

A Critical Literature review on Effective Utilization of Kota Stone Sludge as Replacement of Marble Slurry Wastes in Brick

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Abstract: Stone, one of the most common building material of ancient times, is an ubiquitous material. A sustainable growth in the consumption of stone is observed all over the world in the recent years. Various types of stone such as granite, Kota stone, marble, limestone, slate etc. are used in construction purposes. In the building industry, Marble/Kota stone has been commonly used for various purposes like flooring, cladding, balconies, wall fixing etc., as a building material since the ancient times. Marble/Kota stone industry generates both solid waste and stone slurry. Where a solid waste results from the rejects at the mine sites or at the processing units, stone slurry is a semi liquid substance consisting of particles originating from the sawing and the polishing processes and water used to cool and lubricate the sawing and polishing machines. During the process of cutting, in that original stone waste mass is lost by 25% in the form of dust. Accordingly, the amount of mining and processing waste has increased. Stone waste is generally a highly polluting waste due to both its highly alkaline nature, and its manufacturing and processing techniques, which impose a health threat to the surroundings. The generated sludge from stone cutting factories is prohibited from being discharged to the public sanitary system. Use of stone waste in various engineering applications can solve the problem of disposing of stone waste and other purposes. Stone waste can be used in concrete to improve its strength and other durability factors. Stone waste can be used as a partial replacement of cement or replacement of fine aggregate and as a supplementary addition to achieve different properties of concrete. The use of the replacement materials offer cost reduction, energy savings, arguably superior products, and fewer hazards in the environment.

Keywords: Stone Sludge, Marble Slurry, Kota Stones Sludge, Granite Sludge, Building Stone, Replacement Material

I. INTRODUCTION

Marble slurry and 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.

The use of stone waste in the production of Self-compacting concrete (SCC), Mortar, Tiles, Cement concrete as aggregate and filler. The aim of the application of cutting and polishing stone waste in cementations system is to improve the characteristics of the fresh and hardened material. Stone waste has a filler effect by filling up the voids between the sand grains. With the proper grading, the higher packing density results in improvement of strength (Compressive strength, Tensile strength, Flexural strength), Durability issues, Abrasion resistance with decrement of Coefficient of permeability and Chloride ion penetration by formation of dense microstructure. The produced bricks will be tested for physical and mechanical properties.

II. CRITICAL LITERATURE REVIEW

Following are some critical literature reviews on various national and international papers on use of stone waste into the bricks production and construction. This all reviews are on Marble, Granite and Kota stone sludge utilization and replacement of fine aggregate in bricks production and in construction work.

The followings are the various critical literature reviews based on papers related on replacement material or use of stones sludge in brick production and concrete work.

Singh et al. (2015) studied that Finishing Material Marble Paste is better than a wall putty. Which has more strength & cheaper. Marble paste is a mixture of slurry powder with white cement and slacked or hydrated lime

along with gluing agent. Having a very good impact on the environment. Saved energy and money may be used anywhere else for the development of the nation. [19]

Dharma et al. (2015) Studied that the marble waste and different types of waste can be used as filling material as 15% replacement with natural soil on highway construction. Improve water conductivity, increases in the percentage of coarser particles. It reduces the liquid limit, raises the shrinkage limit and decrease in the plasticity index of the soil in. [4]

Nabil et al. (2015) investigated that the potential utilization of stone slurry powder in artificial stone production. The test results indicated that the compressive strength increased by cement ratio, the compressive strength of the artificial stones is largely affected by the cement to stone powder percent, compaction pressure and curing time. [13]

Ayesha et al. (2014) investigated the use of industrial waste such as marble dust (MD) and steel slag (SS) to produce unfired, environmental friendly bricks. These bricks attained compressive strength superior to conventional burnt clay bricks in less than 7 days. However, water absorption of all the research bricks exceeded the permissible limits set by Indian and American standards. [3]

Kushwah et al. (2014) studied that the utilization of marble slurry in curing. Properties of marble slurry are Bulking is 42%, which is maximum at 5% moisture. Fineness modulus was found to be 0.93. According to these parameters Marble slurry can be utilized in as Curing aid. [8]

Rajni et al. (2014) studied that the utilization of stone waste, in the form of a mineral admixture as a pozzolanic and non-pozzolanic material for mortar and concrete. The stone waste can be utilized for developing low cost building materials such as block, brick, tiles etc. [14]

W. Rehman et al. (2014) found that the marble waste bricks are lower in strength than conventional fired bricks, yet their low cost, ease and speed of fabrication recommend them to be used in area where higher strength is not concern. They can be utilized in shelter for people in earthquake and flood affected areas. [22]

Ankit et al. (2013) carried out an investigation by Compressive strength increase when replacement with stone waste percentage increases when compare to traditional concrete. Replacement of OPC cement with this stone waste material provides maximum compressive strength at 30% replacement. [1]

Mamta et al. (2013) conclude that if the percentage of stone waste increases, compressive strength increases up to a certain point and then after the decreases. The optimum point at which we get maximum strength is replaced 30% stone waste by class F fly ash. [10]

Mamta et al. (2013) studied that if the fly ash is replaced by stone waste (sludge) in fly ash brick by using 10%, 20%, 30%, 40%, 50%, 60% stone waste (sludge) in 1m depth save 0.0993m², 0.1987m², 0.2981m², 0.3975m², 0.4968m², 0.5962m² agricultural land. Use of stone waste (sludge) helps in environmental prevention and prevention of fertile land utilized in brick production. [9]

Ankit et al. (2013) found that the Compressive strength increase when replacement of stone waste percentage increases when compare to traditional concrete. Marble and granite waste had sufficient abrasion resistance according to the American Society for Testing and Materials (ASTM) C902. The Cost change is 21.54%, 13.94%, when replacement of stone waste percentage is 30% of the OPC cement and 20% of PPC cement compare to standard concrete. [2]

Mayor et al. (2013) found that the fineness modulus for basaltic aggregate is 7.71 and for stone chips is 8.0 so stone chips. So the stone chips satisfy this value as per IS code. Specific gravity of stone chips is 2.85 it is satisfied the value as per IS code. Water absorption of stone chips is 0.53 nearer about this value as IS code. [12]

Viswakarma et al. (2013) studied that Marble slurry utilization in the black cotton soil is one of the best ways to improve soil properties and to protect the environment up to some extent from the harmful effects of disposing of marble slurry in land and water. [21]

Mashaly et al. (2012) studied that the marble sludge is used in many products manufacture as replacement of different material, Water content, size, analysis distribution, whiteness index, and chemical characteristics were determined for the marble sludge samples to evaluate its compatibility for various recycling applications. [11]

Rania et al. (2011) found that Marble and granite slurry cement bricks yield similar mechanical, in terms of compressive strength, and physical, in terms of density and absorption, properties. 10% and 20% marble and granite slurry yield Grade S. Most cement brick samples which contain marble and granite waste had sufficient abrasion resistance according to American Society for Testing and Materials (ASTM) C902. [15]

Husam et al. (2010) investigated that the Replacing of the pendant by marble sludge slime significantly reduced the shrinkage values of the produced tiles,

physical properties of the tiles have not been significantly affected. [6]

Swaminathan et al. (2009) studied that from the results of technological tests, it is suggested that granite and marble wastes can be incorporated up to 50 wt. % in clay materials for the production of bricks. The incorporation of granite and marble wastes has negligible effect on the mechanical properties during the entire process of brick. [18]

S. Dhanapandian et al. (2009) investigated that the granite and marble waste content up to 50 wt. % can be added into clay materials of Salem, Namakkal and Erode in the production of bricks with no major determine effect on the properties of the sintered briquette specimens anticipating no costly modifications in the industrial production. [16]

Kamel K. et al. (2009) studied that the using of stone slurry sludge as a source of water in concrete production has insignificant effect on compression strength, while it has a sharp effect on the slump values. [7]

S. Dhanapandian et al. (2009) studied that granite and marble waste content up to 50 wt. % can be incorporated into clay materials, already in use for brick production, without degrading their mechanical properties. Further, it is found that the average strength value of waste mixed brick obtained at 20 wt. % is higher than that of other wt. %. [17]

S. Dhanapandian et al. (2009) investigated that the Marble and granite waste content up to 50 wt. % can be incorporated into Ramanathapuram clay mixture, without degrading their mechanical properties. The presence of marble and granite wastes allow one to obtain a clay brick with better properties as the conventional clay brick at low temperatures as the normally used for brick products in the brick industry. [15]

Halil et al. (2008) observed that the effect of 10-40% Cotton waste replacement in a CW (cotton waste) – LPW (limestone powder waste) matrix does not exhibit a sudden brittle fracture. This CW-LPW composition produce a sturdy lighter composite. Which is about 60% lighter than the conventional concrete brick. Concrete with 30% replacement level of CW which is attained 7MPa compressive and 2.19MPa flexural strength. [5]

Following figure 1 shows development in the area of marble slurry use in construction industry with respect to time.

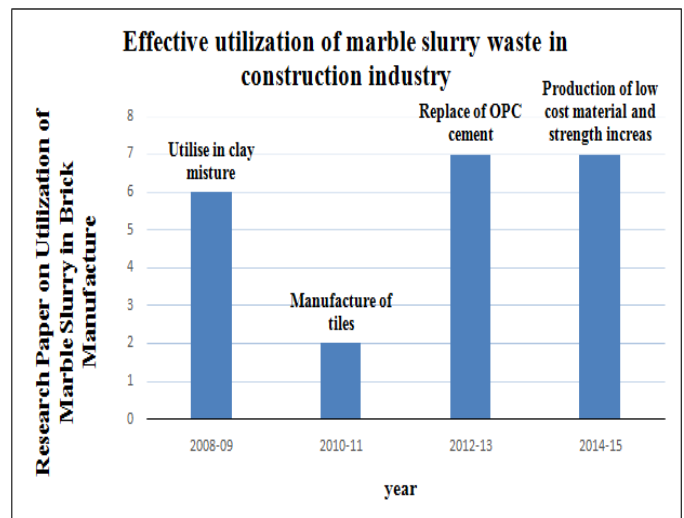


Figure 1: Historical Development of Utilization of Stone Sludge

CONCLUSION

From the previous research paper study and above critical literature reviews following conclusions can be made

1. Granite and marble wastes can be incorporated up to 50 wt. % in clay materials for the production of bricks.
2. Marble and granite waste had sufficient abrasion resistance according to American Society for Testing and Materials (ASTM) C902.
3. Replacement of OPC cement with this stone waste material provides maximum compressive strength at 30% replacement.
4. Stone sludge is used in production of brick, tiles and many more products, it is also used as a filling material and replacement material, and Marble slurry can be utilized in finishing work as White wash.
5. This can reduce up to 4C temperature inside the building. Compressive strength increase when replacement with stone waste compare to conventional concrete.
6. Industrial waste marble dust used in brick as a clay substitute to produce bricks. And brick gain superior compressive strength in less then 7 days compared to burnt clay.

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