in India are estimated at 1,200 million tons, with Rajasthan accounting for 91% of the reserves.

Marble slurry is a processing and polishing waste of mining industry. Its huge quantity is dumped on any empty land, agricultural fields, pasture lands, river beds and roadsides. The present dumping practices have been creating a number of nuisances and problems, including environmental and human health. Scientific disposal systems but with more emphasis on engineering utilization have to be developed simultaneously and as fast as possible. Construction industries can be the main user of marble slurry whether in bulk or minor quantities. The utilization of marble slurry in the manufacturing of bricks, includes full replacement of conventional fine aggregates with marble slurry content.

EXPERIMENTAL MATERIAL

(a) Marble Powder

Marble is a non-foliated metamorphic rock composed of recrystallized carbonate minerals, most commonly calcite or dolomite. Geologists use the term "marble" to refer to metamorphosed limestone. The marble powder generated during the cutting and Polishing Process of Marble is called Stone Waste. Marble stone industry generates both solid waste and stone slurry. During the process of cutting, in that original stone waste mass is lost by 25-30% in the form of dust.

(b) Granite Powder

Granite waste was obtained from granite polishing industries. The specific gravity of granite waste was 2.53 respectively, and its size was less than 90 microns. The fineness modulus of granite waste was 2.43 respectively.

Granite, from igneous rock, is a very hard, crystalline, and primarily composed of feldspar, quartz accompanied by one or more dark minerals. It is visibly homogeneous in texture. The term "Granite" means "grain" in the Latin word "Granum" because of its granular nature. Granite is the hardest building stone, and granite slabs and granite tiles occupy a prominent place among dimensional stones. Due to its hardness, resistance to weathering, capability to take mirror polish, fascinating colours and textural patterns, granite slabs and granite tiles are extremely popular.

The principal characteristics of granite also include high load bearing capacity, crushing strength, abrasive strength, amenability to cutting and shaping without secondary flaws, ability to yield thin and large slabs and - above all - durability.

(c) Cement (OPC)

The most common cement used is an ordinary Portland cement. The Ordinary Portland Cement of 53 grades conforming to IS: 8112- 1989 is being used. Table 1 shows the physical property of OPC cement of 53 grade.

Table 1: Properties of OPC 53 Grade Cement

Sr. No.	Physical Properties of Cement	Result	Requirements as per IS:8112-1989
1	Specific gravity	3.15	3.10-3.15
2	Standard consistency (%)	31%	30-35
3	Initial setting time (hours, min)	35 min	30 minimum
4	Final setting time (hours, min)	178 min	600 maximum

(d) Water

Water is an important ingredient of brick as it actually used for manufacturing of brick. Since it helps to bind all the raw materials for giving proper mix. Water used for making brick should be free from impurities.

PROPERTIES OF MARBLE POWDER AND GRANITE POWDER

The properties of marble powder and Granite powder was tested for their properties according to the relevant IS code provisions. Table 2 shows the physical properties of marble powder and Granite powder. Table 3 shows the chemical properties of marble powder and Granite powder.

Table 2: Physical Properties of Marble Powder and Granite Powder

Property	Marble Powder	Granite Powder
Bulk density (kg/m^3)	1300-1500	1210-1465
Fineness modulus (cm^2/g)	5100-5250	0.90-2.0
Water absorption (%)	22-24	26-28

Specific gravity	2.12-2.67	2.0-2.84
Max particle size (mm)	0.062	0.065
Colour	White/ Dirty white	Pink to grey

Table 3: Chemical Property of Marble and Granite Powder

Sr. No	Chemical Constituent	Chemical Composition (%)	
		Marble Powder	Granite Powder
1	Calcium Oxide	40.41 %	1.89 %
2	Silica	18.57 %	75.58 %
3	Aluminum Oxide	2.09 %	9.89 %
4	Magnesium Oxide	0.43 %	2.10 %

(**Source**: Geo Test House, Vadodara, Gujarat, India)

MANUFACTURING PROCESS

Collect the marble powder, Granite powder on site. Then the material is cleaned of impurities such as vegetation matter, stones or pebbles etc. After removing impurities it is exposed to weather for few days for drying the material and socking the water from the material. After completion of weathering process the marble powder is blended with other fixed percent material to prepare the brick. Then mix the material in fixed percentage quantity by weight. After that, mix the material and pour the water as required in the mixture. Figure 1 show the manufacturing process of brick.

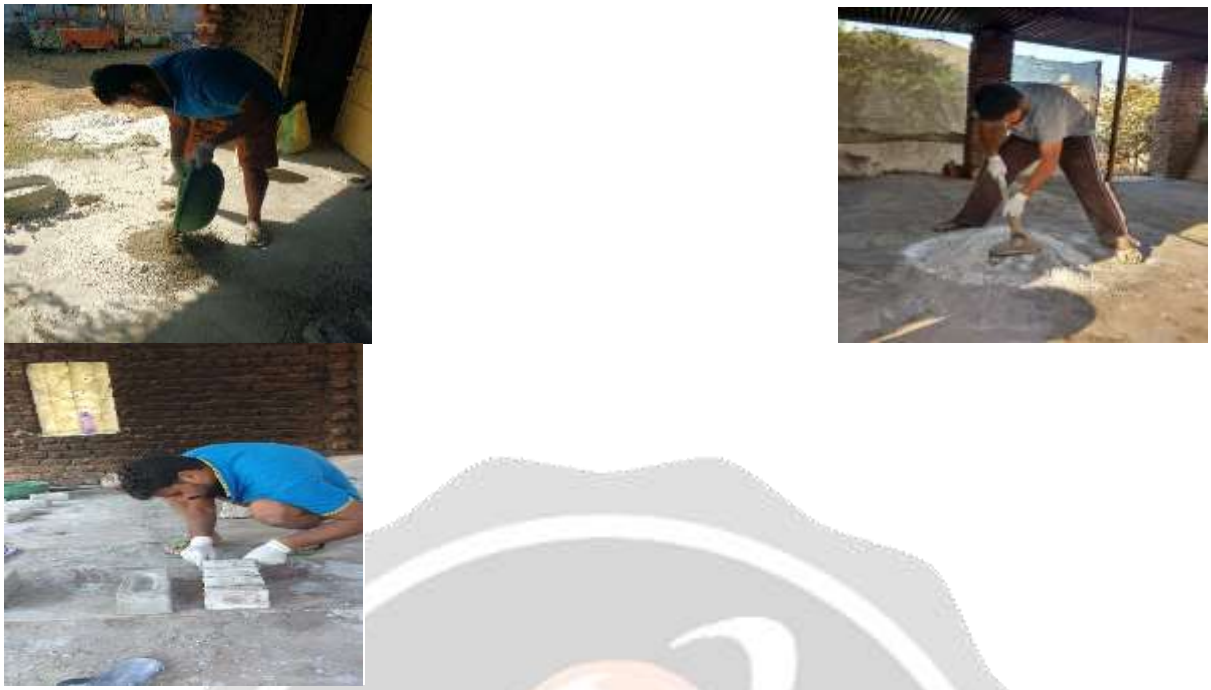

Figure 1: Manufacturing Process of Brick

BRICK MIXES

The brick mixes proportion's as shown in Table 4.

Table 4: Details of Brick Mixes with Marble Brick

Brick Mixes	Marble Powder (%)	Granite powder (%)	Cement (%)	Total (%)
Marble Brick	80	-	20	100
G1	60	20	20	100
G2	40	40	20	100
G3	20	60	20	100
G4	0	80	20	100

TESTS ON BRICKS [IS 3495 (Parts 1 to 4): 1992]

All the tests are performed at Govt. Engineering College Banswara, Rajasthan, which is a government engineering institute, equipped with standardized and sophisticated instruments and testing machines

Compressive Strength Test [IS 3495 (Parts 1 To 4): 1992]

230 mm × 110 mm × 76 mm standard size of a brick, The bricks, when tested in accordance with the procedure laid down in IS 3495 (Part I): 1992 shall have a minimum average compressive strength for various classes. Figure 2 shows the setup of compressive strength test. Table 5 shows the compressive strength of various mixes of bricks. (34)

Figure 2: Setup of Compression Strength Test

Table 5: Compressive Strength of Bricks (230x110x76) at 7, 14, 21days

Brick Mixes	Average Compressive Strength (N/mm^2)		
	7 Days	14 Days	21 Days
Marble Powder Brick			
Marble Brick	3.29	4.07	4.74
Granite powder Mixes Brick			
G1	3.47	4.19	5.29
G2	3.85	5.26	6.85
G3	3.20	3.11	4.81
G4	2.60	3.70	4.20

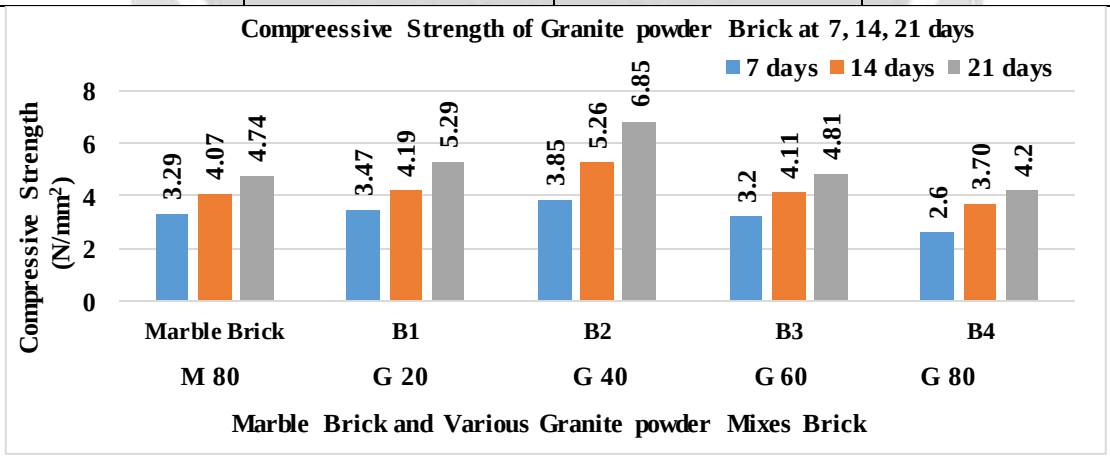

Chart 1: Compressive Strength of Marble Brick and Bricks by Inclusion of Different Proportion of Granite powder in Marble Brick at 7, 14, 21 Days

From the above Chart 1, it can be concluded that with replacement of Granite Powder in marble brick the compressive strength increases gradually after replacement 20% and 40% Granite powder respectively after 21 days. But after increasing the quantity of Granite powder to 60% and 80% the compressive strength was found to be decreasing. Mix shows **44.51 % increase in compressive strength** compare to marble brick.

Water Absorption Test [IS 3495 (Parts 1 To 4): 1992]

Standard size Immerse completely dried specimen in clean water at a temperature of 27 f 2°C for 24 hours. Remove the specimen and wipe out any traces of water with a damp cloth and weigh the specimen. Complete the weighing 3 minutes after the specimen has been removed from the water.

The bricks, when tested in accordance with the procedure after immersion in cold water for 24 hours, water absorption shall not be more than 20 percent by weight up to class 12'5 and 15 percent by weight for higher classes. Figure 4 shows the water absorption of various mixes of bricks. (34)

Water absorption, percent by mass, after 24-hour immersion in cold water is given by the following formula:

$(M_2-M_1)/M1*100$

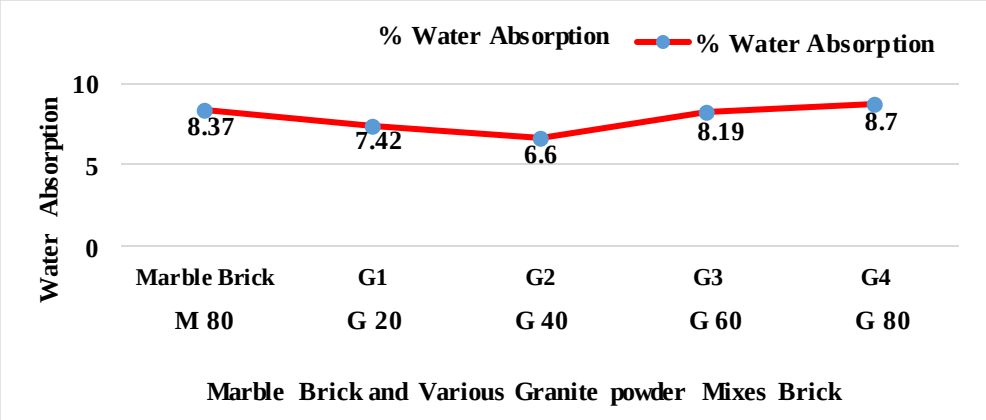

Chart 2: Percentage Water Absorption of Marble Brick and bricks by Inclusion of Granite powder in Marble Brick in Different Proportions.

From the above Chart 2, it can be concluded that with replacement of Granite powder in marble brick the percentage Water absorption gradually decreases after replacement of 20% and 40% Granite powder, But after increasing the quantity of Granite Powder to 60% and 80% the percentage water absorption is increases. Figure 4 show minimum water absorption Shows 21 % decrease in percentage water absorbed as compere to marble brick.

CONCLUSION

Based on the experimental test results obtained from the study, the following conclusion are drawn

- The replacement of Granite powder in marble brick the compressive strength increases gradually after replacement of 20% and 40% Granite powder respectively after 21 days strength 17% and 44.51 %.
- Replacement of Granite powder in marble brick the percentage of Water absorption gradually decreases up to 21 %.
- The possibility to use the Granite powder and marble Powder wastes as an alternative raw material in the production of brick.
- They are low cost, easy and speed of fabrication and recommend to be used in construction.

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