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PARTIAL REPLACEMENT OF FINE AGGREGATE WITH COPPER SLAG AND MARBLE DUST POWDER IN GEO-POLYMER CONCRETE: A REVIEW

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Abstract – *In recent years the rise of concrete production costs has always been a concern of concrete producers and consumers. Utilizing modern waste to supplant concrete and some portion of total can lessen its expense and ecological contamination .The point of this paper is to review the chance of utilizing marble dust powder alongside the copper slag as a partially substitution to fine aggregate total in geo-polymer concrete. Marble dust powder was utilized in blends containing copper slag as partially substitute to sand in percentage of 10%, 20%, 30%, 40% and 50%. The strength of geo-polymer concrete were checked for 7, 28 days. Blend plans were readied and projected independently and afterward tests were completed and at that point the outcomes were contrasted with deference with customary geo-polymer concrete a lot made by substitution materials. To compare the properties of geo-polymer concrete after partially replacing fine aggregate with copper slag and marble dust powder with concrete.*

K***ey points***: *copper slag; geo-polymer concrete; marble dust powder; partial replacement*

1. INTRODUCTION

Concrete is the biggest utilized material around the world. With the expanding pace of populace development, framework to should be grown quickly to satisfy the necessities of individuals and for all these an enormous measure of assets are required. The significant one of them is total. In any case, the inordinate utilization of these assets will make an ecological awkwardness. Hence, we have chosen to supplant these significant element of the development business with marble powder and copper slag individually.

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 created as a side-effect of the purifying cycle of copper by the metal business. Slag is a debasement that accompanies the metal minerals when warmed in the heater all the contaminations begin to glide at the highest point of the heater. The slag is then extinguished in a water shower and changed over into knobs. This grants a decent strength when tried in the research center. Before the connected examination work, it was excessively considered of no utilization. Yet, after some sure outcomes, a few nations have utilized it in street asphalt development and in structures as well. In the event that these two are utilized in restricted extents, at that point they can viably build the general properties of concrete as contrasted and the regular cement. Unreasonable expansion of these substitutions could bring about a negative effect on concrete properties.

Geo-polymer was the name given by Diadovits in 1978 to materials which are characterized by chains or networks or inorganics molecules. Geo-polymer 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 Geo-polymer can provide faithful results but in excess, it decreases the strength of concrete.

Chemical analysis of copper slag, marble dust powder

Component (%)	Copper slag	Marble dust powder
SiO_2	97.01	18.67
Al_2O_3	0.095	8.70
Fe_2O_3	1.05	6.31
CaO	1.064	53.86
MgO	0.118	5.74
SO_3	0.008	1.2
K_2O	0.028	–
Na_2O	0.118	–
TiO_2	0.120	–
Mn_2O_3	0.002	_

For examining the impact of copper slag and marble dust powder as a substitution for fine total in geo-polymer concrete, M30 grade of geo-polymer concrete are used in this study.

Mix design of M30 grade

Grade Quantity of water (kg/m3) GPB (kg/m3) Fine aggregate(W/GPB) coarse aggregate(kg/m3)

M30 108.35 513 690.54 (4)1282.43

0.211 1 1.35

(4)2.5

Ratio of Copper slag in percentage 10%, 20%, 30%, 40%and 50% to be used and marble dust powder percentage 10%, 20%, 30%, 40%and 50% to be used are partially replaced in geo-polymer concrete instead of fine aggregates.

1.1 Materials

1.2.1 Fly ash: Fly ash class F used in this study.

1.2.2 Fine aggregate: Naturally available fine aggregate is used for casting specimens. The fine Aggregate was passing through 4.75mm sieve and had a specific gravity of 2.68.

1.2.3 Coarse aggregate: The Maximum size of coarse aggregate used for this investigation is 20mm and the specific gravity is 2.78.

1.2.4 Copper slag: Copper slag is a result gotten during matte purifying and refining of copper. Creation of one ton of copper produces roughly 2.2–3 ton of copper slag.

1.2.5 Marble dust powder: Marble is typically utilized for enlivening and great purposes. 20% of the marble quarried is gets changed over into powder structure because of the cutting of marble. The particular gravity of marble dust powder is 2.5.

1.2.6 Alkaline activator solution: Catalytic liquid system is used, it is a combination of solutions of silicates and hydroxide, besides distilled water.

1.2.7 Water: Water is central point in development controlling strength, all that else being equivalent, is the measure of water utilized per pack of concrete and restoring reason they utilized.

1.2 Objective

1. To evaluate the optimum % of copper slag and marble dust powder.

2. To evaluate the compressive strength, split tensile strength and flexural strength of the geo-polymer concrete by using copper slag and marble dust powder in different proportions at different ages.

3. To compare the properties of geo-polymer concrete after partially replacing fine aggregate with copper slag and marble dust powder with concrete.

Experimental Program

Following tests are to be conducted on concrete:

1. Compressive strength test

2. Split tensile strength

3. Flexural strength test

2. Literature Review

C. K. Madheswaran, P. S. Ambily, et al. (2014)[1] It is consequently recommended that the copper slag can be utilized for putting of floor materials and level up to 50 % by mass of the fine total, and for vertical surfaces, for example, block/block dividers it tends to be utilized something like 25 %. In this investigation on solid blends were set up with two water concrete proportions and various extents of copper slag going from 0 % (for the control blend) to 100 % of fine aggregate. The Concrete mixes were evaluated for workability, density, and compressive strength.

Pranshu Saxena and Ashish Simalti, (2015)[2] The will defined scope in the future studies of copper slag is that it can also be replaced by cement and fine aggregate very easily and has an application in concrete as a admixture. Maximum compressive, tensile and flexural strength is obtained when copper slag is replaced with fine aggregate up to 40%.

Mahaboob Basha S, Bhupal Reddy Ch et al. (2016)[3] Aggregate offer over 65% for creating Geo-polymer solid Manufacture sand is commonly delivered by smashing, screening and washing a stone in wanted shapes and sizes. Electronic waste is one of the risky waste materials; it is a non-degradable waste material establishes hurtful consequences for climate. Production sand and electronic waste was mostly supplanted by fine aggregates in 10%, 20%, 30%, 40% and 50%.

Neetu Susan Mathew and S.Usha (2016)[4] The outcomes demonstrated that geo polymer concrete with 40% copper slag as fine aggregates substitution indicated an improvement of 17.5%, 13.94% and 22.72% in the 28th day compressive strength, parting rigidity and flexural strength separately in correlation with the geo polymer concrete without copper slag, however regarding solidness of geo polymer solid, it is discovered to be more water absorbent

Vyshak Sajeev, Thariq I at. el. (2018)[5] As a result, the creation cost of SCC is higher than ordinary cement. The essential point of this work is to consider the impact of joining marble powder as a fractional substitution to Fine total. Evaluation of Hardened properties was restricted to

Compressive and flexural strength. Out of the different % substitutions, the ideal % substitution of marble powder was discovered to be 20% and performed well in both new and solidified properties. Ideal compressive strength with water restoring at 28 days is 38 N/mm2and for polythene relieving is 29 N/mm2The got results uncovered the chance of supplanting fine total with 20% marble powder and furthermore polythene relieving can be embraced in water scant regions.

M.V. Patil et al. (2018)[6] Marble dust is the side-effect from marble cutting technique. The point of this paper is to search out the chance of utilizing marble dust alongside the copper slag as an incomplete substitution to fine aggregate in concrete. Marble dust was utilized in blends containing copper slag as incomplete substitute to sand in amounts beginning from 5%, 10%, 15%, 20%, 25%, 30%, 35%, 40%, 45%, furthermore, 50%. The solidified properties of cement were checked for 7, 28, 56 and 112 days. Results show that up to 60% substitution of marble dust and copper slag to fine aggregate, there is an expansion in compressive strength. Likewise, split tensile, flexure, density and modulus of flexibility show an expansion in strength at 60% substitution. Porousness, then again, goes on diminishing up to 60% substitution and increments past 60% substitution of marble dust and copper slag. These discoveries of the investigation express that marble residue will be utilized as the conceivable substitution material to sand to give high strength copper slag concrete.

M. Saravanan, M. Siva, L. Mary Rosary, et al. (2019) [7] For diminishing the ecological risks identified with the fine aggregate mining and garbage removal of slag. The current examination has been attempted to contemplate the impact of granulated impact heater slag supplanted various rates 0%, 20%, 50%, 70%, 90% of sand, for the standard w/c proportion 0.45 is thought of. The concrete examples were tried at various ages of 7 days, 14 days, and 28 days.

Velani RoshanKumar Bhogilal, Mavani Tejas Jayantilal, et al. (2019)[8] Looking for the unfriendly impact of high creation of concrete on the climate, we have considered halfway supplanting of concrete with marble residue and fine aggregate with copper slag. This paper manages a definite writing audit of concrete utilizing waste marble powder and copper slag as a fractional substitution and investigates the correct blend where compressive, split tensile and flexural are ideal. The better outcomes can be received in the middle of 30% to 50% blending of copper slag and in the middle of 10% to 15% blend extent of marble dust, loyal outcomes can be embraced.

Abbas Mohajerani, David Suter, et al. (2019)[9] The exceptionally factor nature of waste materials should be a focal point of future examination, with blend plans that attention on locally accessible waste materials with negligible handling. Much exploration has zeroed in on warmth restored geo polymers; notwithstanding, this builds the exemplified energy while decreasing the ecological advantage, which likewise goes about as a restricting element for in situ applications.

P. Partheeban and L. Iyappan, (2020)[10] Slurry is a result left over after the stone cutting cycle that can't be utilized for anything. Further rock slurry based geo polymer concrete is tried for compressive strength, flexural strength and split tensile strength. It will lessen the utilization of stream sand and will likewise expand the consistency of the concrete. The most extreme compressive strength of 23.55 N/mm2 at 28 days is gotten. Greatest split tensile strength of cement is accomplished when the fine total is supplanted by 10% of stone slurry, When 20% of slag is supplanted instead of fine aggregate the most extreme flexural strength. .

3. CONCLUSIONS

1. Option of up to 60% of copper slag and marble dust picked up 22% extra strength than the control concrete; however the further augmentations of copper slag, marble dust caused a decrease in the strength.

2. The split tensile strength of concrete is expanded by 6% by 60% substitution of fine aggregate with copper slag and marble dust.

3. Because of the high durability of copper slag, the compressive strength and flexural strength is expanded.

4. By adding the polypropylene fibres to concrete it reduces the water permeability and shrinkage.

5. The compressive strength, part elasticity and flexural strength increments by 17.5%, 13.94% and 22.72% individually because of the partially replacement of fine aggregate by copper slag.

6. The water retention limit and sorptivity increments because of the permeable idea of copper slag.

7. Modulus of elasticity and bond strength estimations of Geo-polymer concrete lessens by 0.4% and 4.1% individually when copper slag replaces fine aggregate by 40%.

8. Compressive strength expanded with increases in % substitution of marble powder.

REFERENCES

1. C. K. Madheswaran, P. S. Ambily et al. (2014)."Studies on use of Copper Slag as Replacement Material for River Sand in Building Constructions" Journal of The Institution of Engineers (India): Series A volume 95, pages169–177.

2. Rishi, Dr. Vanita Aggarwal (2014)." Effect on Partial Replacement of Fine Aggregate and Cement by Waste Marble Powder/ Granules on Flexural and Split Tensile Strength" IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) Volume 11, Issue 4 Ver. II , PP 110-113.

3. Pranshu Saxena and Ashish Simalti (2015)." Scope of Replacing Fine Aggregate With Copper Slag in Concrete" International Journal of Technical Research and Applications e-ISSN: 2320-8163 Volume 3, Issue 4, PP. 44-48.

4. Subhash V. Patankar et al. (2015).'' Mix Design of Fly Ash Based Geopolymer Concrete'' Springer India 2015, pages 1619-1625.

5. Mahaboob Basha S, Bhupal Reddy Ch et al. (2016)."Strength Behaviour of Geo-Polymer Concrete Replacing Fine Aggregate by M-Sand and E-Waste" International Journal of Engineering Trends and Technology (IJETT) – Volume-40 Number-7 - October 2016 page 401-407.

6. Neetu Susan Mathew and S. Usha (2016)."Effect of Copper Slag As Partial Replacement of Fine Aggregate in Geo-Polymer Concrete" IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) ISSN: 2320-334X, PP 73-77.

7. Vyshak Sajeev , Thariq I (2018)." Effect of Partial Replacement of Fine Aggregate by Marble Powder on the Fresh and Hardened Properties of SCC" International Journal of Emerging Technologies in Engineering Research (IJETER), Volume 6, Issue 8, August (2018).

8. M.V. Patil et al. (2018).'' A study on properties and effects of copper slag and marble dust in concrete'' S.V. National Institute of Technology, Int. J. Structural Engineering, Vol. 9, No. 2, (2018).

9. Abbas Mohajerani, David Suter et al. (2019)."Recycling of Waste Material in Geo-Polymer Concrete" Clean Technologies and Environmental Policy volume 21, pages493–515.

10. Velani RoshanKumar Bhogilal , Mavani Tejas Jayantilal et al. (2019)."Investigation of Geo-Polymer Concrete by Partial Substitution of Cement with Marble Dust and Fine Aggregate with Copper Slag" MITCOM, MIT Art, Design & Technology University Volume: 06 Issue: 04 | Apr 2019.

11. M. Saravanan, M. Siva et al. (2019)."Replacement of Fine Aggregate by Granulated Blast Furnace Slag" International Research Journal of Engineering and Technology (IRJET) Volume: 06 Issue: 04 | Apr 2019 ISSN: 2395-0072.

12. P. Partheeban and L. Iyappan (2020). "Engineering Properties of Granite Slurry Based Geo- Polymer Concrete" Department of Civil Engineering, Chennai Institute of Technology Volume 83. pp. 14440 – 14447.