

A LITERATURE REVIEW ON THE STUDY AND ANALYSIS OF CONCRETE STRENGTH PARAMETERS USING COPPER SLAG AS A FINE AGGREGATE REPLACEMENT AND EGG SHELL POWDER AS A CEMENT REPLACEMENT

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ABSTRACT

A common trend exists to reduce the usage of natural resources and recycle waste material. As the disposal of waste products becomes a critical task and hence developing countries faced such an issue concrete play a key position and a huge quantity of concrete are required in infrastructure development.

Copper slag is a by-product of the copper industry, and Egg Shell is an egg's hard, outer covering. Egg Shell Powder processed from hen egg. Due to the properties of copper slag like fine aggregate and the properties of Egg Shell powder like cement. The use of these materials in concrete is both economical and environmentally friendly.

An experiment was conducted to study and analysis of concrete parameters using copper slag as a fine aggregate (sand) replacement and Egg Shell Powder as a cement replacement. The replacement of Copper Slag (40%, 60%) And Egg Shell Powder (5%, 7.5%) is performed on the Grade of **M25(1:1:2)**. The concrete strength parameters are Durability's (water penetration) for 90 Days, Compressive strength and Split tensile strength for 7,14,28 Days.

Keywords: Copper Slag, Eggshell Powder.

I. INTRODUCTION

In India, most industries produce large quantities of waste materials. ex, is copper slag, a voluminous waste material obtained during the manufacturing of copper. The copper slag is a fine or blending agent, which helps hold the larger gravel particles within the concrete. In India for each ton of copper created, about 2.2 tons amount of copper slag is produced. It is seen that roughly 24.6 million tons of slags are created from the worldwide industry, the copper slag is used in concrete as a replacement for fine aggregate. It is used in concrete because it has several favorable mechanical properties for aggregate use such as excellent soundness characteristics, good abrasion resistance, and good stability. It was also helpful to increase compressive strength.

Alternatively, the eggshell powder can replace cement in concrete as a replacement. It is made up of agricultural waste products such as eggshells that are discarded by hatcheries, bakeries, fast food restaurants, etc. Due to the fact that there is an equal amount of carbon dioxide released into the atmosphere during the manufacturing of one ton of cement, it is being used as a substitute for cement, as this is a silent killer in the environment. When eggshell waste is used instead of natural lime to replace cement in concrete, there can be benefits, such as minimizing cement consumption.

II. LITERATURE REVIEW

T. Karun Kumar et al, [2017] was experimental investigation will be conducted to study the properties of concrete containing copper slag as a partial replacement of fine aggregates in the concrete mix design. Various durability tests will be conducted on such concrete of M30 grade and M40 grade to know the compressive strength, split tensile strength, flexural strength by varying proportions of copper slag (CS) with fine aggregates by 0%, 5%, 10%, 15%, 20%,25%,30% and Egg shell powder (ESP) as cement by 0%, 5%, 10%, 15%, 20%,

25%,30% by weight. The obtained results will be compared with the conventional concrete, there by knowing the changes in the properties of concrete containing copper slag as a partial replacement of fine aggregates.[1]

Ambrish Dhavamani et al, [2017] was studied replacement of copper slag at 10-25% at cure time of 7 to 14 days. Water demand is reduced 22% at 100% when durability is checked (M25). There's an increase in strength. The replacement grade for Grade M20 will be 5-15-25-35-45-55%.[2]

Maheshwari et al, [2016] was studied the mechanical and durability properties of RC beams using copper slag as fine aggregate. Due to its physical properties, copper slag can be used as a replacement for fine aggregate in concrete since it has similar properties to fine aggregate. Copper slag has lower absorption and higher strength properties than normal sand. Replacement of copper slag increases the self-weight of concrete specimens to a maximum of 15% to 20%.[3]

G. Esakki Muthu et. al. [2016] was investigated the micro formation of cement mixture with green sand and copper slag like a substitute of fine aggregate. The replacement of green sand and copper slag will be regularly from 10%, 20%, and 30% by the weight of fine collection. The results obtained in this research point to that the main function of copper scum and green sand in mortar as alternate material for river Sand gives options for the consumption of this huge waste materials as an alternative material that is environmentally sustainable and appropriate for the building manufacturing.[4]

Zerdi et al, [2016] was conduct an Experimental Investigation on Properties of Concrete by Replacement Copper Slag for Fine Aggregate. The fine aggregates were replaced with percentages 0% (for the control mix), 20%, 40%, and 60% of Copper Slag by weight. Tests were performed for properties of fresh concrete and Hardened Concrete. Compressive strength was determined at 3, 7,14 and 28 days. Properties like workability and density were increased with the use of copper slag in concrete. Improvement in the strength properties of plain concrete by the inclusion of up to 40% Copper slag as replacement of fine aggregate was observed as 25.58 N/mm² at 28 days for M20 concrete.[5]

Patil et al, [2016] was observe the Performance of Copper Slag as Sand Replacement in Concrete.M30 concrete was used and various tests like compressive, flexural, split tensile strength were conducted for different percentages of copper slag and sand from 0 to 100%. The result showed that workability increases with increase in percentage of copper slag. Maximum Compressive strength of concrete increased by 34 % at 20% replacement of fine aggregate with copper slag, and up to 80% replacement of copper slag, concrete gain more strength than normal concrete strength. The flexural strength of concrete found to be increased by 14% with 30% replacement of copper slag.[6]

Leema Rose et al, [2015] was examine the strength and durability properties of copper slag as partial replacements for fine aggregate in concrete. Its main objective is to find out whether concrete can retain its strength and durability when fine aggregate is partially substituted with copper slag, at levels of 10%, 20%, 30%, and 40%. Using copper slag in concrete has been proven to increase the density of the concrete as a result of its addition. According to the results of compression tests, the concrete strength increases with the amount of copper slag added to the fine aggregate by weight up to 30%. [4] For a mix of 1: 1.4: 2.6 keeping a weight/c ratio of 0.4, the strength is 45.42 N/mm². [7]

Binayak Patnaik et al, [2015] was studied the strength and durability properties of copper slag, and tested concrete cubes after 28 to 56 days with replacements up to 50% Durability and compressive strength (M20 and M30), acid attack of concrete containing Copper slog has low resistance to H₂SO₄ and Grade M20 and M30 Curing Days 28, & 56 Replacement as 0-40-50%. [8]

M. V. Patil [2015] this study based on M30 grade concrete was employed and the experiments were conducted for various proportions of copper slag replacement with sand of 0%, to100 % in concrete. Replacement of copper slag in fine aggregate reduces the cost of making concrete. The obtained results were compared with those of control concrete made with ordinary Portland cement and sand.[9]

Madhavi et al, [2015] was studied on Effect of Copper Slag on the Mechanical Strengths of Concrete. Experimental investigations are carried out by replacing the sand with copper slag in proportions of 10%, 20%, 30%, 40%, 50%, 60% and 100% keeping all other ingredients constant. It was seen that the optimum content of copper slag is 40% beyond which the strength starts decreasing.[10]

Amaranth Yerramala et.al, [2014] In this paper, it is studied that quality of construction material is an important issue which enhances the stability of the structure, an attempt has been made to study the possibilities of using Eggshell powder in paver block. Cement was partially replaced by Eggshell Powder at 5% intervals from 0% to 25% by the method of replacement by weight. The paver block Curing process is done for 7 days and 28 days, after curing it is checked for its Compressive Strength and flexural strength. It was noted that 13.4% increase of compressive strength at 10% replacement of Eggshell Powder. Flexural strength was also 19.5% increased at the same 10% replacement of Eggshell Powder. The result showed the Eggshell Powder can give more strength if it was replaced as 10% of cement.[11]

D.Gowsika et.al, [2014] In this study performed to decide the very best excellent per cent of eggshell powder as partial cement replacement. The construction industries are looking for 'alternative material that may lessen the construction cost. Over 5% of world CO₂ emissions can be credited to Portland cement manufacturing. Demand for cement maintains to develop different ESP concretes were established through replacing 4 to 16% of ESP for cement. Concrete performs the important thing function and a large quantity of concrete is being implemented in every introduction exercise. The egg shell commonly that are disposed, is used as an exchange for the cement for the reason that shell is manufactured from calcium. An egg shell is utilized in first rate combos to discover the feasibility of the use of the egg shells as an exchange to cement. Intention of this task is to prevent the pollution of environment with the aid of the usage of the wrong disposal of the eggshell waste, a live from eggshells domestic waste which includes schools, restaurant, bakeries, homes and rapid food accommodations, via the use of the usage of it as an additive fabric in form of ash & powder in traditional concrete with grade M35 because it's far usually utilized in manufacturing internet websites. [12]

M. Chockalingam et al, [2013] they studied about scope for reuse of copper slag in concrete and research works have been done to evaluate the suitability of copper slag for reuse. They give the solution that Reuse of copper slag has the dual benefit of safe disposal and judicial resource management. Application in concrete as an admixture, replacement of cement and as a fine aggregate has very good scope in the future.[13]

R R Chavan et al, [2013] has investigated the performance of high strength concrete (HSC) made with copper slag as a fine aggregate at constant workability and studied the effect conducted experimental investigations to study the effect of using copper slag as a replacement of fine aggregate on the strength properties and concluded that maximum compressive strength increased by 55% at 40% replacement of fine aggregate by copper slag and flexural strength increased by 14% for 40% replacement. Many researchers have investigated worldwide on the possible use of copper slag as a concrete aggregate.[14]

Isaac O. Igwe et.al, [2012] In this paper, it describes the usage of poultry waste in concrete thru the improvement of concrete and studied the Properties of concrete with eggshell powder (ESP) as cement alternative. Different ESP concretes had been advanced through replacing 5-15% of ESP for cement. Test are taken, compressive energy and split tensile strength take a look at turned into better than normal concrete for 5% of ESP alternative and it had lower strength than normal concrete with greater than 10% of substitute on the age of 7 & 28 days. The results proven that irrespective of ESP percentage substitute there has been proper relationship among compressive strength and split tensile strength.[15]

Karthick et al, [2012] has conducted experiment by replacing the fine aggregate by egg shell. Here they had replaced the Egg shell up to 10%, 20%, 30%, 40% & 50%. They concluded that, the tensile strength, flexural strength was decreased with increasing egg shells percent. The tensile strength decreased from (2.36N/mm²) to (0.21 N/mm²) with increasing egg shell from (0%) to (50 %).[16]

Brindha et al, [2011] was studied the durability properties of copper slag admixed concrete and found that the concrete with copper slag has less resistance to the H₂SO₄ solution than the control concrete.[17]

Ngo slew kee et al, [2010] investigated on the topic of "Effect of coconut fiber and egg albumen in mortar for greener environment" and reported the effect of coconut fiber and egg albumen on mortar compressive and flexural strength. 3 types of samples were tested to compare the strength development of each other's that was mortar control, mortar containing 0.1 per cent coconut fiber with 1 per cent egg albumen and mortar containing 0.5 per cent coconut fiber with Percentage albumen. The strength of mortar containing 0.1 per cent coconut fiber with 1 per cent egg albumen was higher than the mortar control whereas the mortar containing 0.5 percent coconut fiber ± 5 per cent egg albumen was lower strength than the mortar control. The strength of

mortar containing 0.1 per cent coconut fiber with 1 per cent egg albumen was higher than the mortar control whereas the mortar containing 0.5 per cent coconut fiber \pm 5 per cent egg albumen was lower strength than the mortar control.[18]

Freire et al [2006] was carried out the investigation on egg shell waste and found out its use in a ceramic wall tile paste. Based on the presence of CaCO₃ in egg shell it can be used as an alternative raw material in the production of wall tile materials they Also found that egg shell can be used as an excellent alternative for material reuse and waste recycling practices.[19]

Amu et al, [2005] was carried out the experiment and stated that common salt with egg shell on lateritic soil obtaining a good compliment for egg shell as a useful stabilizer for road works. Stabilization obtained by adding 2-10 per cent of common salt with optimum egg shell powder. The result showed that the addition of common salt improved the compaction and CBR characteristics of egg shell stabilized soils. [20]

III. CONCLUSION

After reviewing these 20 papers related to our study the Utilizing the industrial waste materials like copper slag and eggshell in concrete results the conservation of natural resources.

From the above study it also indicated that the optimum replacement of copper slag and egg shell powder is feasible or it gives result to achieve the optimum strength of that particular concrete which has been made with the help of copper slag and egg shell powder.

By above study we are concluding that we are going to do Durability test of water penetration for 90 days, Compressive strength and Split tensile strength for 7,14,28 Days.

IV. REFERENCES

- [1] T. Karun Kumar, N. Priyanka, "Experimental study on properties of strength and durability of concrete by partial replacement of fine aggregate with copper slag and cement with egg shell powder for M30 and M40 grade concrete." International journal of professional engineering studies. (2017).
- [2] Ambrish E, Dhavamani Doss S, Shanmuga Nathan N and Ganapathi Raj S, "Partial Replacement of Copper Slag as Fine Aggregate", SSRG International Journal of Civil Engineering, (2017).
- [3] Maheswari, "Mechanical and Durability Properties of RC Beams Using Copper Slag as Fine Aggregate in Concrete." International Research Journal of Engineering and Technology, (2016).
- [4] G. Esakki Muthu, N. Sakthieswaran, G. Shiny Brintha, O. Ganesh Babu "Microstructure Study on cement mortar using green sand and copper slag." International Journal for research in applied science and Engineering and Technology (IJRASET) (2016).
- [5] Zerdi, T. A. "Experimental Investigation on Properties of Concrete by Replacement Copper Slag for Fine Aggregate". Global journal for research analysis, (2016).
- [6] Patil, M. V. "Performance of Copper Slag as Sand Replacement in Concrete." International Journal of Applied Engineering Research, (2016).
- [7] Dr. A. Leema rose, P. Suganya "Performance of Copper Slag on Strength and Durability Properties as Partial Replacement of Fine Aggregate in Concrete." International Journal of Emerging Technology and Advanced Engineering, (2015).
- [8] Binaya Patnaik, Seshadri Sekhar.T, Srinivasa Rao, "Strength and Durability Properties of Copper Slag Admixed Concrete." International Journal of Research in Engineering and Technology, (2015).
- [9] M. V. Patil, "A Study on Properties and Effects of Copper Slag in Concrete", IRF international conference, (2015).
- [10] Madhavi, T.C. "Effect of Copper Slag on the Mechanical Strengths of Concrete." International Journal of ChemTech Research, (2015).
- [11] Amarnath Yerravalla, "Properties of concrete with eggshell powder as cement replacement". The Indian Concrete Journal. (2014).
- [12] D.Gowsika, "Experimental Investigation of Egg Shell Powder as Partial Replacement with Cement in Concrete", International Journal of Engineering Trends and Technology (IJETT)- (2014).

- [13] M.Chockalingam, D. Jayganesh, J. Vijayaraghavan, Dr.J. Jegan, "Scope for Reuse of Copper Slag in Concrete", International Journal of Civil Enigneering and Technology (2013).
- [14] R R Chavan & D B Kulkarni "Performance of copper slag on strength properties as partial replace of fine aggregate in concrete mix design." International Journal of Advanced Engineering Research and Studies . (2013).
- [15] Isaac O. Igwe, Genevive C. Onuegbu," Studies on Properties of Egg Shell and Fish Bone Powder Filled Polypropylene." American Journal of Polymer Science (2012).
- [16] J. Karthick, R. Jeyanthi, M. Petchiyammal, "Experimental Study on Usage of Egg Shell as Partial Replacement for Sand in Concrete", International Journal of Advanced Research in Education Technology, (2012).
- [17] D Brindha, S Nagan. "Durability Studies on Copper Slag admixed concrete." Asian Journal of Civil Engineering (Building and Housing) (2011).
- [18] Ngo slew kee, "Effect of Coconut fiber and Egg albumen in mortar for greener Environment," University of Malaysia, Pahang, Institution open access Journal (2010).
- [19] Freire M.N., and Holanda J. N. F. "Characterization of avian Egg shell waste aiming its use in a ceramic wall tile paste," Journal of Ceramica, (2006).
- [20] Amu O.O., Fajobi A.B., and Oke B.O. "Effect of Egg shell Powder on the Stabilizing Potential of Lime on an Expansive Clay Soil," Research Journal of Agriculture and Biological Science, (2005).
- [21] "Experimental study on properties of plaster with replacement of cement by cow dung and fly ash." Technix International Journal for Engineering Research (TIJER), (2022).
- [22] A review of "experimental study on properties of plaster with replacement of cement by cow dung and fly ash." Technix International Journal for Engineering Research (TIJER), (2022).
- [23] "Spot Speed Survey of Maharashtra State Highway and National Highway." International Journal of Innovative Research in Science, Engineering and Technology, (2022).
- [24] A Review on "Spot Speed Survey of Maharashtra State Highway (SH-264) and National Highway (NH-44)." International Journal of Advanced Research in Science, Communication and Technology, (2022).
- [25] A review on "study and analysis on concrete strength parameter using red mud as a partial replacement of cement with and without hydrated lime." International Conference on Advancement and Innovation in Civil Engineering, (2021).
- [26] "Study and analysis on concrete strength parameter using red mud as a partial replacement of cement with and without hydrated lime." International Research Journal of Mordenization In Engineering Technology and Science, (2021).
- [27] A review on "study of concrete strength parameter using red mud as a partial replacement of cement with fly ash." International Journal of Advance Research and Innovation Ideas in Education, (2021).
- [28] A review on "study of concrete strength parameter using red mud as a partial replacement of cement with hydrated lime." International Journal of Advance Research and Innovation Ideas in Education, (2021).
- [29] "Study of concrete strength parameter using red mud as a partial replacement of cement with hydrated lime." International Journal of Innovation Research in Technology, (2021).
- [30] "Study of concrete strength parameter using red mud as a partial replacement of cement with fly ash." International Journal of Innovation Research in Technology, (2021).