Utilization of Marble and Granite Slurry in Clay Bricks

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Abstract— Stone industries of Rajasthan spread across all its districts forms the backbone of its economy. The increasing popularity of the marbles of Rajasthan, growing demand for finished and unfinished products, discovery of new marble deposits have led to a significant growth in marble industry of this State. This leads to simultaneous rise in waste generation causing concern towards the deteriorating environmental quality. A wide spread need is being felt to make This industry environmentally sustainable. It proposes the use of waste marble and granite slurry in clay bricks. In this report, investigation will be carried out to use such clay brick in compression strength, density and water absorption. And the problem of waste stone slurry would be solved drastically by use of marble and granite waste in the clay brick as brick is the most widely used construction material at present.

Key words: Brick, Marble Slurry, Granite Slurry, Clay Brick, Strength

I. Introduction to UHPC

The infrastructure such as buildings for housing and industry and the facilities for handling water and sewage will require large amounts of construction materials. Brick making is as ancient as human civilization itself. Great architectural wonders and the immortal monuments built in the antique past had been built with bricks besides stones and mortar. Ever since man realized the housing as basic need, he started using bricks in various forms like green bricks, sun dried bricks and the fired bricks. Brick is one of the most accommodating masonry units as a building material due to its properties. The dried-clay bricks were used for the first time in 8000 BC and the fired-clay bricks were used as early as 4500 BC. The high temperature kiln firing not only consumes significant amount of energy, but releases large quantity of greenhouse gases. Clay bricks, on average, have an embodied energy of approximately 2.0 KWh and release about 0.41 kg of carbon dioxide (CO2).It is also noted that there is a shortage clay in many parts of the world. Today, one cannot imagine a construction at the exclusion of bricks and such is the importance that bricks have assumed as a building material. Besides shelter, bricks are being used in the development of infrastructure such as construction of dams, canals and business houses which are needed for improvement in the levels of living of the people everywhere. Brick making improvements have continued in the twentieth century which made remarkable improvements in rendering brick shape such as absolutely uniform, in lessening weight, and in speeding up the firing process. The history of brick industry is very old and can be traced back to about 5000 years old Mohenjo-Daro civilization in where fired brick had been used probably for the first time in human history. In spite of the technological revolutions, today's brick is weaker and more porous than it had been in the past in the country. This could be certainly surprising to many in the event that in the past several decades, significant advances in scientific and technological research have been registered, particularly in the developed countries, with respect to low-cost construction techniques and building materials. Bricks can be divided into various groups on the basis of mineralogy namely, silica bricks, zircon bricks, alumina bricks, mullite bricks, magnesite bricks and dolomite bricks. The main parameter investigated in this study is clay brick with replacement of sand by granite powder and marble slurry power by0,5%,10%15%,20%,25%.The proposed utilization of waste stone slurry in various alternative in the manufacture of ceramic and glass tiles, thermoset resins.

II. Scope of the Study

This study will facilitate in obtaining an optimal composition of different constituents to make a Clay brick .The use of waste marble slurry powder in brick creates further opportunities to study in the area of alternative uses for marble waste. The use of waste stone slurry powder in brick opens new avenues to further study in the area of alternative uses for stone waste. The possibility of such concrete is beneficial both economically as well as environmentally. On one hand the extensive use of waste stone slurry dust in brick will put at end to sky climbing heaps of such waste that destroys our ecology and aesthetics while on the other it will reduce the cost of concrete as use of cement and sand would come down. Also the pressure on sources of clay would come down which is again in favour of environment. The experimented with the use of granite fines in concrete and found that 35% optimum replacement of fine aggregate with granite increases the compressive strength while the flexural strength remains almost constant. This paper represents the use of sludge generated from natural marble manufacturing process as raw material or as a bi-product instead of being a waste material. All natural stone including marble, granite and slate which can be used for construction purposes. The studied the utilization of marble waste of different sizes in the manufacturing of concrete bricks in place of conventional coarse and fine aggregates with full replacement of conventional fine and coarse aggregates with slurry powder and marble waste scrapes of content up to 40%. The produced bricks were tested for physical and mechanical properties according to the requirements of the American Standards for Testing Materials (ASTM) and the Egyptian Code.

Additionally, by acting as micro filler, the marble slurry promotes an accelerated formation of hydrated compounds, hence resulting in a significant improvement of compressive strength at earlier ages. The reuse of the marble by-products coming from the marble industries. Most of the industries are using carbonate rock product in various application. Marble powder is also contains ultrafine CaCO3 dust. The possibility of using micronized marble powder to produce diverse commodities for the building industry has been studied. The data emerging from the analyses demonstrate the feasibility of these uses. In this study, marble powder was being used in manufacturing of bricks and it resulted as improvement of quality of bricks.

III. METHODOLOGY

In order to achieve the objectives of the research and for the development of concepts, which are fundamental for the formation of the whole research work, a comprehensive literature review is made to understand the previous efforts which include the review of text books, periodicals and academic journals, seminars and research papers. The method followed to achieve the objectives of the research determines the required data, which intern is a ground to decide on type and method of data collection and their analysis.

A. Mechanical and Physical Properties of clay bricks

1) Compressive Strength

Compressive strength is strongly influenced by the characteristics of the raw material and by the production process. It is known that the raw clay of old bricks was often of low quality and the

Manufacturing process was relatively primitive and inefficient. Other characteristics of existing old bricks can provide an indication about compressive strength, such as mineral composition, texture, crack pattern and porosity level, by revealing the conditions of drying and firing. An average compressive strength of 12.5–27.5 MPa

2) Water Absorption

The acceptable water absorption for clay bricks are between 12% and 20%. If you are using engineering bricks the closer you are to the 12% the better the result will be. When the water absorption is too low, i.e. below 12%, it may be difficult to obtain a proper bond between the mortar and the bricks.

3) Density of Bricks

Usually sulphate of magnesium, calcium, sulphate and carbonate of sodium and potassium are found in efflorescence. These salts may be traced to the brick itself, sand used in construction, the foundation soil, ground water, water used in the construction and loose earth left over in contact with brick work. Bricks with magnesium sulphate content higher than 0.05 percent should not be used in construction. Soluble salt content in sand should not exceed 0.1 percent. Water, if it finds access to brick work, moves along its pores by capillary action and carries with it dissolved salts. As the solution evaporates from the exposed surface of the brick work, the salts are left as deposit on the surface or on layers just below it. Disintegration or flaking of the brick surface is caused by the mechanical force exerted by salts as these crystallize just below the exposed surface. Magnesium sulphate, in particular, disintegrates bricks and pushes out plaster.

Compound	Marble	**Granite**	**Clay**
SiO_2	10.41	73.19	65.04
CaO	31.33	20.14	4.12
MgO	20.91	Nil	1.96
Loss of Ignition (LOI)	37.20	0.53	5.66
Fe_2O_3	Nil	5.93	5.06
Al_2O_3	Nil	Nil	12.95

IV. RESULT AND DISCUSSION

Chemical composition of Clay, Granite slurry and Marble Slurry Powder Specific Gravity Test for Clay, Granite slurry and Marble Slurry Powder Specific gravity of aggregates, marble slurry powder and granite slurry power were tested using pycnometer test and Le-Chatelier's test was performed for specific gravity of cement. The formula used to calculate the specific gravity is –

$$\text{sp. gr.} = \frac{(W_2 - W_1)}{(W_2 - W_1) - (W_3 - W_4)\rho}$$

Where, W_1 = Weight of Pycnometer in gm.

W_2 = Weight of Pycnometer + aggregate in gm.

W_3 = Weight of Pycnometer + aggregate + water in gm.

W_4 = Weight of Pycnometer + water in gm.

ρ = density of medium

After adding water, pycnometer was rotated so that all the voids get filled with water and all the air bubbles come on the surface. Again water was poured to fill the pycnometer completely. The test results for coarse and fine aggregates, cement and marble slurry are as follows.

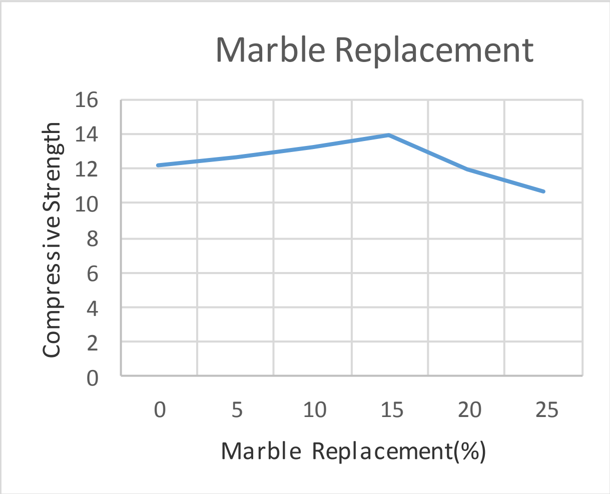
S. No.	Weight Combinations	Weight (gm.)
1	Weight of pycnometer (W_1)	657
2	Weight of pycnometer + Marble Slurry Powder (W_2)	1157
3	Weight of pycnometer + Marble Slurry Powder + Water (W_3)	1859
4	Weight of pycnometer + Water (W_4)	1543
5	Specific Gravity of Marble Powder	2.72

S. No.	Weight Combinations	Weight (gm.)
1	Weight of Pycnometer (W_1)	657
2	Weight of Pycnometer + Clay (W_2)	1157
3	Weight of Pycnometer + Fine Aggregate + Water (W_3)	1853
4	Weight of Pycnometer + Water (W_4)	1543
5	Specific Gravity of Clay	2.63

A. Compressive Strength

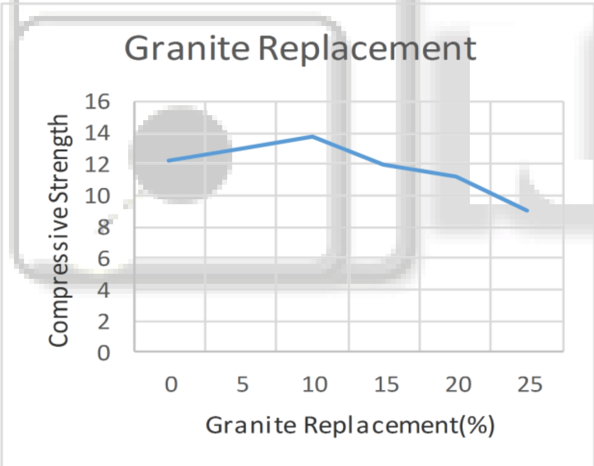
1) Marble Replacement in Clay Bricks

Sample	Marble Replacement (%)	Compressive Strength (N/mm^2)
M0	0	12.23
M5	5	12.71
M10	10	13.29
M15	15	13.95
M20	20	12.01
M25	25	10.73



2) Granite Replacement in Clay Bricks

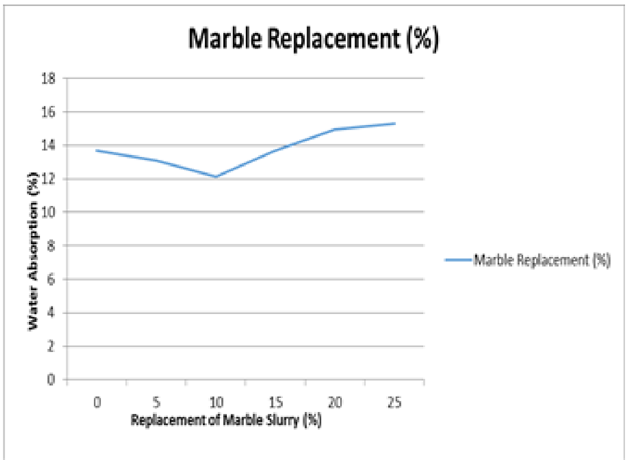
Sample	Granite Replacement (%)	Compressive Strength (N/mm^2)
G0	0	12.23
G5	5	12.94
G10	10	13.71
G15	15	12.01
G20	20	11.18
G25	25	9.07



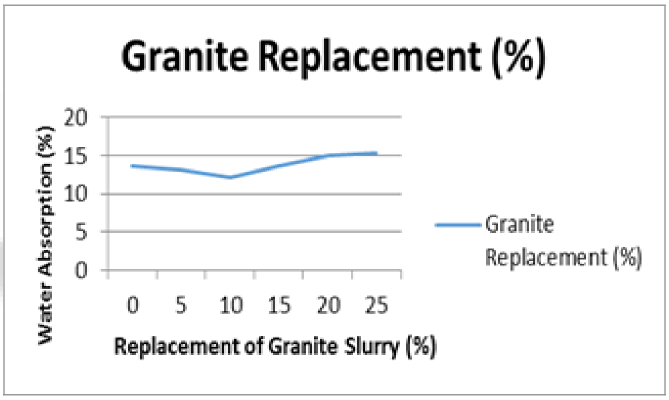
We can conclude that, at 10 % replacement of clay with granite slurry and marble slurry gives maximum compressive strength. After 15%, the compressive strength starts decreasing in both granite and sand replacement.

B. Water Absorption

Sample	Marble Replacement (%)	Water Absorption (%)
M0	0	13.67
M5	5	13.10
M10	10	12.11
M15	15	13.71
M20	20	14.95
M25	25	15.30



Sample	Granite Replacement (%)	Water Absorption (%)
G0	0	13.67
G5	5	12.86
G10	10	12.41
G15	15	13.69
G20	20	15.71
G25	25	16.22



Water absorption observed for both replacement granite and marble decreases up to 10 %.

V. CONCLUSION

After collecting and analyzing all the results, we can conclude that, at 10 % replacement of clay with granite slurry and marble slurry gives maximum compressive strength. After 15%, the compressive strength starts decreasing in both granite and sand replacement. Water absorption observed for both replacement granite and marble decreases up to 10 % after that increases. Density of brick after replacement of granite continuously decreases and after replacement marble continuously increases. So we can analyzed that 10 % replacement of marble and granite slurry is optimum.

