International Journal of Advances in Engineering and Management (IJAEM)
Volume 3, Issue 12, pp: 399-404 www.ijaem.net ISSN: 2395-5252

Comparative Study on the Properties of Concrete Using Marble and Granite Waste as Coarse Aggregates

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Date of Submission: 20-11-2021 Date of Acceptance: 05-12-2021

Abstract – Today we are facing an important consumption and a growing need for aggregates because of the growth in industrial production, this situation has led to a fast decrease of available resources. On the other hand, a high volume of marble production has generated a considerable amount of waste materials. Leaving the waste materials to the nature directly can cause serious environmental problems therefore it is necessary to reuse marble waste. Marble has been commonly used as a building material since the ancient times. The industry's disposal of the marble powder material, consisting of very fine powder, today constitutes one of the environmental problems around the world.

In the building industry, Marble/Granite has been commonly used for various purposes like flooring, cladding etc, as a building material since the ancient times. Marble/Granite stone industry generates both solid waste and stone slurry.

The focus of this study was on the use of waste marble as coarse aggregates in concrete. Because of continual depletion of quarries aggregates, construction materials are more and more judged by their ecological characteristics. The lack of technology and unscientific methods of quarrying marble in India has generated a huge quantity of waste of this valuable.

I. INTRODUCTION

Marble ranks the largest produced natural stone in the world. Most of the world's production of marble comes from India and approx. 85% of India's production is received from Rajasthan and almost all mining and processing activities are concentrated around Udaipur, where the proposed study is planned to undertake. The marble mining industry has come up significantly in recent past. Rajasthan has around 4000 marble mines and about 1100 marble gang saws.

Photo:- Marble Mine at Rajasthan.

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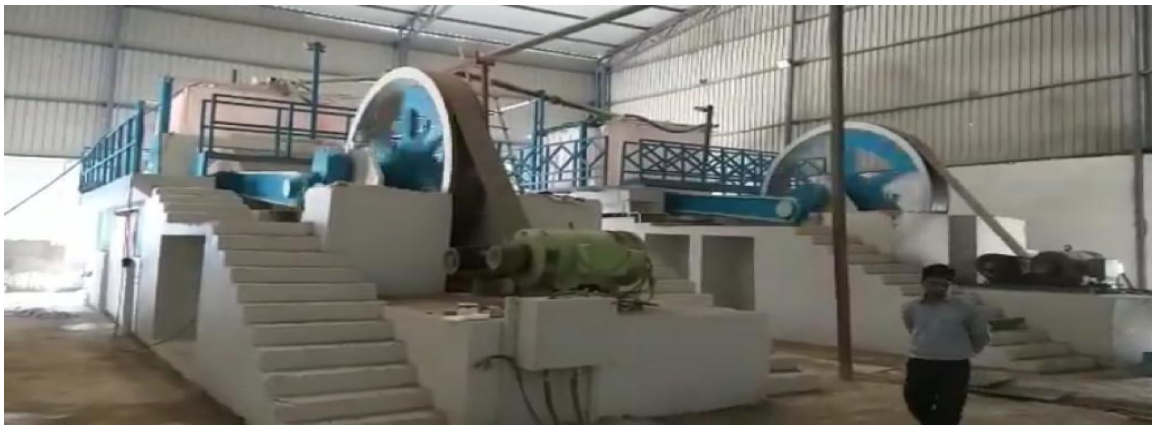

Photo:- Marble Gang saw machine at Rajasthan.

The industry involves Mines, Processing plants, Cutters for the production of tiles for walls and floors, articles, waste reproduction and other ancillary works. The marble mining and the industry as a whole is different from other industries with the very fact that the marble is a" Dimensional Stone", which means the stone is sold by size not by weight. Since the selling price increases manifolds with size, all the operations involving mining & processing are aimed to get slabs as big as possible. Marble dust can be used either to produce new products or as an admixture so that the natural sources are used more efficiently and the environment is saved from dumpsites of marble waste. Disposal of marble slurry anywhere by the marble cutting entrepreneurs realistically falls in typical category. It's inadvertent and virtually 'throw away' practice is avoidable in the interest of common man.

Photos:- Disposal of Marble Slurr

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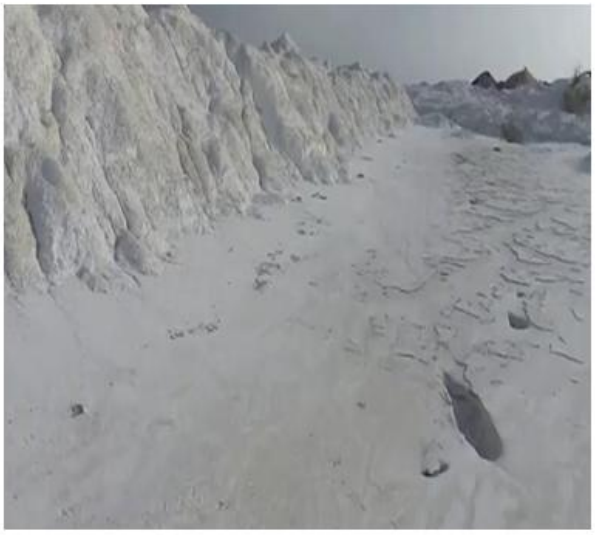

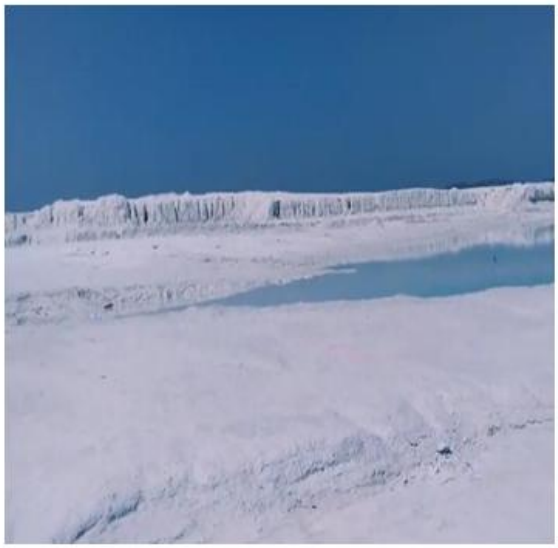

Today we are facing an important consumption and a growing need for aggregates because ofthe growth in industrial production, this situation has led to a fast decrease of available resources. On the other hand, a high volume of marble production has generated a considerable amount of waste materials. Leaving the waste materials to the nature directly can cause serious environmental problems therefore it is necessary to reuse marble waste. Marble has been commonly used as a building material since the ancient times. The industry's disposal of the marble powder material, consisting of very fine powder, today constitutes one of the environmental problems around the world. Marble blocks are cut into smaller blocks in order to give them the desired smooth shape. During the cutting process about 25% the original marble mass is lost in the form of waste. The marble waste is settled by sedimentation and then dumped away in dumping yards which results in environmental pollution, in addition to forming waste in summer and threatening both agriculture and public health. Therefore, utilization of the marble waste in various industrial sectors especially the construction, agriculture, glass and paper industries would help to protect the environment. Marble dust can be used either to produce new products or as an admixture so that the natural sources are used more efficiently and the environment is saved from dumpsites of marble waste. Disposal of marble slurry anywhere by the marble cutting entrepreneurs realistically falls in typical category. It's inadvertent and virtual y 'throwaway' practice is avoidable in the interest of common man.

II. TEST RESULTS AND DISCUSSION

4.1A 3 Days Compressive Strength of Concrete

Table: 3 Days Compressive Strength of Conventional Concrete withMarble

S.No.	Specimen Name	Grade of Concrete	Cube Size(mm^3)	Area (mm^2)	Load (KN)	Strength (N/mm^2)	Average Strength (N/mm^2)
1	3A	M20	150x150x150	22500	240	10.67	
2	3A	M20	150x150x150	22500	220	9.77	10.11
3	3A	M 20	150x150x150	22500	230	10.22	

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4	3M	M 20	150x150x150	22500	270	12	
5	3M	M 20	150x150x150	22500	250	11.11	11.5 5
6	3M	M 20	150x150x150	22500	260	11.55	

4.1B 7 days Strength of Concrete

Table: 7 Days Compressive Strength of Concrete

S.No.	Specimen Name	Grade of Concrete	Cube Size(mm^3)	Area (mm^2)	Load (KN)	Strength (N/mm^2)	Average Strength (N/mm^2)
1	7A	M20	150x150x150	22500	490	21.77	
2	7A	M20	150x150x150	22500	380	16.88	18.80
3	7A	M 20	150x150x150	22500	400	17.77	
4	7A*	M20	150x150x150	22500	390	17.33	
5	7A*	M20	150x150x150	22500	420	18.66	17.62
6	7A*	M 20	150x150x150	22500	380	16.88	
7	7M	M 20	150x150x150	22500	390	17.33	
8	7M	M20	150x150x150	22500	410	18.22	17.77
9	7M	M 20	150x150x150	22500	400	17.77	

In above 7 days testing of cubes, the results of 1^{st} 3 Specimens of '7A' are invalid due to having more than 15% variation in average, ref Is 456-2000,clause 15.4.So, we have tested 3 more cubes & got the valid results.

C28 Days Strength of Concrete

Table: 28 Days Compressive Strength of Concrete

S.No.	Specimen Name	Grade of Concrete	Cube Size(mm^3)	Area (mm^2)	Load (KN)	Strength (N/mm^2)	Average Strength (N/mm^2)
1	28A	M20	150x150x150	22500	560	24.88	
2	28A	M20	150x150x150	22500	540	24	24.73
3	28A	M20	150x150x150	22500	570	25.35	
4	28M	M20	150x150x150	22500	590	26.22	
5	28M	M20	150x150x150	22500	560	24.88	25.62

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6	28M	M20	150x150x150	22500	580	25.77	

Workability

Table: Slump Value of Concrete

S.No.	Specimen Name	Grade of Concrete	Slump Value (mm)
1	Specimen 1A	M20	120
2	Specimen 2A	M20	115
3	Specimen 3A	M20	110
4	Specimen 1M	M20	100
5	Specimen 2M	M20	110
6	Specimen 3M	M20	100

III. DISCUSSIONS

A Discussion for Marble:

- The impact value of waste marble chips was found to be 3.85%lesser than that ofthe standard aggregate.
- The crushing values of waste marble chips were found to be 1.4% greater than thatof the standard virgin aggregate
- The results obtained show that marble chips exhibit more strength and are almostsame harder than the standard stone aggregate.
- The specific gravity of marble was found out to be 1.5% higher than that ofstandard aggregate.
- Water absorption of marble chips came out to be much lesser than standard stone aggregate.

B Discussion for Concrete:

Compressive Strength:

- The compressive strength of 28 days cubes of marble aggregate is 3.6% higherthan the standard aggregate.
- This happens when the standard stone aggregate is completely replaced by marbleaggregate i.e. 100%replaced.
- This behavior is seen in M20 grade of concrete.
- The probable reason for this may be the lower impact and almost same crushingvalues of marble aggregate than standard stone aggregate.

Workability:

- The slump values obtained for marble aggregate is slightly higher than the standardstone aggregate.
- This behavior is seen in M20 grade of concrete.
- The probable reason for this behavior may be the lower water absorption of marble aggregate than standard aggregate and the relatively smoother surface of marble aggregate.

IV. CONCLUSIONS

This research is an experimental approach to substitute natural aggregates by the waste marble aggregates; the concern is more scientific than economical and environmental. The results obtained demonstrated the performance of various concrete mixtures which may help to understand the behavior of concrete with marble aggregates.

Analysis of these results has revealed that the appropriate incorporation of marble waste aggregates can lead to interesting characteristics in terms of strength, indeed the use of marble aggregates resulted in a considerable increase in the compressive strength. Marble slurry acquires dryness very quickly because water absorption and moisture content properties are very low. Marble slurry would be a good admixture to concrete so that a cheaper material is available to construction industry.

Following conclusions are made based on the experiment work carried are:

- Concrete replaced with marble aggregate showed a lot improved workability because of less water absorption and relatively high density than natural aggregates.
- Compressive strength of concrete is also increased when natural aggregate is completely replaced with marble aggregates.
- Marble can be used as a good replacement material in place of coarse natural aggregate

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