Strength Study on Marble Waste Concrete- A Review

Ms. Khushbuben K. Mewada[1], Dr. P.J. Patel[2]
[1, 2] Department of Civil Engineering
[1] M.I.T. Piludara
[2] Ganpat University, Kherva

Abstract- *Leaving the waste materials to the environment directly can cause environmental problem. Hence the reuse of waste material has been emphasized. Marble powder is a waste material generated in considerable amounts in the world. Marble waste leads to a serious environmental problem as well. Therefore, the use of waste marble in the concrete production as an admixture material. In this study, we reviewed the waste marble powder obtained from the industry and investigate its effects on the concrete and also compare the compressive, flexure and split tensile strength, of concrete.*

Keywords- Waste marble powder, concrete, compressive strength, flexure strength, split-tensile strength.

I. INTRODUCTION

Concrete is a widely used construction material consisting of cementing material, fine aggregate (sand), and coarse aggregate. Due to the high in demand of natural resources our engineers & architect has growing interest in sustainable development by choosing the industrial waste. Leaving the industrial waste materials to the environment directly can cause environmental problem. Hence the reuse of waste material has been emphasized. Waste can be used to produce new products or can be used as admixtures so that natural resources are used more efficiently and the environment is protected from waste deposits. Variety of waste materials including marble dust, blast furnace slag, silica fume, fly ash, and lime stone have been used in concrete production.

Marble waste is industrially processed by being cut, polished, and used for decorative purposes, and thus, economically valuable. In marble quarries, stones are cut as blocks through different methods. During the cutting process, 20-30% of a marble block becomes marble waste. Marble stone industry generates both solid waste and stone slurry. All these wastes are thrown away in the areas near the factories and cause severe environmental problems.

India being the topmost exporter of marble, every year million tons of marble waste form processing plants are released. The disposal of this waste marble on soils causes reduction in permeability and contaminates the over ground water when deposited along catchment area. Thus, utilizing these marble waste in construction industry itself would help to protect the environment from dumpsites of marble and also limit the excessive mining of natural resources of sand.

According to the study, marble has cementing properties like high Blaine fineness value and high oxide calcium content which imparts the cohesiveness in concrete. So by using marble powder as the constituent of concrete by partially replacing the cement and sand makes it economical and improves the environmental problem.

Table I
Characterstics Properties of Cement

Sr. No	Characteristics	Specified values per IS:8112-1989
1	Consistency of cement (%)	---
2	Specific gravity	3.15
3	Initial setting time (minutes)	>30
4	Final setting time (minutes)	<600
5	Compressive strength (N/mm2) (i) 3 days (ii) 7 days (iii)28days	 >23 >33 >43
6	Soundness (mm)	10
7	Fineness of Cement (gm)	10

Table II
Physical Properties of Fine Aggregates

Sr. No	Physical Properties	Specified values per IS:383-1970
1	Specific gravity of fine aggregate	2.60
2	Free moisture content	2%
3	Water absorption	1.82%

Table III
Sieve Analysis of Fine Aggregate

Sr. No	IS Sieve Designation	Specified values per IS:8112-1989			
		I	II	III	VI
1	10mm	100	100	100	100
2	4.75mm	95-100	90-100	90-100	95-100
3	2.36mm	60-95	75-100	85-100	95-100
4	1.18mm	30-70	55-90	75-100	90-100
5	600 micron	15-34	35-59	60-79	80-100
6	300 micron	5-20	8-30	12-40	15-50
7	150 micron	0-10	0-10	0-10	0-15

II. LITERATURE REVIEW

In past studies different researches had been done with marble powder for the improvement in concrete mix. Mainly marble powder is replaced with constituents of concrete to test the mechanical properties and also its economical value.

Bhupendra Singh Kalchuri, Dr. Rajeev Chandak, R.K.Yadav (2015) presented in his paper that the marble can be utilized in concrete mix by replacement of fine aggregates in four different proportions i.e. 10%, 20%, 30% and 40%. This compressive strength compared with the conventional concrete i.e. concrete prepared without marble powder. And they conclude The compressive strength of concrete is increased when the percentage of marble powder waste is increased up to 20% and by further increasing the percentage of marble powder waste compressive strength gets reduced.[3]

Kür at Esat Alyamaç, and Alp Bu ra Aydin (2015) studied the develop a concrete mixture with maximum marble content that has strength properties comparable to that of the non-marble reference concrete (without marble powder), as opposed to developing a marble powder concrete with maximum compressive strength. The main purpose is to replace sand with marble powder in concrete because such a mixture will be environmentally friendly and economically feasible. The concrete samples are produced by replacing sand with marble powder at 10%, 20%, 30%, 40%, 50% and 90% by volume. the compressive strength values are determined after 7, 28 and 90 days with splitting tensile strength values at 28-th day And they conclude Based on the feasibility evaluation it is shown that using up to 40% marble powder in concrete is suitable in accordance with the requirements.[7]

R. Rodrigues, J. de Brito, M. Sardinha (2015) presented in his research paper is to evaluate the mechanical performance of concrete with various incorporation ratios of sludge from the marble extraction industry as cement replacement (0%, 5%, 10% and 20% of the total volume of cement), as well as with plasticizers. Workability and bulk density tests were carried out on fresh concrete, while compressive strength, splitting tensile strength, modulus of elasticity, ultrasonic pulse velocity and abrasion resistance tests were performed to evaluate the relevant properties of concrete in the hardened state. And they was found that the mechanical properties of concrete containing sludge from the marble extraction industry tend to decline. However, satisfactory results were obtained for replacement ratios of up to 10%, thereby validating the use of this concrete in the construction sector. Regarding the use of plasticizers, it was observed that they improve the mechanical performance of concrete with marble sludge by offsetting the decline of its properties relative to conventional concrete.[12]

Aalok D. Sakalkale, G. D. Dhawale, R. S. Kedar (2014) presented study is aimed at utilizing Waste marble powder construction industry itself as fine aggregate in concrete, replacing natural sand. The replacement is done partially and fully in the proportion 0%, 25%, 50% and 100% and its effect on properties of concrete were investigate in this paper and they are conclude The compressive strength of concrete is increased with addition of waste marble powder up to 50% by weight in place of sand and further any addition of waste marble powder the compressive strength decreases. The split tensile strength of cylinders is decreased with addition of waste marble powder, from control mix to 100% replacement of sand. The flexural strength of beams is also increased with addition of waste marble powder up to 50% sand replacement and then gradually decreases.[1]

Diogo Silva, Filipe Gameiro, and Jorge de Brito (2014) presented in his paper is to assess the mechanical performance of concrete containing different percentages of fine aggregates produced from waste generated by the marble quarrying industry (0, 20, 50, and 100% of the total volume of aggregates). More specifically, the workability and bulk density of fresh concrete were measured and the compressive strength, splitting tensile strength, modulus of elasticity, and abrasion resistance of hardened concrete were determined. In general, concrete containing secondary fine aggregates proved to have worse mechanical properties than conventional concrete made with primary siliceous sand, basalt, and granite fine aggregates. This poorer performance was more noticeable when the replacement percentage was higher. However, the reduction in mechanical performance is acceptable and does not compromise use of these secondary aggregates in structural concrete.[4]

Rishi, Dr. Vanita Aggarwal (2014) studied shows the experimental investigations on the replacement of cement and

sand both partially & combined with the waste marble powder/waste marble granules in which, by the partial replacement of cement and sand, the compressive, flexure and split-tensile strength get increased up to a certain percentage but get decreased with the combined replacement of combination of cement & sand. The result obtained in the present study indicates that partially it is feasible to replace the fine aggregate and cement by waste marble powder for improving the strength characteristics of concrete but the strength get decreased when replace the fine aggregate and cement combine by waste marble powder by 20%, thus the combination against cement and sand cannot be replaced.[11]

Pooja J.Chavhan, Prof. S. D. Bhole (2014) studied in her paper marble powder is replace by sand the research is carried out by using M25 grade concrete with replacement of 0%, 5%, 10%, 15%, 20%, 25%, 30%, 35%, 40%, 45%, 50% marble powder by sand and is carried out to determine the optimum percentage of replacement at which maximum compressive strength and also split tensile strength is achieved There are several reuse and recycling solutions for this industrial by-product, both at an experimental phase and in practical applications. These industrial wastes are dumped in the nearby land and the natural fertility of the soil is spoiled. The physical, chemical and mechanical properties of the waste are analyzed. They conclude the compressive strength increases with 30% replacement and also 45%, 50% replacement by sand and also found that the maximum 28 days split tensile strength was obtained with 45% marble powder replaced with fine aggregate.[9]

F. Gameiro, J. de Brito, D. Correia da Silva (2013) presented in his paper is to assess the durability performance of concrete containing various percentages of fine aggregates produced from the waste generated by the marble quarrying industry (0%, 20%, 50% and 100% of the total volume of fine aggregates). They conclude the workability of fresh concrete tends to decrease as the replacement ratio increases (0%, 20%, 50% and 100%), except for the river sand specimens. And the incorporation of fine marble waste aggregates was beneficial to some durability-related characteristics. Furthermore, it was found when the use of marble fines adversely affected properties this did not compromise the intended durability properties of sound structural concrete.[6]

António André, Jorge de Brito, Alexandra Rosa, Diogo Pedro (2013) studied in his paper marble powder is replace by conventional primary aggregates (PA; basalt, granite and limestone) were replaced in the three families by coarse marble aggregates (CMA) at ratios of 20%, 50% and 100% of the total volume of aggregates. And they conclude Workability is neither significantly affected (for a constant w/c ratio) nor does it exhibit a defined trend when CMA is incorporated. Despite this, there is still an increase in workability for the 20% incorporation ratio and a decrease for the 50% ratio for mixes made with BCA and LCA. Water absorption by immersion and carbonation depth, the behavior of concrete made with CMA is similar to that of the reference concretes. The incorporation of CMA in the mixes made with BCA results in high water absorption by capillary action. In CMA concrete workability increase in 20% incorporation ratio. Compressive strength decreases with increases ratio of PA with CMA.[2]

Prof. P.A. Shirulea, Ataur Rahmanb , Rakesh D. Gupta (2012) presented in his paper he was used M20 grade. The concrete mix proportion (cement: fine aggregate: coarse aggregate) is 1: 1.5: 3 by volume and a water cement ratio of 0.5. Marble powder were added in concrete in step of 5 (0%, 5%, 10%, 15%, 20%). For each percent of marble powder replacing Cement. Compressive test and spilt tensile test is done in his paper. They are conclude The Compressive strength of Cubes and spilt tensile test are increased with addition of waste marble powder up to 10% replace by weight of cement and further any addition of waste marble powder the compressive strength decreases.[10]

III. DISCUSSION

Today we live in the world full of development and enthusiastic for still more comfort and facilities. This leads to innovations and revolutions in each and every field, but on contrary it has negative impact on environment as resources get depleted and pollution to different natural sources are occurred. Marble powder as a waste has properties which has bad impact on the environment but when mix with concrete constituents in some proportion it helps in enhancing the properties of concrete mix specially its strength. By adding marble powder it can reduce the environmental pollutions and save natural resources. According to the researches, it shows that marble powder is give good impact in construction line.

IV. CONCLUSIONS

1. According to earlier experimental studies, it concludes that use of wastes as a partial replacement of concrete constituents had a great prospective.
2. Industrial wastes are capable of improving the physical and chemical properties. Use of marble waste powder shows a great performance in mechanical and durability properties of concrete.
3. As per the study it, marble powder gives good performance in durability and mechanical properties of concrete.

4. According to the study, waste marble powder has some cementations properties. Because of these properties of marble powder, it can be used and fulfills the economical and environmental problems.
5. According to study, Both sand and cement (combine) replacement ratio increases give low performances in mechanical properties of concrete.
6. According to study, Compressive strength of concrete decreases with increases ratio of primary aggregate with coarse marble aggregate
7. Marble powder can also affects the shrinkage and plasticity.
8. Marble powder is easily available so it might be cost effective.

REFERENCES

[1] Aalok D. Sakalkale, G. D. Dhawale, R. S. Kedar "Experimental Study on Use of Waste Marble Dust in Concrete" International Journal of Engineering Research and Applications, October 2014

[2] António André, Jorge de Brito*, Alexandra Rosa, Diogo Pedro "Durability performance of concrete incorporating coarse aggregates from marble industry waste" Journal of Cleaner Production (ELSEVIER),1 October 2013

[3] Bhupendra Singh Kalchuri, Dr. Rajeev Chandak, R.K.Yadav "Study on concrete using marble powder waste as partial replacement of sand" International Journal of Engineering Research and Application, April 2015

[4] Diogo Silva, Filipe Gameiro, Jorge de Brito "Mechanical properties of structural concrete containing fine aggregate from waste generated by the marble quarrying industry" American Society of Civil Engineers. (ASCE), 2014

[5] Emmanuel K. Attiogbe and Sami H. Rizkalla "Response of Concrete to Sulfuric Acid Attack" ACI Materials Journal I November-December 1988

[6] F. Gameiro, J. de Brito, D. Correia da Silva "Durability performance of structural concrete containing fine aggregates from waste generated by marble quarrying industry" Engineering Structures (ELSEVIER), 24 December 2013

[7] Kür at Esat Alyamaç and Alp Bu ra Aydin "Concrete Properties Containing Fine Aggregate Marble Powder" KSCE Journal of Civil Engineering (SPRINGER), 17 February , 2015

[8] Olutoge, F. Adeyemi and Amusan and G. Modupeola "The Effect of Sea Water on Compressive Strength of Concrete" International Journal of Engineering Science Invention, July 2014

[9] Pooja J. CHavhan, Prof. S. D. Bhole "To Study the Behavior of Marble Powder as Supplementary Cementations Material in Concrete" International Journal of Engineering Research and ApplicationsApril 2014.

[10] Prof. P.A. Shirulea, Ataur Rahmanb, Rakesh D. Guptac "Partial Replacement of Cement with Marble Dust Powder" International Journal of Advanced Engineering Research and Studies, April-June, 2012

[11] Rishi, Dr. Vanita Aggarwal "Effect on partial Replacement of Fine Aggregate and Cement by Waste Marble Powder/ Granules on flexural and Split tensile strength" IOSR Journal of mechanical and civil Engineering, Jul-Aug. 2014

[12] R. Rodrigues, J. de Brito , M. Sardinha "Mechanical properties of structural concrete containing very fine aggregates from marble cutting sludge" Construction and Building Materials (ELSEVIER), 12 January 2015

[13] IS: 456-2000, Indian Standard code of practice for plain and reinforced concrete. Bureau of Indian Standard, New Delhi.

[14] IS: 10262-2009, Indian Standard code of practice for recommended guidelines Concrete Mix Design. Bureau of Indian Standard, New Delhi.

[15] IS: 383-1997, Specification for coarse and fine aggregates from natural sources for concrete. Bureau of Indian Standard, New Delhi.

[16] IS 1489 (Part 1) : 1991, Portland-Pozzolana cement Specification. Bureau of Indian Standard, New Delhi.

[17] Concrete Technology by M.S. Shetty.

[18] Concrete technology by M. L. Ghambhir.