IJCSE International Journal of Computer Sciences and Engineering Open Access
Review Paper Volume-5, Special Issue-2, Dec 2017 E-ISSN: 2347-2693

Influence of the Marble dust on Hardened properties of the Concrete - A State of art review

M. Manwani [1*], P. K. Goyal [2]

[1,2]Govt. Engineering College, Ajmer

Available online at: www.ijcseonline.org

Abstract- This paper presents the state- of -art review of the influence of the marble dust on hardened properties of the Concrete. The main purpose of this review paper is to find out the great potential for the use of waste marble dust in concrete production, so that the environment must protect with the effect of waste marble dust. In this review paper, the influence of the marble dust on the hardened properties of concrete mix will be discussed in two segments. The first segment will discuss the impact of concrete by changing the soil from the marble dust and second segment deals with changing the cement from the marble dust.

Keywords: Waste, Marble Dust, Concrete, Environment protection.

1. INTRODUCTION

A new revolution took place in the construction industry when cement was invented in the 19th century. Concrete manufacturing is one of the technique related to building and construction industry have been developed after the invention of cement. Marble industry was one of the pristine industry related to building and construction.

'Marble' is a building stone that, because of its aesthetic values, wants to put everyone in their houses from poor to rich. Even so, many splendid buildings all over the world are made of marble stones. From the perspective of the Indians, the houses made of marble are considered as proof of grandeur.

The maximum mining (around 88%) of the finest quality of marble is done in Rajasthan state which is situated in North – West India. Gradually marble processing in Rajasthan has taken the form of a giant industry. The excavation and processing of marble are done in 20 districts out of 33 districts of Rajasthan. Mainly 5 to 6 million tons of waste generated from processing units in the form of marble slurry in which 70-75% water is present. Therefore, to avoid damage to the environment, safe disposal of marble industries is a vivid issue of the present time.

This marble slurry is the main cause of environmental pollution as it contains dolomite, gypsum and sulfates in addition to calcium carbonate, which destroys the top layer of soil. Apart from this the salinity of the soil increases, which ultimately harms the productivity of soil and farmers do not get good crop yield.To maintain soil fertility, waste marble can be used in art, industrial and construction activities.

Many researchers have looked for the possibility to re-use waste marble in the building and construction industry for making bricks, concrete and tiles. In this review paper, discuss the ongoing research on the use of marble dust in concrete and its effects on the hardened properties of concrete.

2. LITERATURE REVIEW

2.1 Replacement of Sand with Marble Dust

Binici et al (2007), while studying his tests on concrete, replace fine aggregate with 0%, 5%, 10% and 15% by volume with marble dust. He revealed from his study that if the fine aggregate is replaced with 15% of the marble dust, a 24% increase in the compressive strength of concrete after comparing with the Control mix. They have been also reported that due to the sulphate attack, the reduction in the compressive strength of concrete is, at least when 15% replacement of marble dust. Along

with this, the maximum abrasion resistance of the concrete, and minimum depth of penetration of water into concrete is obtained at the 15% replacement of marble dust with fine aggregates.

M Shahul Hameed et al (2009) tried to perform their experiments something different from other researchers and acquired the positive results. It is known to all that the quarry rock dust is also harmful to the environment, just like marble dust. Thus, recognizing the importance of the environment, they prepared the sample of concrete cubes with introducing the 50% of the quarry rock dust and 50% of marble dust in place of 100% sand. They published that the compressive strength and split tensile strength of concrete increases approximately 10% and 8% respectively when compare with control mix. They also indicated that the durability properties, i.e. resistance to sulphate attack, permeability of concrete etc. was increased.

Kursat Esat et al (2015) in his experiments on concrete, replaces the fine aggregates from marble dust at 0%, 10%, 20%, 30%, 40%, 50% and 90% by volume. The experiments manifested, that the maximum increase in compressive strength observed in a cube of concrete in which fine aggregate is replaced by 20% of marble dust and after that compressive strength of concrete, again decreases. They have been also explained that the splitting tensile strength and friction resistance of concrete, similarly behaves like the compressive strength of concrete, i.e. increasing as the percentage of marble dust increases in the concrete. But if talks about the water absorption of concrete, then results revealed that the 20% and 30% replacement of marble dust with fine aggregate gives lower values of water absorption of concrete.

M Vijaya Sekhar Reddy et al (2015) performed the experiments on concrete for utilization of waste marble dust in concrete to defend the environment. The experiments unfold that the if the marble dust uses up to 50% instead of fine aggregate in the concrete, then the compressive strength of concrete increases. Identical results trend also shown by G V Vigneshpandian et al (2017), which studied that 28% increase in compressive strength of concrete when marble dust replaces 50% of fine aggregates.

Raj. P. Singh et al (2015) found in his studies that up to 30% of marble dust replaces fine aggregate the compressive strength is above the control mix, whereas the maximum value of compression strength was got at 15% replacement of marble dust with fine aggregates. Similar results have also been incorporated by Siva Kishore et al (2015), that the compressive strength of concrete is increased up to 15% of replacement of Marble dust with fine aggregates and further increase in marble dust content shows the decreasing pattern of compressive strength of concrete.

Baboo Rai et al (2011), on the basis of the tests, said that if the marble dust is added to 10% instead of fine aggregates, the compression strength of the concrete increases and if more than 10% of the marble dust is added at the concrete it slightly reduces the compressive strength of concrete. S Suresh et al (2013) also shows the similar results from their experiments that the concrete blended with marble dust in place of fine aggregates improves the hardened properties of concrete.

A.A. Aliabdo et al. (2014) during the tests was replaced the fine aggregates by marble dust with a ratio of 0%, 5%, 7.5%, 10% and 15% and they also suggested that when maintaining the same marble dust and the sand replacement ratio, reduction in the proportion of water and cement improves the compressive strength of the concrete. Based on their tests, they proved that the tensile strength of concrete and bond strength between steel-concrete increases and optimum value of both properties are obtained when up to 10% of marble dust is used in concrete. The results regarding Porosity of concrete and ultrasonic pulse velocity resemble with results Bahar Demirel experiments on concrete.

Bahar Demirel (2010) differently exercised and took a two fractions of fine aggregates in the experiments, one fraction was 0 - 0.25mm and other fraction was 0.25mm - 4mm.BaharDemirel only replaces the 0-0.25mm portion of fine aggregates from 0% to 100% of marble dust and investigated that the compressive strength of concrete is increased as curing age and percentage of marble dust in place of fine aggregate increases. It also had said that mixing marble in the place of sand in concrete has a profound effect on concrete porosity and concrete porosity decreases with increasing the amount of marble dust and increase its ultrasonic pulse velocity.

Alok D Sakalkale et. al. (2014) examined the behavior of concrete when one of the ingredients of concrete (fine aggregate) was replaced by marble dust in proportions of 0%, 25%, 50% and 100%. From their study, they found optimum compressive strength of concrete by adding up to 50% of the waste marble dust to the concrete in place of fine aggregate, the compressive strength and flexural strength of the concrete shows increasing pattern on the graph. But they also declared that the split tensile strength of concrete cubes shows a decreasing pattern of the curve on the graph from 0% to 100% use of marble dust in place of fine aggregates.

Like the rest of the researchers, Raman Kumar and Ankit (2016) have shown that the compression strength and splitting tensile strength of concrete increases with replacement of 10% to 15% of the amount of marble dust in place of fine aggregates. According to the two attributes of concrete mentioned above, the flexural strength of the concrete also shows the same trends of results when sand replaced by the marble powder.

Ms. Monica C. Dhoka (2013) also created an extraordinary experimental program in which she prepared three types of concrete mixes. The first was the conventional concrete mix, in the second mix, they replaced completely the fine aggregates with 50% marble powder and 50% of the dust and in the final mix was provided by 10% of paper pulp in place of cement. The results described that the compressive strength and the split tensile strength of second mix was increased about 8% and 25% respectively as compared to conventional mix.

2.2. Replacement of Cement with Marble Dust

Anwesha Gayan and Diksha Das (2016) performed the experiments on the 150mm x 150mm x 150mm cube specimens, which was cast by inserting the marble dust in at 0%, 5%, 10%, 15% and 20% proportions in place of cement and fine aggregates are completely replaced by quarry dust. They revealed from their experiments that the compressive strength of concrete increases as the marble content percentage increases and the optimum value found when 20% marble dust used in place of concrete. They did a comparative analysis of the cost of conventional concrete and environment friendly concrete (i.e. Green concrete) and found that the cost of construction can be reduced by using green concrete.

Hazrat Amin et al (2014) to prove the usefulness of marble dust, they have experimented differently, replaced the cement with dose of marble dust which kept constant around 30% and then alter the doses of silica fume in the concrete by 0%, 5% and 10% in place of cement.. The maximum compressive strength that has been achieved is in the control mix i.e. neither the marble dust was in the concrete nor the silica fume, that was really surprising result.

Deepanshu Patel et al (2016) also communicated the marble dust from 0% to 15% instead of cement in the concrete mix, the outcomes were very positive. Maximum compressive strength of concrete specimen was observed at the time when 10% of marble dust replaces cement in the concrete mix. Similar outcomes were also presented by ChandraprabhaSahu (2016) and Vijaya Kumar Y M (2016)

Abdullah Anwar et al (2015) presented the opposite results from the other researchers through his trials, which states that if the percentage of cement replacement by the marble dust in concrete mix increases than the compressive strength of concrete cubes continuously reduces.

A.A. Aliabdo et al. (2014) while making concrete for his experiments, the cement was replaced by the waste marble dust. They demonstrated that if the 10% waste marble dust is used in place of cement, then the maximum bond strength between the steel-concrete will be obtained. According to the researcher, it is more worthwhile to use marble dust in place of fine aggregates instead of replacing the cement with marble dust.

E. Bacarji (2013) had shown the use of marble and granite residue on concrete in a very praiseworthy manner.The experimental programs were used to replace some amount of cement with 0%, 5%, 10% and 15% of marble and granite residues. Based on the results of their experiments, they pointed out that as the amount of marble and granite residues was increased in the concrete, decreases the compressive strength of concrete but the water absorption of the concrete increases.

Raminder Singh et al (2015) has also tried to apply innovative ideas in his experiments and he had obtained the very promising results. They utilize the marble dust and waste crushed tiles in place of cement and coarse aggregates, respectively. The results revealed that employing the 5% marble dust and 15% to 30% of crushed tiles in concrete increases the compressive strength of concrete.

Rochak Pandey (2016)carried out some investigation on concrete in which marble dust in mixed in place of cement in addition of superplasticizer. The experimental results showed that the concrete mix in which replacement of 15% of cement with waste marble powder and blended with superplasticizer at 1.5% by weight of cement, results into maximum compressive strength.

N. Gurumoorthy (2014) also used marble dust in place of cement in proportions of 0%, 10%, 15%, 20%, 25% and 30%. The investigation revealed that the replacement of cement by marble waste powder at different ranges, in concrete production,

resulted in higher compressive strength, split tensile strength and flexural strength as compared to the control mix and the optimum values of these hardened properties were achieved at 25% proportion of marble dust to the cement.

Mohsen Tennich et al (2017) worked on to find out the influence on hardened properties of self compacting concrete. The results pointed out that the addition of the waste marble dust in concrete developed the resistant properties in concrete to combat the chemical degradation. Therefore, it can be said that adding the waste marble dust to the concrete production increases the durability of the concrete.

A.S.E. Belaidi et al (2012) produced the self compacting concrete mixes with natural pozzolan and waste marble dust for their experimental program. They suggested from the positive test results that the industrial waste was very beneficial to the production of self compacting concrete.

A. Boukhelkhal et al (2016) studied experimentally the effect of marble dust on self compacting concrete by applying the testing program in which cement is partially replaced by marble waste at 5%, 10%, 15% and 20%. The results manifested regarding the hardened properties of self compacting concrete that the incorporation of waste marble powder decreases compressive strength, tensile strength, and ultra pulse velocity of the self compacting concrete.

3. CONCLUSION

Many researchers performed the state - of - art experiments to visualize the results that in what way the properties of hardened concrete produced by partial addition of marble waste affected. After reading the research papers of several researchers, the following conclusions have been obtained.

1. Most researchers suggested that in the concrete production, if fine aggregate ingredient changes from 10% to 25% of waste marble dust, then the optimum compressive strength of concrete attained when compared from traditional concrete.

2. Many researchers have claimed that the compressive strength of the concrete decreases as conventional concrete, when the cement would be partially replaced by waste marble dust.

3. Several researchers have been concluded that if the marble dust was mixed in place of fine aggregates during concrete production, then the results of split tensile strength and the flexural strength follow the same pattern quasi results of compressive strength of concrete.

4. Researchers also discovered that the abrasion resistance of the concrete increases with using marble dust in the concrete production.

REFERENCES

1.A Boukhelkhal, L Azzouz, A S E Belaïdi& B Benabed 2016. Effects of marble powder as a partialreplacementof cement on some engineering properties of self compacting concrete. Journal of Adhesion Science and Technology, Vol. 30, no. 22, 2405–2419.

2. S Manpreet, S Anshuman, D Bhunia 2017. An investigation on effect of partial replacement of cement by waste marble slurry.Construction and Building Materials, 134, 471–488.

3. M Tennich, M B Ouezdou, A Kallel 2017. Behavior of self-compacting concrete made with marble and tilewastes exposed to external sulfate attack. Construction and Building Materials, 135, 335–342.

4. K E Alyamaç and A B Aydin 2015. Concrete Properties Containing Fine Aggregate Marble Powder. KSCE Journal of Civil Engineering.

5. M Sardinha, J Brito, R Rodrigues 2016. Durability properties of structural concrete containing very fine aggregates of marble sludge. Construction and Building Materials, 119, 45–52.

6. A S E Belaidi, L Azzouz, E Kadri, S Kenai 2012. Effect of natural pozzolana and marble powder on the properties of self-compacting concrete. Construction and Building Materials, 31, 251–257.

7. N M Soliman 2013. Effect of using Marble Powder in Concrete Mixes on the Behavior and Strength of R.C. Slabs. International Journal of Current Engineering and Technology, Vol.3, No.5, 1863-1870.

8. A D Sakalkale, G D Dhawale, R SKedar 2014. Experimental Study on Use of Waste Marble Dust in Concrete. Int. Journal of Engineering Research and Applications, Vol. 4, Issue 10 (Part - 6), 44-50.

9. H Binici, H Kaplan and S Yilmaz 2007. Influence of marble and limestone dusts as additives on some mechanical properties of concrete. Scientific Research and Essay Vol. 2 (9), 372-379.

10. A A Aliabdo, A E M A Elmoaty, E M Auda 2014. Reuse of waste marble dust in the production of cement and concrete. Construction and Building Materials, 50, 28–41.

11.B Demirel 2010. The effect of the using waste marble dust as fine sand on the mechanical properties of the concrete. International Journal of the Physical Sciences, Vol. 5(9), 1372-1380.

12. G V Vigneshpandian, E A Shruthi, C Venkatasubramanian, D Muthu 2017. Utilization of Waste Marble Dust as Fine Aggregate in Concrete. IOP Conf. Series: Earth and Environmental Science, 80.

13. Raj P S Kushwah, I C Sharma, P B L Chaurasia 2015. Utilization of "Marble Slurry" In Cement Concrete Replacing Fine Agreegate. American Journal of Engineering Research, Volume-04, Issue-1, 55-58.

14. I S Kishore, M Chowdary 2015. A Study on Waste Utilization of Marble Dust in High Strength Concrete Mix. International Journal of Civil Engineering and Technology, Volume 6, Issue 12, 01-07.

15. Anwesha Gayan and Diksha Das 2016. An Effort in Developing a Sustainable Concrete using Marble Powder as Partial Cement Replacement and Quarry Rock Dust as Fine Aggregrate with an Emphasis on Cost of Production. Journal of Civil Engineering and Environmental Technology, Volume 3, Issue 4, 293-296.

16. A Mishra, A Pandey, P Maheshwari, A Chouhan, S Suresh, S Das 2013. Green Cement For Sustainable Concrete Using Marble Dust. International Conference on Global Scenario in Environment and Energy, Vol.5, No.2, 616-622.

17. Ms. Monica C. Dhoka 2013. Green Concrete: Using Industrial Waste of Marble Powder, Quarry Dust and Paper Pulp. International Journal of Engineering Science Invention, Volume 2, Issue 10, 67-70.

18. N. Gurumoorthy 2014. Influence of Marble Dust as Partial Replacement of Cement in Concrete. International Journal of Engineering Research & Technology, Vol. 3 Issue 3, 740-743.

19. R Pandey, M C Paliwal, J Mehta, J N Tiwari 2016. Optimum Partial Replacement of Cement in Concrete With Waste Marble Dust Inconjuction With Superplasticizers. Int. Journal of Engineering Sciences & Research Technology, 5(8), 867-876.

20. R Singh, M Bhutani and T Syal 2015. Strength evaluation of concrete using Marble Powder and Waste Crushed Tile Aggregates. International Journal for Science and Emerging Technologies with Latest Trends, 20(1), 18- 28.

21. M S Hameed and A S S Sekar 2009. Properties of Green Concrete Containing Quarry Rock Dust and Marble Sludge Powder as Fine Aggregates. ARPN Journal of Engineering and Applied Sciences, VOL. 4, NO. 4, 83 – 89.

22. A Anwar, S Ahmad, S M A Husain, S A Ahmad 2015. Replacement of Cement by Marble Dust and Ceramic Waste in Concrete For Sustainable Development. International Journal of Innovative Science, Engineering & Technology, Vol. 2 Issue 6, 496 – 503.

23. E. Bacarji, R D Toledo Filho, E A B Koenders, E P Figueiredo, J L M P Lopes 2013. Sustainability perspective of marble and granite residues as concrete Fillers. Construction and Building Materials, 45, 1–10.

24. D Patel, P Bodiwala, T Joshi, U Dave 2016. To Study The Properties of Concrete as a Replacement of Cement With The Marble Dust Powder. International Journal of Civil Engineering and Technology, Volume 7, Issue 4, 199–207.

25. H Amin, A R Khalid, A Alam 2014. Use of Silica Fume and Marble Dust as Partial Binding Material in Concrete. First International Conference on Emerging Trends in Engineering, Management and Scineces.

