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Experimental study of partial replacement of marble dust by cement in concrete and mortar

Vishal Nandurkar[a], Amit Lokhande[a], Gaurav Srivastava[a],HemantNikhare[a],
Prof. Mr. V. S. Vairagade[b]
[a]*U. G. Student, Tulsiramji Gaikwad-Patil College of Engineering and Technology, Mohgaon, Nagpur, INDIA*
[b]*Assisstant Professor, Tulsiramji Gaikwad-Patil College of Engineering and Technology, Mohgaon, Nagpur, INDIA*

***Abstract*—Marble is a building material which use especially in palaces and monuments. Marble is nothing but metamorphic rock composed of carbonate minerals, most commonly calcite. Presently large amounts of marble dust are generated in natural stone processing plants with an important impact on environment and humans. The marble dust generated at quarries and fabrication plants. This huge mass of marble waste consisting of very fine particles is today one of the important environmental problems around the world. Marble blocks are cut into smaller blocks in order to give them the desired shape. During the cutting process nearly 25% of the original marble mass is lost in the form of dust. This marble dust is settled by sedimentation and then dumped away which results in environmental pollution, in addition to forming dust in summer and threatening both agriculture and public health. Therefore, utilization of the marble dust in various industrial sectors especially the construction, would help to protect the environment. Marble waste use as a material is a very important environmental management tool for achieving sustainable development. And this waste material is so much cheaper. So by the use of marble dust as partial replacement in concrete and mortar as pozzolanic material by cement and sands the environmental problems, health problems, disposal problems can be sort out. And the concrete and mortar made after replacement will economic and durable.Because the particles of marble powder is smaller than cement and it is also circular in shape so therefore this waste can be use as pozzolanic material and this will help to reduce heat of hydration. Basically marble powder is not cementitious material, but it has much more content of calcium carbonate so therefore it helps in hydration reaction process.**

Keywords—metamorphic; pozzolanic;fabrication; cementitious

I. INTRODUCTION

The Concrete has very old history. It is in use from ancient time. It is most consumptive material after water. The components of concrete are cement, coarse aggregate, sand and water. The important components of concrete is cement which play as role of binder in concrete. But the production cost of cement is too high and also production of cement creates harmful impact on environment. Unfortunately during production of cement carbon dioxide is released into the atmosphere. This creates a lot of problems on human body. So keeping these points in mind the replacement of marble dust by cement as pozzolanic material had been done. This project describes the feasibility of using the marble dust in concrete and mortar as partial replacement of cement.Marble is a building material which use especially in palaces and monuments. Marble is nothing but metamorphic rock composed of carbonate minerals, most commonly calcite. Presently large amounts of marble dust are generated in natural stone processing plants with an important impact on environment and humans. The marble dust generated at quarries and fabrication plants. This huge mass of marble waste consisting of very fine particles is today one of the important environmental problems around the world. Marble blocks are cut into smaller blocks in order to give them the desired shape. During the cutting process nearly 25% of the original marble mass is lost in the form of dust. This marble dust is settled by sedimentation and then dumped away which results in environmental pollution, in addition to forming dust in summer and threatening both agriculture and public health. Therefore, utilization of the marble dust in various industrial sectors especially the construction, would help to protect the environment. Marble waste use as a material is a very important environmental management tool for achieving sustainable development. And this waste material is so much cheaper. So by the use of marble dust as partial replacement in concrete and mortar as pozzolanic material by cement and sands the environmental problems, health problems, disposal problems can be sort out. And the concrete and mortar made after replacement will economic and durable.Marble slurry has got all the above mentioned qualities as compared to the ingredients by which it will get replaced in the concrete. The rates are feasible of marble slurry as because it is waste also its use in concrete will reduce CO_2 emission because of its chemical properties and as there is disposal problem of marble slurry the problem of disposal will also gets solved thus having a two way sustainable development i.e. solving the problem of disposal which will cause health hazards and also reduces aesthetic view of the nearby vicinity where marble powder or slurry is being dumped and secondly because of its use in the concrete which will reduce the emission of carbon-dioxide gas which is the major factor contributing to the global warming and also causing other environmental problems too.Marble is a metamorphic rock resulting from the transformation of a pure limestone. The purity of the marble is responsible for its colour and appearance: it is white if the limestone is composed solely of calcite (100% $CaCO_3$). Marble is used for construction and decoration; marble is durable, has a noble appearance, and is consequently in great demand. Chemically, marbles are crystalline rocks composed predominantly of calcite, dolomite or serpentine minerals. The other mineral constituents vary from origin to origin. Quartz, muscovite, tremolite, actinolite, micro line, talc, garnet, osterite and biotite are the major mineral impurities whereas SiO2, limonite, Fe2O3, manganese, 3H2O and FeS2 (pyrite) are the major chemical impurities associated with marble. The main impurities in raw limestone (for cement) which can affect the properties of finished cement are magnesia, phosphate, leads, zinc, alkalis and sulphides. A large quantity of powder is generated during the cutting process. The result is that the mass of marble waste which is 20% of total marble quarried has reached as high as millions of tons. Leaving these waste materials to the environment directly can cause environmental problem.

Marble waste use as a material is a very important environmental management tool for achieving sustainable development. On the other hand, recycling waste without properly based scientific research and development can result in environmental problems greater than the waste itself. Marble waste from quarry operations can be unsafe and environmentally detrimental. Now-a-days the cost of material is increasing so if we use the waste material in the production of the concrete so we decrease the price. In India, million tons of wastes from marble industries are being released from marble cutting, polishing, processing and grinding. Exposing the waste material to the environment directly can cause environmental problems. Therefore, many countries have still been working on how to re-use the waste materials. Marble powder can be used as an admixture in concrete, so that strength of the concrete can be increased. Marble dust is mixed with concrete, cement or synthetic resins to make counters, building stones, sculptures, floors and many other objects. Marble powder is not available in all the places. Despite this fact, concrete production is one of the concerns worldwide that impact the environment with major impact being global warming due to CO2 emission during production of cement. In addition to this, due to fineness of the marble powder, it will easily mix with aggregates so that perfect bonding is possible. Marble powder will fill the voids present

II. Literature Review

The research aims to study the effect of using marble powder as partially replace of cement on the properties of concrete. The influence of using marble powder on the behavior of reinforced concrete slabs is also investigated. The main variable taken into consideration is the percentage of marble powder as partial replacement of cement content in concrete mixes. The experimental results showed that, using definite amount of marble powder replacement of cement content increases the workability, compressive strength and tensile strength. Using marble powder enhanced also the structural performance of the tested slabs as it increased the stiffness and the ultimate strength compared to the control slabs. The experimental program conducted in this study was performed in the laboratory of testing of building materials at the Faculty of Engineering, Menoufia University, Egypt. Cubes 10x 10 x10 cm, cylinders 10x20 cm and beams 10x10x40 cm. were caste and tested to determine the slump, compressive, indirect tensile and modulus of elasticity of the concrete using marble powder as the replacement of cement content with different ratios. The Reinforced Concrete Slabs under investigation were loaded and tested under flexural. This slabs consisted of mixes contained different marble powder ratios of (0%, 2.5%, 5%, and 7.5%) as replacement of cement. The cost was decreased by increasing marble powder ratio because the price of cement is high but the price of powder is low [1].

Waste management is a fundamental component to any manufacturing or production enterprise. It is estimated that there are million tons of quarrying waste are produced in each year. Although a portion of this waste may be utilized on-site such as for excavation pit refill. Waste generated at quarries and fabrication plants is quite similar. Most commonly, scrap stone must be mitigated and managed, but attention must be paid to other types of wastes, as well. These include marble sludge/slurry. Marble sawing powder wastes is widespread by-product of industrial process in India. Generally these wastes pollute and damage the environment due to sawing and polishing processes. This waste is used for making a marble waste concrete. The main aim of this waste management is to evaluate recovery and use marble waste in making a low cost concrete [2].

Leaving the waste materials to the environment directly can cause environmental problem. Hence the reuse of waste material has been emphasized. Stone slurry generated during processing corresponds to around 40% of the final product from stone industry. This is relevant because the stone industry presents an annual output of 68 million tonnes of processed products. Therefore the scientific and industrial community must commit towards more sustainable practices. Hence sustainable concrete is developed and its results are compared with conventional one. Test results show that this industrial bi product is capable of improving hardened concrete performance up to10%, Enhancing fresh concrete behaviour. 30 cubes and 30 cylinders have been casted. The compressive strength and split tensile strength of cubes and cylinders was measured for 7 and 28 days [3].

In this paper the effect of using marble powder and granules as constituents of fines in mortar or concrete by partially reducing quantities of cement as well as other conventional fines has been studied in terms of the relative workability & compressive as well as flexural strengths. Partial replacement of cement and usual fine aggregates by varying percentage of marble powder and marble granules reveals that increased waste marble powder (WMP) or waste marble granule (WMG) ratio result in increased workability and compressive strengths of the mortar and concrete. Marble dust concrete has higher compressive strength than that of the corresponding lime stone dust concrete having equal w/c and mix proportion. The results indicated that the Marble dust concrete would probably have lower water permeability than the lime stone concrete. As non -pozzolanic fines it is at present the limestone and dolomite ones which are most frequently used to increase the content of fine particles in self compacting concretes [4].

Marble and granite slurry cement bricks yield similar mechanical, in terms of compressive strength, and physical, in terms of density and absorption, properties. There is a positive effect of granite slurry on cement brick samples that reach its optimum at 10% slurry incorporation. Absorption is the major drawback of slurry incorporation in cement bricks according to the ASTM C55 where water absorption requirement is fulfilled only at Zero, 10 %, and 20% slurry samples for grade S. The accelerated hydration, endued by heating, compensated the detrimental effect of volumetric changes associated with temperature variation. Most cement brick samples, including the control, are of normal weight according to both the Egyptian specifications and ASTM International Journal of Bioscience, Biochemistry and Bioinformatics, Vol. 1, No. 4, November 2011 C55.All cement brick samples tested in this study comply with the Egyptian code requirement for structural bricks. This is not true when compared to ASTM C55. Instead, 10% and 20% marble and granite slurry yield Grade S. Mostcement brick samples which contain marble and granite waste had sufficient abrasion resistance according to ASTM C902 [5].

the effects of using waste marble dust (WMD) as a fine material on the mechanical properties of the concrete have been investigated. For this purpose four different series of concrete-mixtures were prepared by replacing the fine sand (passing 0.25 mm sieve) with WMD at proportions of 0, 25, 50 and 100% by weight. In order to determine the effect of the WMD on the compressive strength with respect to the curing age, compressive strengths of the samples were recorded at the curing ages of 3, 7, 28 and 90 days. In addition, the porosity values, ultrasonic pulse velocity (UPV), dynamic modulus of elasticity (Edin) and the unit weights of the series were determined and all data were compared with each other. Finally, all of the data were compared with each other. For each series, total of twenty pieces of concrete specimens were prepared, with five specimens being taken from each curing age (3,7, 28 and 90 days). Because four different series are used in the experiments, a total of 80 cubic specimens (100 × 100 × 100 mm) were prepared in order to determine the properties of the concretes such as compressive strength, apparent porosity, sorptivity and UPV [6].

The utilization of the waste of marble dust (MD) in self-compacting concrete (SCC), as filler material, is the main objective of this study. Besides, the MD is used directly without attempting any additional process. Thus, this would be another advantage for this objective. For this purpose, MD has replaced binder of SCC at certain contents of 0, 50, 100, 150, 200, 250 and 300 kg/m3. After then, slump flow test, L-box test and V-funnel test are conducted on fresh concrete. Furthermore, compressive strength, flexural strength, ultrasonic velocity, porosity and compactness are determined at the end of 28 days for the hardened concrete specimens. The effect of waste MD usage as filler material on capillarity properties of SCC isalso investigated. SSC is also one of the concrete technologies contributing the sustainable development by using filler materials such as limestone powder [7].

The possibility of marble sludge recycling in the use in useful materials such as house building materials. The other objectives can be summarized in saving natural resources and reducing their used quantity. The experimental results and their theoretical interpretation show that suitable incorporation of marble sludge can result in building blocks of 15 cm with superior properties in terms of water absorption (7%). The compressive strength at age of 28 days only reached (195.8 kN or 7.8 N/mm2). This work is actually directed to the field of designing new wall building blocks, dimensional compositions which can meet Jordanian market requirements as well as global sustainable environment and everlasting the natural resources all over the world. Among the wide commercial and traditional concretes, building blocks must satisfy the highest and most strict quality standards, which apparently depend on the high quality of the raw materials and the optimization of the processing parameters [8].

The use of marble dust collected during the shaping process of marble blocks has been investigated in the asphalt mixtures as filler material. The samples having marble dust and limestone dust filler were prepared and optimum binder content was then determined by Marshall Test procedure. Dynamic plastic deformation tests were carried out by using the indirect tensile test apparatus. Optimum filler content was then determined considering the filler/bitumen ratio and filler ratio. Test results showed that plastic deformation of marble waste is between the upper and the lower limits of grounded marbles. The filler/bitumen ratio of the sample containing limestone dust increases the plastic deformations decrease up to 7% filler/bitumen ratio; after that the plastic deformation increases. Test results of the samples containing the marble dust and limestone dust have almost similar plastic deformations. Therefore, asphalt mixtures containing marble dust can be used directly in the mix without any process. Since the asphalt mixtures containing the marble dust have slightly higher plastic deformations, it is recommended to the asphalt mixtures containing marble dust for low volume roads such as secondary roads and local roads [9].

The use of Marble dust and Granite dust as filler in asphalt concrete (referred as bituminous concrete in India). Marble dust and Granite dust are produced as wastes during the shaping of marble and granite blocks. Dynamic Shear Rheometer and ring and ball softening point test were used to evaluate the effect of different percentages of these industrial wastes on properties of asphalt-filler matrix. Marshall stability parameters, permanent deformation from static creep test and Tensile Strength Ratio (TSR) are also evaluated. Performance of asphalt concrete having marble dust and granite dust as filler is compared with asphalt concrete having conventional crusher dust as the filler. The fillers can be used up to 7 % in asphalt concrete mixes. But it is suggested to use them in the range of 4 to 5.5 % initially to observe their performance in field. Rheological tests conducted on filler-asphalt mastic showed highest value of granite dust indicating high resistance to rutting of this filler. Optimum binder content of a mix reduces with increase in marble dust in mix. The major objective of this study was to explore the possibility of using marble dust and granite dust as filler in asphalt concrete. Crusher dust also known as stone dust is the most commonly used filler in bituminous construction in India. This shows that marble dust can be used as bitumen extender also [10].

III. RESEARCH METHODOLGY

Ordinary Portland Cement 43 Grade was selected to use in project. And according to IS 8112-1989 the test performed on cement. The sieve analysis is use to find out fineness of cement. Fineness of cement is very important factor in hydration reaction process. Finer the cement provides greater surface area for hydration process and hence it gives faster development of strength.Coarse aggregate is the major component of concrete. Angular shape aggregate were used for casting. The aggregate possessing well-defined edges formed at the intersection of roughly planer faces. The purpose of using angular aggregate is, it exhibit better interlocking effect in concrete, which property makes it superior in concrete. Rough surface aggregate used in the project. Because the total surface area of rough textured angular aggregate is more than rounded surface aggregate. By having greater surface area, the angular aggregate may show higher bond strength than rounded shape aggregate. The sieve analysis of coarse aggregate is conducted to determine the particle size distribution (gradation).Fine aggregate is used as gap filler in concrete. The sieve analysis of fine aggregate is also done for gradation purpose i.e. dividing the aggregates samples in to various fractions. This test is also conducted to know the zone of sand. There are four types of zone in India i.e. zone 1, 2, 3 &4. Zone 1 belongs to finest sand and for zone 2, 3 &4 the sand becomes coarser and coarser.

To determine the chemical properties of marble dust the sample was given to ANACON LAB, Buttibori MIDC, Nagpur and following results were obtained.

Fig. 1. Sample of marble slurry (left) and dust (right)

Table 1. Test result for the marble dust & stone

Sr. No	Test Parameter	Measurement Unit	Test Result 1 Stone	Test Result 2 Powder
1.	Magnesium Oxide (Mgo)	g/100g	25.32	22.02
2.	Silicon Oxide (SiO_2)	g/100g	2.64	4.27
3.	Calcium Oxide (CaO)	g/100g	31.42	28.48
4.	Ferrous Oxide (Fe_2O_3)	g/100g	0.85	1.00
5.	Aluminium Oxide (Al_2O_3)	g/100g	0.08	0.24

The casting of cubes of mortar with varying partial replacement of cement with the 0, 5, 10, 15, 20% marble dust were casted. The ratio of cement to sand was 1:3 with 0.4 water cement ratio. The quantity for different mix proportion is given in table no 5.2. The aim of work is to determine compressive strength of mortar for 0% replacement to 20% replacement. The test were conducted for three different curing i.e. 7, 21 28 days. And then compressive strength of 5, 10, 15, 20% replacement was compared with 0% replacement. There was total 60 number of cubeswere casted and tested (12 cubes for each replacement). Following table gives the details of quantity of mix proportions.

Table 2.Quantities of mix proportion for mortar

Replacement	Cement	Dust	Sand	Water
0%	2775	0	8325	1113
5%	2661.2	113.8	8325	1113
10%	2547.5	227.5	8325	1113
15%	2433.7	341.3	8325	1113
20%	2320	455	8325	1113
25%	2260.2	568.80	8325	1113
30%	2092.5	682.5	8325	1113

From mix design the final proportions which get the casting was done according to IS 10262-2009 and IS 456-2000. The replacement of cement by marble dust was done by 0, 5, 10, 15 & 20%. Following table gives the detail of quantity of materials used. The standard proportion of concrete mix is 1: 1.53: 2.45 with 0.45 water cement ratio. The size of concrete cubes is 15cm x 15cm x15cm according to IS 10086-1982. The mixing was done by transit mixer. All the ingredients of concrete were taken by weigh batching of sensitivity 1.0gm.

Table 3.Quantities of mix proportion for concrete

Replacement	Cement (kg)	Marble (kg)	F.A. (kg)	C.A. (kg)	Water (lit)
0%	22.17	0	34	54.32	9.97
5%	21.06	1.1	34	54.32	9.97
10%	19.97	2.2	34	54.32	9.97
15%	18.87	3.3	34	54.32	9.97
20%	17.77	4.4	34	54.32	9.97

IV. TEST PERFORMED

1. Workability of concrete

IS:6416 (Part-VII)-1973 defines workability as that property of freshly mixed concrete or mortar which determines the ease and homogeneity with which it can be mixed, compacted and finished. Ease is related to rheology of fresh concrete which includes performance parameters of stability, mobility and compatibility. These parameters are redefined in rheology in terms of forces involved in transmission of mechanical stresses, resistance to segregation and bleeding, and resistance to flow by cohesive, viscous and frictional forces.It is used conveniently as a control test and gives an indication of the uniformity of concrete from batch to batch. Repeated batches of the same mix, brought to the same slump, will have the same water content and water cement ratio; provided the weights of aggregate, cement andadmixtures are uniform and aggregate grading is within acceptable limits.It does not measure all factors contributing to workability, nor is it always representative of the pliability of the concrete.

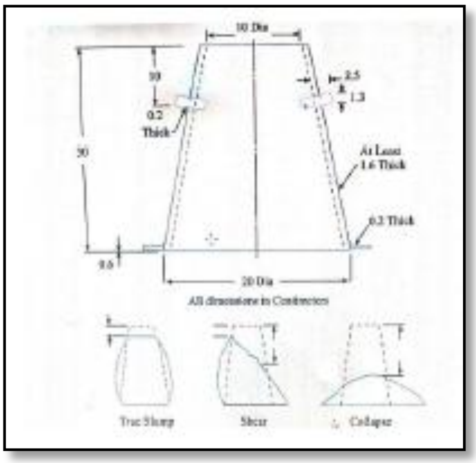

Fig. 2. Slump Cone Dimension

2. Compressive Strength of Concrete

The usual primary requirement of good concrete is a satisfactory compressive strength in its hardened state. Many of the desirable properties like durability, impermeability, and aberration resistance are highly influenced by the strength of concrete. For purpose of mix design, the strength of concrete can be considered slowly dependent on the water cement ratio for low and medium strength concrete mixes. In the case of high strength concrete mixes, the aggregate cement ratio workability of the mix and the type and maximum size of aggregate influence the selection of water cement ratio for a desired of concrete. The compression test is carried out on a specimen cubical or cylindrical in shape. the compression strength is determine using part of a beam tested in flexure the end of part beam left intact after fleur in flexure and because a beam is usually square cross section this part of the beam could be used to find the compressive strength. The cube specimen is of the size 15×15×15 cm if the largest size of aggregate does not exceed 210 mm, 10 cm size cube may also be used as an alternative cylindrical specimens have length equal to twice the diameter. They are 15 cm in diameter and 30cm long.

Fig. 3.Testing of 5% Replaced Concrete Cubes in compression testing machine

Fig. 4.Testing of 15% Replaced Mortar Cubes in compression testing machine

V. RESULT AND DISCUSSION

1. Compressive Strength of Concrete

It is observed from Fig. 5 that, after 15% & 20% replacement the graph moves downward means the compressive strength decreases after 15 & 20 % replacement of marble dust powder in concrete.The compressive strength for 5 & 10% replacement increases and at 10% replacement of marble dust in concrete by cement gives maximum strength.So the replacement of marble dust powder in cement should be done up to 10%.

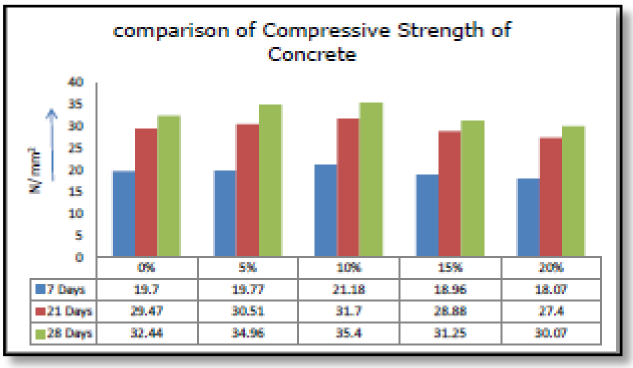

Fig. 5. Compressive Strength of Concrete

2. Compressive Strength of Mortar

From Fig. 6, it is observed that the compressive strength after 7, 21 & 28 days of curing for 15 & 20% replacement is decreased. So the compressive strength increases for 5 % & 10% replacement.Therefore, the replacement of marble dust powder in mortar should be done up to 10% only.

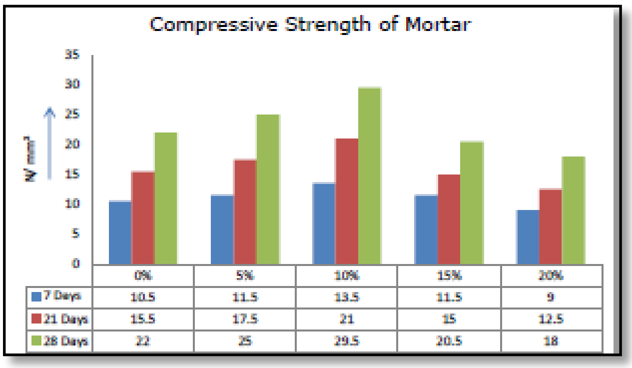

Fig. 6. Compressive Strength of Mortar

3. Workability

Concrete is said to be workable when it is easily placed and compacted homogeneously i.e. without bleeding or segregation. Workability is one of the physical parameter which affects strength and Durability as well as cost of labour and appearance.The slump cone test result continuously decreases with the increase of the percentage of the marble content in the concrete. Though up to 15% replacement shows satisfactory results.From Fig. 7, the workability for conventional concrete is maximum, but it reduces after more and more replacement of marble dust powder. Means workability reduces as cement reduces and marble dust content increases.

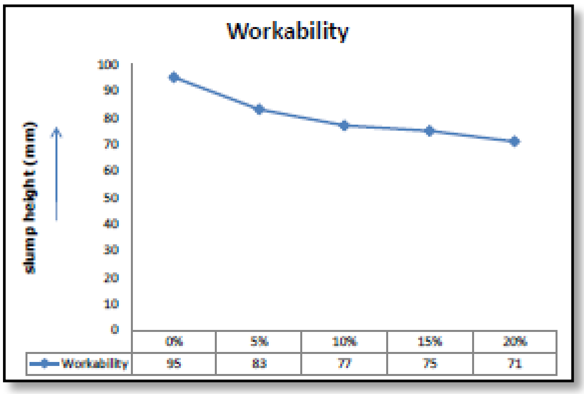

Fig. 7. Comparison of slump value of concrete samples

VI. CONCLUSION

Based on the results presented above, the following conclusions can be drawn:

- The compressive strength of concrete after 28 days of curing increases after 5, 10 & 15% replacement. But in 20% replacement strength decreases. So in concrete the replacement of cement by marble dust can be done up to 15%. After more than 15% replacement the compressive strength is decreased.
- Due to replacement of cement by marble dust in concrete the workability decreases by some amount. Till 5% replacement of marble dust in concrete does not affect the workability so much. But after more than 5% replacement workability decreases.
- In mortar the compressive strength increased after 5 & 10% of replacement. But after more than 15% replacement strength decreases. So marble dust can be use in mortar up to 10% replacement.
- At use of more than 10% replacement of marble dust in mortar, the mortar becomes dry and with addition of more and more marble dust mortar becomes drier. So after 5% replacement there is a need to add admixture in mortar.
- By the use of marble dust in concrete and mortar the cost is reduced.
- By the use of marble dust in concrete and mortar by replacing cement the use of cement will reduce and this will help in reduction of carbon dioxide emission and ultimately the problem of pollution will also reduced.
- Due to use of marble dust the use of limestone in cement will reduce and this will helps in saving of natural resources.
- It can be also use for replacement of cement at site as the results of replacement are satisfactory within certain limits.
- After finishing of marble it‘s 25% by mass converted into powder and this powder get disposed of to empty places. This creates the problem of disposal. About 7,000,000 tons of marble have been produced in the world. Disposal of the marble powder material of the marble industry is one of the environmental problems worldwide today. Using of marble powder in the concrete has not found adequate attention. Therefore by the use of marble waste the problem of disposal will reduce.
- In cement factories during cement production 0.93 tone carbon dioxide emits per one tone of coal. 50% carbon dioxide emits during burning of coal and remaining 50% carbon dioxide emits when limestone converted into lime. By replacing marble dust in concrete the use of cement will reduce and this will ultimately result in reduction in carbon dioxide.
- The cost of one bag of cement is 350 Rs per 50 kg (a/c to market rate). While marble powder waste is free of cost or very negligible cost as compare to cement. So by the use of marble dust in cement the cost of concrete will also reduce.
- Due to fineness of the marble powder, it will easily mix with aggregates so that perfect bonding is possible. Marble powder will fill the voids present in concrete and will give sufficient compressive strength when compared with the ordinary concrete.
- Chemically, marbles are crystalline rocks composed predominantly of calcite, dolomite or serpentine minerals. The other mineral constituents vary from origin to origin. So these chemical helps in hydration reaction process.

VII. SCOPE FOR FUTURE WORK

1. The Flexural strength, split tensile strength of the concrete without marble can be compared with compressive strength.
2. The Concrete and Mortars can be made more workable with using marble as the admixture.
3. The properties of concrete with marble can be studied by using various fibres in it to increase the tensile strength.
4. The evolution of heat by the concrete with marble can be studied.
5. Determining the strength of mortar by using various types of ingredients other than marble.
6. Cement is a costly material so replacing cement by marble and find the compressive strength, flexural strength and split tensile strength of concrete.

7. Analyzing the effect on concrete with marble slurry due to shearing.

8. To determine the Effect on the permeability of concrete with marble slurry and marble dust.

REFERENCES

[1] Soliman, N., (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.

[2] Patel, N., Raval, A., and Pitroda, J., (2013). "Marble Waste: Opportunities for Development of Low Cost Concrete". Global Research Analysis vol.2, 94-96.

[3] Shirule, P.A., Rahman, A., and Gupta, R.D., (2012). "Partial Replacement of Cement with Marble Dust Powder". International Journal of Advanced Engineering Research and Studies Vol.1, Issue 3, 175-177.

[4] Rai, B., Khan, N., Kumar A., TabinRushad, and Duggal, S.K., (2011). "Influence of Marble powder/granules in Concrete mix". International Journal of Civil and Structural Engineering Volume 1, No 4, 827-834.

[5] Rania A. Hamza, Salah El-Haggar, and SafwanKhedr (2011). "Marble and Granite Waste: Characterization and Utilization in Concrete Bricks". International Journal of Bioscience, Biochemistry and Bioinformatics, Vol. 1, No. 4, 286-291.

[6] Demirel, B., (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), pp. 1372-1380.

[7] IlkerBekirTopcu, TurhanBilir, TayfunUygunog˘lu (2009). "Effect of Waste Marble Dust Content as Filler on Properties of Self-Compacting Concrete". Construction and Building Materials 23, 1947-1953.

[8] Aukour, F.J., (2009). "Incorporation of Marble Sludge in Industrial Building Eco-blocks or Cement Bricks Formulation". Jordan Journal of Civil Engineering, Volume 3, No. 1, 58-65.

[9] Karasahin, M., and Terzi, S., (2007). "Evaluation of marble waste dust in the mixture of asphaltic concrete". Construction and Building Materials 21 (2007) 616–620.

[10] Choudhary, R., and Chandra, S., "Granite and Marble Dusts as Filler in Asphalt Concrete". Indian Institute of Technology Roorkee, 1-10.