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A Review on Investigation of Geopolymer Concrete By Partial Substitution Of Cement With Marble Dust And Fine Aggregate With Copper Slag

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Abstract - *In Our World, as civilization is evolving, the need for building materials is too increasing day by day. As we know Concrete is the largest material after food and water. The main constituents of concrete are Cement and Fine aggregate. Many studies have been done to know the environmental impact of cement and concrete. Seeking the adverse effect of high production of cement on the environment, we have thought of partial replacement of cement with marble dust and fine aggregate with copper slag. This paper deals with a detailed literature review of concrete using waste marble powder and copper slag as a partial replacement and explores the right mix where compressive, split tensile and flexural are optimum.It also seeks the possibility to use polymer in concrete and its effect on the property of hardened concrete.*

Key Words: **Marble Dust, Copper Slag, Plastic Waste.**

1. INTRODUCTION

Concrete is the largest used material worldwide. With the increasing rate of population growth, infrastructure to needs to be developed rapidly to fulfill the needs of the people and for all these a huge amount of resources are required. The major one of them is cement and sand. But the excessive consumption of these resources will create an environmental imbalance. Therefore, we have decided to replace these two major ingredients of the construction industry with marble dust and copper slag respectively.

Marble is a metamorphic rock made from the conversion of pure limestone. The whiteness in the marble symbolizes its purity. Marble is normally used for decorative and monumental purposes. 20% of the marble quarried is gets converted into powder form due to the cutting of marble. The growing rate of marble consumption is resulting in more and more production of marble dust. At present, the mining industry in Rajasthan is producing 4500 tons (1800 m^3) per year. A large proportion of this huge production becomes waste and a large area of land is required to store this.

Copper slag is produced as a by-product of the smelting process of copper by the metal industry. Slag is an impurity that comes with the metal ores when heated in the furnace all the impurities start to float at the top of the furnace. The slag is then quenched in a water bath and converted into nodules. This imparts a good strength when tested in the laboratory. Before the related research work, it was too considered of no use. But after some positive results, some countries have used it in road pavement construction and in structures too. If these two are used in limited proportions then they can effectively

increase the overall properties of concrete as compared with the conventional concrete. Excessive addition of these replacements could result in a negative impact on concrete properties.

Geopolymer is an organic as well as inorganic waste like as polyvinyl chloride waste which is producing thousands of tons every day. The decomposition of this plastic waste in the environment is harmful to human being. A little amount of Geopolymer can provide faithful results but in excess, it decreases the strength of concrete.

2. LITERATURE REVIEW

The 26 research Papers have been reviewed in this review paper. In this review paper, the main focus is on the utilization of industrial waste like Marble dust, copper slag, and Plastic waste.

Experiment Adopted-

- Compressive strength test

- Flexural strength test
- Split tensile strength test

S. No	Year	Ref. no.	Location	Material	Material replaced by	Day of test	Grade of concrete	% replace	Compressive strength(N/mm^2)			Flexural strength(N/mm^2)			Split Tensile strength(N/mm^2)		
									Strength	% increased	% reduced	Strength	% increased	% reduced	Strength	% increased	% reduced
1	2016	2	Maharashtra	Fine aggregate	copper slag	28 days	M20	0 10 20 30 40 50 60 70 80 90 100	29.19 31.56 34.59 41.70 38.74 **42.22** 34.81 32.74 31.70 30.15 30								
2	2016	3	Bangladesh	Coarse aggregate	Polyethylene Terephthalate (PET) Bottles waste	28 days	M15	0 5 10 **17.92** 20	17.23 14.47 9.65						2.06 1.62 1.93 1.10		
3	2017	4	Lucknow	Fine aggregate	Copper slag	28 days	M40	0 10 20 30 40 50	48.90 49.20 49.65 49.95 **50.45** 49.30	0 .61 1.53 2.14 3.16 .81		6.85 7.03 7.14 7.29 **7.41** 7.09	0 2.62 4.23 6.42 8.75 3.50		5.92 5.94 5.97 6.15 **6.50** 6.01	0 .33 .84 3.88 9.79 1.52	
4	2015	5	Punjab	Fine aggregate	Polyethylene Bottles	28 days	M25	0 2 4 6	20 **22.2** 17.2 16.9								
5	2014	6	Jabalpur	Admixtures	P.V.C waste and steel fibre	28 days	M20	0 0.2 0.4 0.6 0.8 1	46 45 **43** 41.5 40.5 40								
6	2016	7	Andhra Pradesh	Fine aggregate	Copper slag	28 days	M30	0 10 20 30 40 50 60 80 100	0 36 40 **43** 38 37 41 39.5 33			0 4.15 4.45 **4.48** 4.3 4.4 4.35 4.2 4.36			3.5 5 5.8 **5.8** 5.8 4.3 4.3 4.1 3.8		
7	2009	8	Oman	Fine aggregate	Copper slag	28 days	M25	0 40 80	34.4 33.9 31.3								
8	2015	9	Jharkhand	Cement	Marble dust	28 days	M25	0 5 10 15 20	33.18 34.67 **35.85** 30.22 29.19	0 4.49 8.05 0 0	0 0 8.92 12.03	5.33 5.43 5.63 **5.73** 4.70	0 1.88 5.63 7.500	0 0 0 11.82	3.91 4 4.04 **4.27** 3.30	0 2.3 4.09 9.210	0 0 0 15.60
9	2015	10	Salem	Coarse aggregate	Plastic waste	28 days	M30	0 5 10 15	25 26 **27** 25.5			5 5.5 **6.6** 6			3 3.4 **3.6** 3.3		
			Madras	Fine	Copper	28		0 15				5.49 4.97					

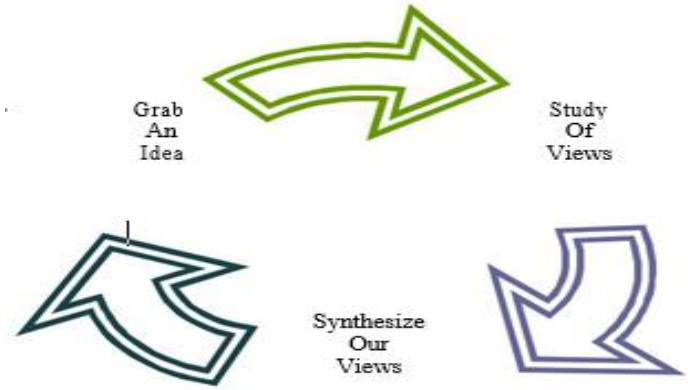
10	2017	11	htra	aggregate	slag	days	M20	30 45				**6.16** 5.45					
11	2014	12	Tamilnadu,	Fine aggregate	Copper slag	28 days	M40	0 20 40 60 80 100	38.80 40.70 **42.95** 34.44 31.39 27.66			4.79 7 **7.73** 6.27 5.46 4.42			2.45 2.68 **3.09** 2.43 2.22 1.85		
12	2017	13	Lucknow	Sand	Copper slag	28 days	M35 M40	40 40	**44.75** **50.10**			**4.3** **5.465**					
13	2016	14	Tamil Nadu	Fine aggregate	Copper slag	28 days	M25	0 10 20 30 40 50	30.76 32.85 34.19 34.96 **35.68** 31.38			2.48 2.51 2.66 2.79 **2.86** 2.63			2.45 2.81 3.21 3.41 **3.64** 3.53		
14	2015	15	Gujarat	Sand	Copper slag	28 days	M30	10 20 30 40 50 60 70 80 100	37..27 40.97 **48.13** 40.83 38.80 39.43 43.33 35.17 32.07			4.19 4.32 **4.81** 4.33 4.40 4.50 4.28 4.22 4.60					
15	2013	16	Rajaram nagar	Sand	Copper slag	28 days	M25	0 10 20 30 40 50 60 75 100	30.36 35.17 38.22 42.29 **43.01** 39.53 35.89 26.88 25.14			3.49 3.60 **4.00** 3.63 3.67 3.75 3.57 3.52 3.83					
16	2016	17	karnataka	Cement	Marble dust	28 days	M20	5 10 15	28.81 **28.88** 20.07						2.36 2.55 **2.69**		
17	2016	18	Bhopal	Cement	Marble dust	28 days	M20	0 5 10 15	26.75 29.83 31.05 **33.71**								
18	`2012	19	Maharashtra	Cement	Marble powder	28 days	M20	0 5 10 15 20	23.41 26.96 **28.44** 20.30 19.25								
19	2017	20	Andhra Pradesh	Cement	Marble dust	28 days	M25	0 5 10 15	26.5 27.2 **28.4** 25.8						3.34 3.45 **3.78** 3.23		
20	2017	21	Gwalior	Cement	Marble powder	28 days	M20	0 5 10 15 20 25	28.10 28.90 30.15 **31.27** 29.38 26			3.8 3.84 3.87 **3.94** 3.85 3.6					
21	2016	22	Jaipur	Cement	Marble and granite waste	28 days	M40	0 5 10 15	48.72 49.25 **51.68** 50.03			7.29 7.38 **7.76** 7.49			2.93 2.95 **3.10** 2.99		
22	2016	23	Gujarat	Cement	Marble dust	28 days	M25	0 5 10 15	33.33 34.66 **35.85** 31.55								
23	2016	24	Jharkhand	Cement	Marble dust	28 days	M20	0 5 10 15 20	24.84 26.51 **28.03** 25.55 23.07	0 6.72 12.84 2.86 0	0 0 0 0 7.13 18.4				3.12 3.37 **3.68** 3.32 2.60	0 8.01 17.95 6.410	0 0 0 0 16.67

								25 30	20.25 18.18	0 0	8 26.8 1				2.41 2.30	0 0	22.76 26.28
24	2017	25	Gujarat	Fine aggregate	Poly vinyl chloride and glass waste	28 days	M25	0 5 10 **15** 20 25 30	32 32.1 32.2 **33.5** 31.8 30 28.7								
25	2015	26	Tamil nadu	Coarse aggregate	Pvc waste	28 days	M20	0 2 4 6 8 10	26.9 **26.4** 26.1 20 17 14								
26	2012	27	Maharashtra	Admixtures	Pvc waste	28 days	M20	0 .2 .4 .6 .8 1	28.92 **23.2** 22.1 20.26 19.85 20.2						4.12 4.38 4.92 5.16 **5.57** 5.12		

3. STRENGTH OF RESEARCH ARTICLE REVIEWED

By the increment of copper slag as fine aggregate up to 50%, the strength of the concrete is increased but in excess give bad results. (1)

- When the quantity of Polyethylene Terephthalate (PET) Bottles waste as coarse aggregate increases up to 10% results are good in terms of compressive strength. (2)
- The flexural strength and split tensile strength results are good up to 40% replacement of sand with copper slag. (3)
- Polyvinyl chloride waste had better result up to.2% for compressive strength but for tensile strength, at .8% results are better. (26)
- Polyethylene Bottles as sand having increment up to 2%. Replacement results are good. (4)
- When the marble dust increased between 10% to 15% gave satisfactory results. (8)(16)(17)(18)(19)(20)(21)(22)(23)
- When the inorganic waste or plastic waste increases up to 2% results are not good.
- Due to the excess of marble dust strength parameters also affected and after increasing mix quantity higher than 15% results decreases rapidly.



4. CONCLUSIONS

The better results can be adopted in between 30% to 50% mixing of copper slag.

In between 1% to 2% addition of Polyvinyl chloride give satisfactory results.

In between 10% to 15% mix proportion of marble dust, faithful results can be adopted.

Plastic waste as coarse aggregate give better results up to 4% replacement.

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