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# An Experimental Study on Partial Replacement of Cement with Marble Dust and Coarse Aggregate with PET Material (Bottle Caps)

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**ABSTRACT:** Concrete is major building material Which is been used in Construction industry throughout the world. It is an extremely versatile material and can be used for all all types of concrete structures. Concrete is composite construction material composed mainly of cement, water and aggregates. Advancement in technology enhances human comforts and at the same time it causes damages to environment.

Waste plastic bottles are major cause of solid waste disposal and also disposal of metal caps of soft bottles are headache to environmental engineers and involves either recycling or reusing. There we are going to add metal caps and PET bottles caps in concrete to increase the strength. Marble dust is an industrial byproduct obtained during sawing, shaping and polishing of marble and causes a serious problem to the environment. Now we are going to add 5 % of bottle caps and 5%, 10%, 15%, 20 % of marble dust in coarse aggregates and cement respectively. Research indicates that the effect of mixing marble dust on the properties of cement such as consistency, initial and final setting times remain within the acceptable ranges of different standards. This study presents the feasibility of the production of concrete with marble dust as partial replacement of cement. Final result indicates the modification of properties of concrete by replacement of bottle caps with coarse aggregates and marble powder with cement without decreasing strength and flexural strength of concrete. By using bottle caps and marble powder it increases compressive strength and workability of the concrete cubes which are being tested for 7, 14 days and 28 days strength

**KEYWORDS:** Marble powder, bottle caps, compressive strength, engineering properties of cement

## I. INTRODUCTION

Advancement of concrete technology can reduce the consumption of natural resources and energy sources and will lessen the burden of pollutants on environment. Presently large amount of marble dust are generated in natural stone processing plants which cause an important impact on environment and humans. The feasibility of using the marble sludge dust as an admixture in concrete production as partial replacement of cement will lead to further increase in proper utilisation and disposal of sludge keeping the environment away from the hazards. In India, effects of varying marble dust contents in concrete will lead to variation in the physical and engineering properties of fresh and hardened concrete.

The cement materials serve as a binder for the aggregates. The coarse aggregate gets hardened through the process called hydration. and fine aggregate are used in concrete. Water is mixed in concrete so that the concrete gets its shape and then since it is found deficient in aggressive environmental conditions, time of construction, energy absorption capacity, repair and retrofitting jobs etc. Hence some alternative needs to be found which can replace either fully or partially any of the concrete composite without affecting the properties of concrete which give better strength to concrete. The use of such materials not only resulting good strength and improved properties in concrete but also helps in maintaining good environmental conditions by effecting utilisation of these products which will otherwise remain a waste material. PET (polyethylene terephthalate) can be used as a partial replacement of coarse aggregates.

However, recently the ordinary Portland cement has been no longer manufactured in Indonesia except upon special request. The cements that are still produced are Portland pozzolana cement and Portland composite cement, which certainly has different characteristics compare to that of ordinary Portland cement. In this study, the Portland composite

cement is used. The purpose of this study is to determine the compressive strength of concrete with marble dust as cement & bottle caps as CA replacement in concrete.

## II. RELATED WORK

The mixing procedures divided into three stages. In the first stage, all the binder (cement) were weighted accordingly and mixed by hand until all the constituents mixed uniformly. This was making sure that all the binders were mixed thoroughly to produce a homogeneous mix. The second stage involves mixed in the binders with aggregates and for about five minutes. At the final stage, water was added into the concrete mix. The step was crucially important make sure that water was distributed evenly so that concrete we have similar water binder ratios for every specimen. After that, the concrete can be placed in cubes as per recommended. The cement and sand were first added and mixed thoroughly in the dry state until homogeneity was achieved. The dry coarse aggregate were added to the mixture and again mixed thoroughly. Water was slowly added and mixed thoroughly for 3 min. After mixing all the ingredients, concrete specimens were cast using steel moulds and compacted with a table vibrator in three layers. For each mix, six 150\*150\*150 mm cubes were produced for measurement of the compressive strength. Based on the Indian Standard (IS: 10262 - 1982), design mix for M20 grade of concrete was prepared by partially replacement of cement with three different percentages by weight of Marble powder (5%, 10%, 15%, 20%) and bottle caps (5%). The mix proportion for M25 Grades of concrete with varying percentage of Marble dust and bottle caps is presented. Casting of cubes as marble powder and bottle caps added in concrete in step of 5%, 10%, 15%, 20% and 5% each per cent of replacing Cement, 3 cubes were casted for 7 days, 14 days and 28 days. Concrete derives its strength by the hydration of the cement particles. The hydration of cement is not a momentary action but a process continuing for long time. Of course, the rate of hydration is fast to start with, but continues over a long time at a decreasing rate. The antity of the product of hydration and consequently the amount of gel formed depends upon the extent of hydration.

Curing can also be described as keeping the concrete moist and warm enough so that the hydration of cement can continue. Concrete, while hydrating releases high heat of hydration. This heat is harmful from the point of view of volume stability. If the heat generated is removed by some means the adverse effect due to the generation of heat can be reduced. This can be done by thorough water curing. and the other related work is following by steps are [1] Take three cube moulds for each mix. Assemble the mould with base plate so that it is rigidly held together. [2] Clean the inside of the mould and see that joints (at the edges) are perfectly tight. [3] Pour properly mixed concrete for the given mix to the cube moulds. [4] Compaction by needle vibrator will be preferred. If vibrator is not available, hand compaction is to be done by placing concrete in three layers; each layer be compacted with the help of standard temping rod by means of 25 blows. [5] Level the concrete at the top of the mould by means of trowel and give proper identification mark of the specimen. [6] Keep the cubes in laboratory for 24 hours. [7] After 24 hours, dismantle the plates of cube mould and take out the hardened concrete cubes carefully so that edges specimens are not damaged. [8] Immerse the cubes in curing tank filled with water. Keep it for curing up to 28 days. [9] Test the cubes after 7, 14 and 28 days of curing to find the compressive strength. [10] Tabulate Compressive strength for each cube and calculate average value for each mix

## III. METHODOLOGY

The evaluation of marble dust and bottle caps for use as a partial replacement of cement and coarse aggregate material begins with the concrete testing. The study is conducted to analyze the compressive strength of concrete when the base materials, i.e. Cement and coarse aggregates is replaced with marble dust and bottle caps respectively. Compressive strength tests were done on compression testing machine using cube samples. Three samples per different proportions were tested with the average strength values reported in this paper. The Marble dust and bottle caps replacement with cement and coarse aggregate was kept at 5%, 10%, 15%, 20%, and 5% by weight of M 25 grade concrete. In all total 36 cubes of OPC (150mm \* 150mm\*150mm) were examined and results were analyzed after 28 days. Information obtained from the replacement is compared with data from a Conventional concrete. The fresh concrete can be conducted on workability test as Slump cone test and The hardened concrete can be conducted on test on Strength as compression test. The methodology for slump cone test is the following steps are [1] Take Mix proportion: 1:1:2 by weight and Use W/C ratio is 0.5. [2] Prepare three mixes. [3] Clean the internal surface of the mould thoroughly and it should be freed from superfluous moisture. [4] Place the mould on a smooth, horizontal, rigid and non-absorbent surface, such as a carefully levelled metal plate, and fixed it. [5] Fill the mould with freshly prepared concrete in four layers and compact each layer by tamping with 25 strokes of temping rod. After the top layer has been rodded, struck off the excess concrete, make level with a trowel or tamping rod. [6] Carefully lift the mould vertically upwards, so as not to disturb the concrete cone. [7] Determine the level difference between the height of the mould and the highest point of the subsided concrete. [8] Height difference in mm is taken as Slump of concrete.

The hardened concrete is compression test. Testing hardened concrete plays an important role in controlling and conforming the quality of cement concrete work. The main factor in favour of the use of concrete in structures is its compressive strength. One of the important properties of the hardened concrete is its strength which represents its ability to resist forces. The compressive strength of the concrete is considered to be the most important and is often taken as an index of the overall quality of concrete. The compressive strength of concrete is defined as the load which causes the failure of specimen per unit cross section on compression under given rate of loading

#### IV. EXPERIMENTAL RESULTS

The Cement and cashew nut shell ash weights per cubes for different proportions are as follows.

Mix	% of replacement material (CNSA)	Material used	
		Cement (kg/cube)	CNSA (Grams/cube)
M20	10	1.161	129
	15	1.096	193
	20	1.032	258

Table 1

The Compression Strength Test Result at nominal mix proportion in m25 grade of concrete (0% Replacement)

Number of days	Compressive load in KN	Compressive strength in N/mm <sup>2</sup>	AVG Compressive strength in N/mm <sup>2</sup>
7	475	21.11	21.32
	484	21.53	
	480	21.34	
14	598	26.57	26.39
	585	25.98	
	600	26.63	
28	680	30.20	30.46
	689	30.61	
	688	30.57	

Table 2

Then At 5% replacement of cement with marble dust powder and coarse aggregate with bottle caps in concrete

Number of days	Compressive load in KN	Compressive strength in N/mm <sup>2</sup>	AVG Compressive strength in N/mm <sup>2</sup>
7	412	18.34	18.3
	408	18.11	
	414	18.45	
14	479	21.32	22.23
	497	22.16	
	522	23.20	
28	706	31.45	31.43
	687	30.50	
	727	32.36	

Table 3

Then At 10% replacement of cement with marble dust powder and coarse aggregate with bottle caps in concrete

Number of days	Compressive load in KN	Compressive strength in N/mm <sup>2</sup>	AVG Compressive strength in N/mm <sup>2</sup>
7	410	18.24	18.19
	403	17.94	
	408	18.15	
14	644	28.63	28.48
	651	28.94	
	627	27.84	
28	702	31.23	31.50
	695	30.89	
	728	32.38	

Table 4

Then At 15% replacement of cement with marble dust powder and coarse aggregate with bottle caps in concrete

Number of days	Compressive load in KN	Compressive strength in N/mm <sup>2</sup>	AVG Compressive strength in N/mm <sup>2</sup>
7	370	16.41	16.57
	372	16.76	
	382	17.01	
14	373	16.58	16.72
	378	16.82	
	367	16.31	
28	600	26.69	26.47
	590	26.21	
	597	26.53	

Table 5

Then At 20% replacement of cement with marble dust powder and coarse aggregate with bottle caps in concrete

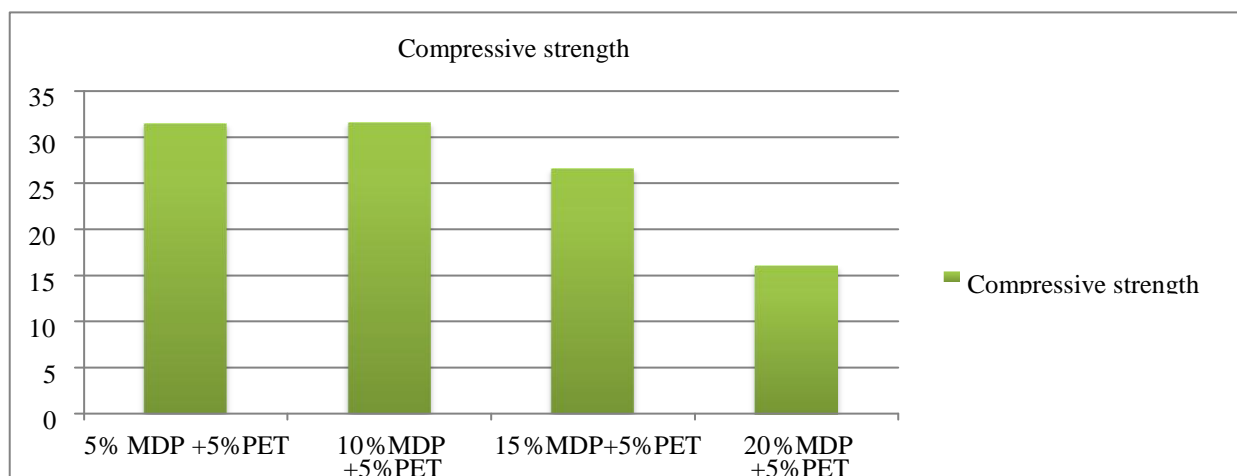
Number of days	Compressive load in KN	Compressive strength in N/mm <sup>2</sup>	AVG Compressive strength in N/mm <sup>2</sup>
7	246	10.95	10.84
	243	10.83	
	241	10.74	
14	300	13.33	13.33
	309	13.72	
	306	13.61	
28	358	15.92	15.91
	362	16.08	
	354	15.73	

Table 6

Then At 28 days maximum compressive strength is the following table

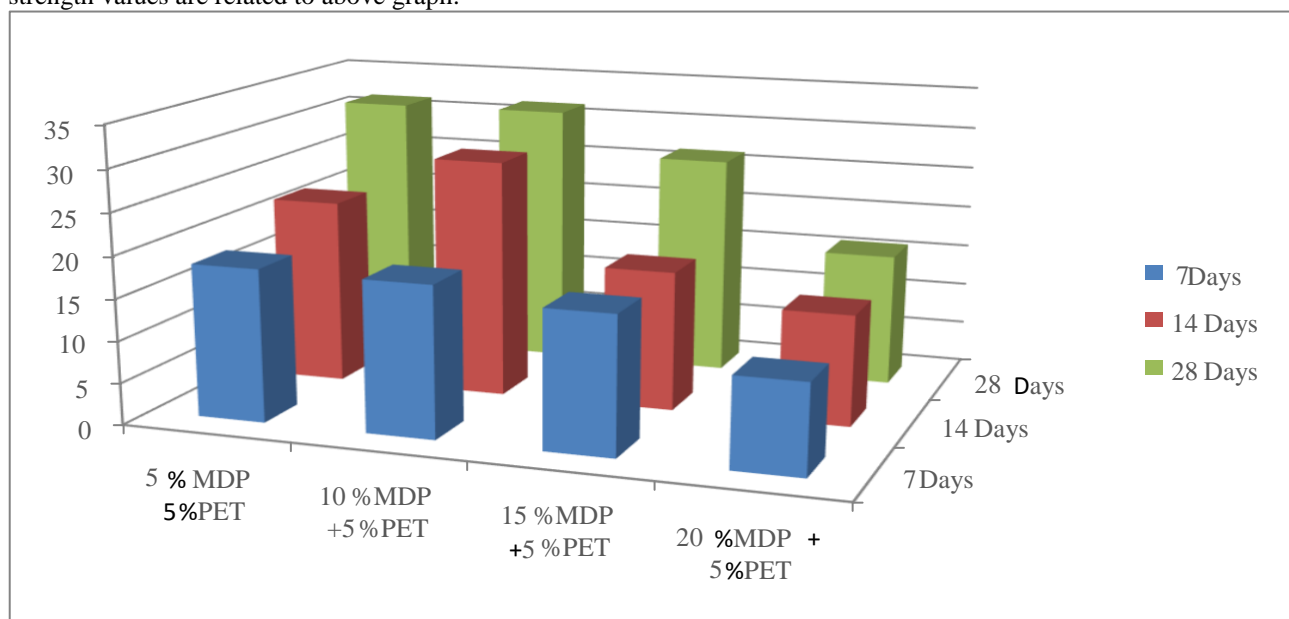
Number of days	Percentage of replacement of material in (MDP+PET) %	Compressive strength in N/mm <sup>2</sup>
28	5+5	31.43
28	5+10	31.50
28	5+15	26.47
28	5+20	15.91

Table 7



(a) compressive strength results at 28 days

Figures shows the results of compressive strength test for nominal M25 concrete is 25 N/MM<sup>2</sup>, by using ratios of initially 5% marble dust powder and 5% of PET material, and that 5% of PET material is constant, then gradually increased by 5% of marble dust powder as a replacement of cement at up to 20%. the graph shows the compressive strength values are related to above graph.



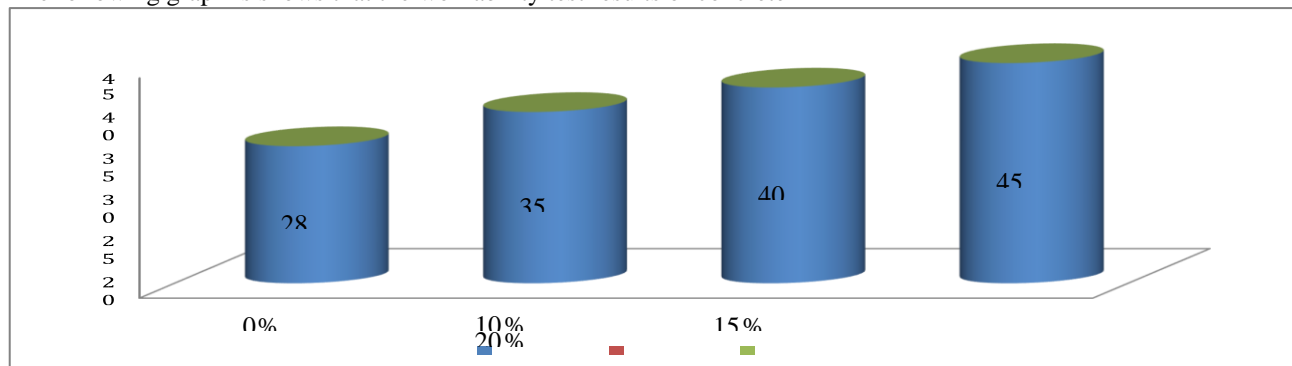
(b) Compressive strength results at 7, 14, 28 days

Fig (c) is the Slump in mm (Partial replacement of cement with MDP & CA with PET)

SI NO.	Water -Cement ratio	Cashew shell ash as partial replacement in cement	Height of mould H <sub>1</sub> (mm)	Height of subsided concrete H <sub>2</sub> (mm)	Slump(mm) H <sub>1</sub> -H <sub>2</sub>
1	0.5	0%	300	272	28
2	0.5	10%	300	265	35
3	0.5	15%	300	260	40
4	0.5	20%	300	255	45

(c) the workability test results

The following graph is shows that the workability test results of concrete



(d)workability test results graph

Then on X-axis is the % of replacement material ,and on Y-axis is the slump in mm ..

#### V. CONCLUSION

The cement can be partial replaced with MDP & CA can be partially replaced with PET. Ultimately 10% MDP & 5% PET is partial replaced in cement & CA was given good results as compared to conventional concrete and other percentages MDP & PET material mixed in concrete.As compared to conventional concrete the strength has been increased 10% by adding 10% of MDP & 5% PET in concrete.

The maximum compressive strengths 31.50N/mm<sup>2</sup> was attained at 10 % replacement of cement by MDP & CA by PET for M25 mix by Normal Curing.With constant proportion i.e. 10% & 5%replacement of cement by MDP & CA by PET and the compressive strengths are more than the target mean strengths for M25 mix.There is an increase in compressive strength up to 10% & 5%replacement of cement by MDP & CA by PET and compressive strength i.e. 31.50 N/mm<sup>2</sup> in normal curing for M25Mix.There is a decrease in compressive strength at the proportion of 20% MDP & 5% PET and we get 15.99 N/mm<sup>2</sup> in normal curing for M25Mix.

#### REFERENCES

- [1] IS 4031(Part-4):1988 Methods of physical tests for hydraulic cement: Determination of consistency of standard cement paste.
- [2] IS 4031(Part-1):1996 Methods of physical tests for hydraulic cement: Determination of fineness by dry sieving.
- [3] IS 4031(Part-5):1988 Methods of physical tests for hydraulic cement: Determination of initial and final setting times.
- [4] IS 4031(Part 6):1988 Methods of physical tests for hydraulic cement: Determination of compressive strength of hydraulic cement (other than masonry cement).
- [5] IS 516:1959 Method of test for strength of concrete.
- [6] IS 2386(Part-1):1963 Methods of test for aggregates for concrete: Particle size and shape.
- [7] IS 2386(Part-3):1963 Methods of test for aggregates for concrete: (Specific gravity, density, voids, absorption and bulking)
- [8] A .Ishaya ,I.M Oyemogum, study on strength of concrete by partial replacement of cement with MDP.
- [9] Dr. Muhammad Maqbool Sadiq, Analysis of the PET and plastic waste materials used in concrete.
- [10] IS 10262:1982 - Recommended Guidelines for Concrete Mix design.
- [11] IS 12269:1987 - Methods of Physical Testing for Hydraulic cement.
- [12] IS 4031:1988 - Specification for 53 grade OPC.
- [13] IS 456:2000 - Plain and Reinforcement Concrete-Code of practice
- [14] IS 3812:1981 - Specification for fly ash for use as pozzolana and admixture.
- [15] M. S. SHETTY - Concrete Technology S.CHAND & Co



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