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

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Abstract

In Our World, as the 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 environment, we have thought of partial replacement of cement with marble dust and fine aggregate with copper slag. This paper deals with detailed literature review of concrete using waste marble powder and copper slag as 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 property of hardened concrete.

Keywords: *Marble Dust, Copper Slag, Plastic Waste.*

1. Introduction

Concrete is the largest used material worldwide. With the increasing rate of population growth, infrastructure too 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 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 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.

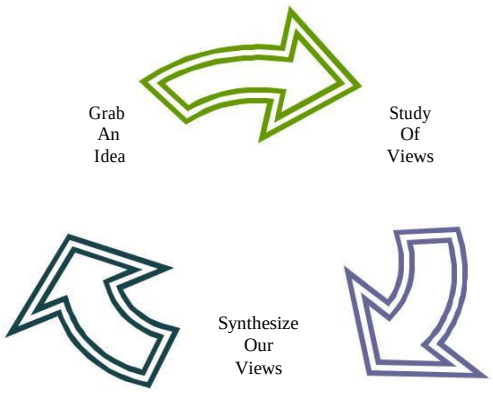
Copper slag is produced as a by-product of the smelting process of copper by the metal industry. Slag is an impurity that comes with the metal ores, when heated in the furnace all the impurities start to float at the top of the furnace. The slag is then quenched in a water bath and converted into nodules. 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 negative impact on concrete properties.

Geopolymer is an organic as well as inorganic waste like as poly vinyl chloride waste which is produces thousands of tons every day. The decomposition of this plastic waste in environment is harmful for 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 utilization of industrial waste like Marble dust, copper slag and Plastic waste.



Experiment Adopted-

- Compressive strength test
- Flexural strength test
- Split tensile strength test

Table 1. Literature review

S. No	Year	Ref. no.	Location	Material	Material replaced by	Day of test	Grade of concrete	% replace	Compressive strength(N/mm^2) Strength	% increased	% reduced	Flexural strength(N/mm^2) Strength	% increased	% reduced	Split Tensile strength(N/mm^2) Strength	% increased	% reduced
								0	29.19								
								10	31.56								
								20	34.59								
								30	41.70								
				Fine	copper	28		40	38.74								
1	2016	2	Maharashtra	aggregate	slag	day	M20	50	**42.22**								
						s		60	34.81								
								70	32.74								
								80	31.70								
								90	30.15								
								100	30								
					Polyethylene												
								0	17.23						2.06		
				Coarse	Terephthalate	28		5	14.47						1.62		
2	2016	3	Bangladesh	aggregate	(PET)	day	M15	10	**17.92**						1.93		
					Bottles	s		20	9.65						1.10		
					waste												
								0	48.90	0		6.85	0		5.92	0	
				Fine		28		10	49.20	.61		7.03	2.62		5.94	.33	
			Lucknow		Copper			20	49.65	1.53		7.14	4.23		5.97	.84	
3	2017	4		aggregate	slag	day	M40	30	49.95	2.14		7.29	6.42		6.15	3.88	
				e		s		40	**50.45**	3.16		**7.41**	8.75		**6.50**	9.79	
								50	49.30	.81		7.09	3.50		6.01	1.52	
				Fine	Polyethy	28		0	20								
								2	**22.2**								
4	2015	5	Punjab	aggregate	lene	day	M25	4	17.2								
					Bottles	s		6	16.9								
								0	46								
					P.V.C	28		0.2	45								
				Admixtu	waste			0.4	**43**								
5	2014	6	Jabalpur	res	and steel	day	M20	0.6	41.5								
					fibre	s		0.8	40.5								
								1	40								
								0	0			0			3.5		
								10	36			4.15			5		
								20	40			4.45			5.8		
			Andhra	Fine	Copper	28		30	**43**			**4.48**			**5.8**		
6	2016	7	Pradesh	aggregate	slag	day	M30	40	38			4.3			5.8		
				e		s		50	37			4.4			4.3		
								60	41			4.35			4.3		
								80	39.5			4.2			4.1		
								100	33			4.36			3.8		
				Fine	Copper	28		0	34.4								
7	2009	8	Oman	aggregate	slag	day	M25	40	33.9								
				e		s		80	31.3								
								0	33.18	0	0	5.33	0	0	3.91	0	0
						28		5	34.67	4.49	0	5.43	1.88	0	4	2.3	
8	2015	9	Jharkhand	Cement	Marble dust	day	M25	10	**35.85**	8.05	8.92	5.63	5.63	0	4.04	4.09	0
						s		15	30.22	0	12.0	**5.73**	7.50	11.8	**4.27**	9.21	0
																	15.60

								20	29.19	0	3	4.70	0	2	3.30	0		
				Coarse		28		0	25			5			3			
				aggregat	Blast	day		5	26			5.5			3.4			
9	2015	10	Salem	e	waste	s	M30	10	**27**			**6.6**			**3.6**			
								15	25.5			6			3.3			
				Fine		28		0				5.49						
			Majaras		Copper			15				4.97						
10	2017	11	htra	aggregat	slag	day	M20	30				**6.16**						
				e		s		45				5.45						
								0	38.80			4.79			2.45			
				Fine		28		20	40.70			7			2.68			
			Tamilna		Copper			40	**42.95**			**7.73**			**3.09**			
11	2014	12	du,	aggregat	slag	day	M40	60	34.44			6.27			2.43			
				e		s		80	31.39			5.46			2.22			
								100	27.66			4.42			1.85			
			Luckno		Copper	28	M35	40	**44.75**			**4.3**						
12	2017	13	w	Sand	slag	day	M40	40	**50.10**			**5.465**						
						s												
								0	30.76			2.48			2.45			
				Fine		28		10	32.85			2.51			2.81			
			Tamil		Copper			20	34.19			2.66			3.21			
13	2016	14	Nadu	aggregat	slag	day	M25	30	34.96			2.79			3.41			
				e		s		40	**35.68**			**2.86**			**3.64**			
								50	31.38			2.63			3.53			
								10	37..27			4.19						
								20	40.97			4.32						
								30	**48.13**			**4.81**						
					Copper	28		40	40.83			4.33						
14	2015	15	Gujarat	Sand	slag	day	M30	50	38.80			4.40						
						s		60	39.43			4.50						
								70	43.33			4.28						
								80	35.17			4.22						
								100	32.07			4.60						
								0	30.36			3.49						
								10	35.17			3.60						
								20	38.22			**4.00**						
			Rajaram		Copper	28		30	42.29			3.63						
15	2013	16	nagar	Sand	slag	day	M25	40	**43.01**			3.67						
						s		50	39.53			3.75						
								60	35.89			3.57						
								75	26.88			3.52						
								100	25.14			3.83						
					Marble	28		5	28.81						2.36			
16	2016	17	karnatak	Cement	dust	day	M20	10	**28.88**						2.55			
			a			s		15	20.07						**2.69**			
						28		0	26.75									
					Marble			5	29.83									
17	2016	18	Bhopal	Cement	dust	day	M20	10	31.05									
						s		15	**33.71**									
								0	23.41									
	`201		Maharas		Marble	28		5	26.96									
18	2	19	htra	Cement	powder	day	M20	10	**28.44**									
						s		15	20.30									
								20	19.25									
						28		0	26.5						3.34			
			Andhra		Marble			5	27.2						3.45			
19	2017	20	Pradesh	Cement	dust	day	M25	10	**28.4**						**3.78**			
						s		15	25.8						3.23			
								0	28.10			3.8						
						28		5	28.90			3.84						
					Marble			10	30.15			3.87						
20	2017	21	Gwalior	Cement		day	M20											
					powder			15	**31.27**			**3.94**						

						s		20	29.38			3.85					
								25	26			3.6					
					Marble	28		0	48.72			7.29			2.93		
					and			5	49.25			7.38			2.95		
21	2016	22	Jaipur	Cement	granite	day	M40	10	**51.68**			**7.76**			**3.10**		
					waste	s		15	50.03			7.49			2.99		
						28		0	33.33								
					Marble			5	34.66								
22	2016	23	Gujarat	Cement	dust	day	M25	10	**35.85**								
						s		15	31.55								
											0					0	
								0	24.84	0	0				3.12	8.01	0
								5	26.51	6.72	0				3.37	17.9	0
			Jharkhan			28		10	**28.03**	12.84	0				**3.68**	5	0
23	2016	24	d	Cement	Marble	day	M20	15	25.55	2.86	7.13				3.32	6.41	0
					dust	s		20	23.07	0	18.4				2.60	0	16.67
								25	20.25	0	8				2.41	0	22.76
								30	18.18	0	26.8				2.30	0	26.28
											1						
								0	32								
					Poly			5	32.1								
				Fine	vinyl	28		10	32.2								
24	2017	25	Gujarat	aggregat	chloride	day	M25	**15**	**33.5**								
				e	and glass	s		20	31.8								
					waste			25	30								
								30	28.7								
								0	26.9								
				Coarse		28		2	**26.4**								
			Tamil		Pvc			4	26.1								
25	2015	26	nadu	aggregat	waste	day	M20	6	20								
				e		s		8	17								
								10	14								
								0	28.92						4.12		
						28		.2	**23.2**						4.38		
			Maharas	Admixtu	Pvc			.4	22.1						4.92		
26	2012	27	htra	res	waste	day	M20	.6	20.26						5.16		
						s		.8	19.85						**5.57**		
								1	20.2						5.12		

3. Strength of research article reviewed

- By the increment of copper slag as fine aggregate up to 50%, strength of the concrete is increases 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)
- Poly vinyl chloride waste had better results 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 in between 10% to 15% gave satisfactory results. (8)(16)(17)(18)(19)(20)(21)(22)(23)

4. Weakness of research article reviewed

- 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.
- The increment in copper slag up to 50%, cause of reduction in strength parameters.

5. Conclusions

- The better results can be adopted in between 30% to 50% mixing of copper slag.
- In between 1% to 2% addition of Poly vinyl 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.

6. References

1. Abhinav Shyam, Abdullah Anwar, Syed Aqeel Ahmad, " Experimental Study on the Behavior of Copper Slag as Partial Replacement of Fine Aggregate in Concrete" , International Journal for Research in Applied Science & Engineering Technology (IJRASET), Volume 5 Issue IV, April 2017, ISSN: 2321-9653
2. B. P. R. V. S. Priyatham, D. V. S. K. Chaitanya, Bimalendu Dash, " EXPERIMENTAL STUDY ON PARTIAL REPLACEMENT OF CEMENT WITH MARBLE POWDER AND FINE AGGREGATE WITH QUARRY DUST" , International Journal of Civil Engineering and Technology (IJCIET) Volume 8, Issue 6, June 2017
3. Deepanshu Patel, Parin Bodiwala, Prof. Tejas JoDr. Urmil daveshi, " TO STUDY THE PROPERTIES OF CONCRETE AS A REPLACEMENT OF CEMENT WITH THE MARBLE DUST POWDER" , International Journal of Civil Engineering and Technology (IJCIET) Volume 7, Issue 4, July-August 2016
4. Harshad G Patel, Sejal P Dalal, " An experimental investigation on physical and Mechanical properties of concrete with the replacement of fine aggregate by Poly Vinyl Chloride and Glass waste" , Harshad G. Patel and Sejal P. Dalal / Procedia Engineering 173 (2017) 1666 – 1671
5. Khilesh sarwe, " Study of Strength Property of Concrete Using Waste Plastics and Steel Fiber" , The International Journal Of Engineering And Science (IJES) || Volume || 3 || Issue || 5 || Pages || 09-11 || 2014 || ISSN (e): 2319 – 1813 ISSN (p): 2319 – 1805
6. M. V. PATIL, " PROPERTIES AND EFFECTS OF COPPER SLAG IN CONCRETE" , International Journal of Advances in Mechanical and Civil Engineering, ISSN: 2394-2827 Volume-2, Issue-2, April-2015
7. M. V. Patil, Y. D. Patil, G. R. Veshmawala, " Performance of Copper Slag as Sand Replacement in Concrete" , International Journal of Applied Engineering Research ISSN 0973-4562 Volume 11, Number 6 (2016) pp 4349-4353
8. MB Hossain, P Bhowmik, KM Shaad, " Use of waste plastic aggregation in concrete as a constituent material" , Progressive Agriculture 27 (3): 383-391, 2016
9. Mr. Neel P. Patel , Dr.P.J.Patel, " SAND REPLACEMENT WITH COPPER SLAG ON MECHANICAL PROPERTIES OF CONCRETE" , International Journal of Advance Engineering and Research Development (IJAERD) Volume 3,Issue 5,May 2016,e-ISSN: 2348 - 4470 , print-ISSN:2348-6406

10. Mr. Ranjan Kumar, Shyam Kishor Kumar, " Partial Replacement of Cement with Marble Dust Powder" , Mr. Ranjan Kumar Int. Journal of Engineering Research and Applications, ISSN: 2248-9622, Vol. 5, Issue 8, (Part - 4) August 2015, pp.106-114
11. Prof. J. R. Mali, Kirti Gajare, Mrunmayee Patil, Kajal Patil, Latika Pawar, Yashsvini Jadhav, " Flexural Behavior of Concrete Beam by Replacing Copper Slag as Fine Aggregate" , International Journal of Engineering Science and Computing, April 2017
12. Prof. P.A. Shirulea, Ataur Rahmanb , Rakesh D. Guptac, " PARTIAL REPLACEMENT OF CEMENT WITH MARBLE DUST POWDER" , International Journal of Advanced Engineering Research and Studies E-ISSN2249–8974
13. R R Chavan & D B Kulkarni, " PERFORMANCE OF COPPER SLAG ON STRENGTH PROPERTIES AS PARTIAL REPLACE OF FINE AGGREGATE IN CONCRETE MIX DESIGN" , Chavan, et al, International Journal of Advanced Engineering Research and Studies E-ISSN2249–8974
14. Raghatate Atul M., "USE OF PLASTIC IN A CONCRETE TO IMPROVE ITS PROPERTIE" , IJAERS/Vol. I/ Issue III/April-June, 2012/109-111
15. Raghvendra, Prof. M. K. Trivedi, " Partial Replacement of Cement with Marble Dust Powder in Cement Concrete" , International Journal for Research in Applied Science & Engineering, Technology (IJRASET), Volume 5 Issue V, May 2017
16. Rahul S, Rasl Muhammed Rafeeq, Dr. T Senthil Vadivel, Dr. S Kanchana, " Experimental Study on Properties and Effects of Copper Slag in Self Compacting Concrete" , IJSTE - International Journal of Science Technology & Engineering | Volume 2 | Issue 12 | June 2016, ISSN (online): 2349-784X
17. RochakPandey, Prof. M.C.Paliwal, Jatin Mehta, Jeet N Tiwari, " OPTIMUM PARTIAL REPLACEMENT OF CEMENT IN CONCRETE WITH WASTE MARBLE DUST IN CONJUNCTION WITH SUPER PLASTICIZERS" , IJESRT, INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH, TECHNOLOGY [Pandey*et al., 5(8):August, 2016]
18. S. Alnuaimi, " Use of copper slag as a replacement for fine aggregate in reinforced concrete slender columns" , WIT Transactions on Engineering Sciences, Vol 64, © 2 009 WIT Press, ISSN 1743-3533
19. S. Vanitha, V. Natrajan and M. Praba, " Utilisation of Waste Plastics as a Partial Replacement of Coarse Aggregate in Concrete Blocks" , Indian Journal of Science and Technology, Vol 8(12), DOI: 10.17485/ijst/2015/v8i12/54462, June 2015
20. Sahil Verma, Sahil Arora, " Replacement of Natural Sand in Concrete by Polyethylene Bottles" , International Research Journal of Engineering and Technology (IRJET), Volume: 02 Issue: 01 | Apr-2015
21. Savita Devi, Nitish Gandhi , Mahipal 3, Nimisha Marmat , Balveer Manda , Mahesh Vaishnav, " Utilization of marble and granite waste as partial replacement of cement in concrete" , SSRG International Journal of Civil Engineering (SSRG-IJCE) – volume 3 Issue 5 – May 2016
22. Sonu Pal, Amit Singh, Tarkeshwar Pramanik, Santosh Kumar, "Effects of Partial Replacement of Cement with Marble Dust Powder on Properties of Concrete" , IJIRST –International Journal for Innovative Research in Science & Technology| Volume 3 | Issue 03 | August 2016
23. T.Subramani , V.K.Pugal, " Experimental Study On Plastic Waste As A Coarse Aggregate For Structural Concrete" , International Journal of Application or Innovation in Engineering & Management (IJAIEM), Volume 4, Issue 5, May 2015
24. Tamil Selvi P, Lakshmi Narayani P and Ramya G, " Experimental Study on Concrete Using Copper Slag as Replacement Material of Fine Aggregate" , J Civil Environ Eng Volume 4 • Issue 5 • 1000156, ISSN: 2165-784X JCEE, an open access journal
25. Vijaya Kumar YM | Shruti D | Tharan SN | Sanjay SR | Sricharan PM, " Partial Replacement of Cement to Concrete by Marble Dust Powder" , Volume: 2 | Issue: 05 | May 2016 | ISSN: 2455-3778
26. Zine Kiran Sambhaji, Prof.Pankaj B. Autade, " Effect of Copper Slag As A Fine Aggregate on Properties of Concrete" , International Research Journal of Engineering and Technology (IRJET), Volume: 03 Issue: 06 | June-2016