A Review And Taxonomy on Effect of Glass Powder, Pond Ash & Recycled Aggregate on The Strength of Concrete

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Abstract- *It has been estimated that several million tons of waste glasses are generated annually worldwide. The key sources of waste glasses are waste containers, window glasses, window screen, medicinal bottles, liquor bottles, tube lights, bulbs, electronic equipments etc. Only a part of this waste glass can be used in recycling. The remaining waste glass cannot be used for any purposes. But recently the research has shown that the waste glass can be effectively used in concrete either as glass aggregate (as fine aggregate or as coarse aggregate) or as a glass pozzolana. The waste glass when grounded to a very fine powder shows some pozzolanic properties. Therefore the glass powder to some extent can replace the cement and contribute for the strength development.*

In a growing country like India a huge amount of industrial waste are polluting the environmental. With a view to the above, this study aims at utilization of such industrial by product for value added application. In addition the waste can improve the properties of construction materials. The recycled glass has been used in the form of powder. The glass powder was tested with concrete and mortar. Cement was replaced by the glass powder in the proportion of 5%, 10%, 15%, 20% and 25% . The flexural strength were conducted for the above replacements.

I. INTRODUCTION

Concrete is a most widely used construction material today. Flexibility, moulding ability of concrete material, its high compressive strength and the steel reinforcing and pre-stressing technique in concrete facilitates to improve its strength as against its low tensile strength property and contributed largely for its wide spread use.

The following factors contribute to the production of good quality of concrete.

- Type and quality of its component materials Based on exposure of concrete to atmosphere, temperature, rain, sea water select w/c ratio
- Water content in the mix.
- Curing time and placing time of concrete
- Method of compaction of concrete
- Ratio of cement :sand: coarse aggregate: water as per design of the mix
- Temperature maintained during pouring and compaction.
- Competent direction and supervision.

Many researchers are made their efforts into the use of Waste Materials like Pulverized fly Ash (PFA) and ground granulated blast furnace slag (GGBS), there are many waste materials that can be used in the replacement of concrete, Pond Ash and Glass Powder are also waste materials in which Pond Ash is collected from thermal power plant and Glass Powder is collected from glass manufacturing.

Growing concern about global environmental impact in last few decades is forcing Civil Engineers and construction industry to review the conventional method of producing cement and concrete and replace them with a new sustainable alternative. Sustainable construction is in a large part is implemented by recycling secondary materials and adapting them for use in concrete. Green concrete, industrial waste and by products in concrete, will lead us to green environment. The most commonly used Industrial waste materials to replace sand and aggregate in concrete are Fly Ash, Rice Husk Ash, Sugar Cane Bass age Ash, Foundry Sand, Blast Furnace Slag, Hypo Sludge, Red Mud and Phosphor, Gypsum, Silica Fume, Crushed glass and Pond Ash.

II. OBJECTIVES

The research work has the following objectives-

1. To determine the best combination of Glass Powder, Pond Ash and Recycled Aggregate by partial replacement of Cement, Sand and Aggregate content respectively in concrete that gives high compressive strength.
2. To determine the best combination of Glass Powder, Pond Ash and Recycled Aggregate by partial replacement of Cement, Sand and Aggregate content respectively in concrete that gives high flexural strength.
3. Cost compression between controlled concrete & modified concrete.
4. Utilization of Industrial waste in a useful manner and protect the environment by the use of industrial waste.
5. To provide economical construction material.

III. LITERATURE SURVEY

Elaqra, H. A., Haloub, M. A. A., & Rustom, R. N. (2019) - This study investigates the effects of using local wastes of Glass Powder (produced from crushing the glass waste) as replacement of cement in fresh and hardened concrete. Four percentages of Glass Powder (GP) were used: 0%, 10%, 20%, and 30%. Two mixing methods were used in the study. First, the conventional mixing method, where the glass powder was added with the cement and aggregates. Second, the glass powder was dissolved in water before adding it to cement and aggregates. The slump increased as the glass powder replacement increased in the concrete due to the presence of more free water in the structure, which leaded to have lower density and higher water absorption. As a result, the compressive strength of conventional mixes method decreased as the glass powder increased at early age. Later, after 90 days, the highest compressive strength was obtained for the 20% GP.

He, Z. H., Zhan, P. M., Du, S. G., Liu, B. J., & Yuan, W. B. (2019)- Glass powder (GP) is a solid waste with increasing reserves. GP can be used as a supplementary cementitious material (SCM) to produce concrete in order to effectively save resources and solve environmental pollution problems. The effect of GP to replace cement partially by weight on the compressive strength, elastic-modulus and creep of concrete has experimentally been studied, and the internal microstructure is also determined by mercury intrusion porosimetry, scanning electron microscope and nanoindentation.

The results show that the use of GP reduces the compressive strengths and elastic modulus at the early ages, but the use of GP content less than 20% increases the compressive strengths and elastic modulus at the later ages. The use of GP content less than 20% can obviously reduce the creep and the use of 20% GP content seems to be the best in terms of the reduction of the creep. The use of GP with the appropriate content can effectively improve the internal microstructure of concrete and increase the content of high density calcium silicate hydrate at the later ages which is helpful in reducing the creep. This may be attributed to the pozzolanic reaction and micro filler effect of GP.

Hama, S. M., Mahmoud, A. S., & Yassen, M. M. (2019) - Most of the previous studies on the usage of WG as powder tackled the mechanical properties, but the current work focuses on the structural performance of reinforced concrete (RC) beams incorporating WG powder. This research investigates the effect when WG powder is used as a replacement in the following cement weight percentages: 0% (reference), 10%, and 15%. Similarly, the structural behavior of RC beams containing WG powder was examined. Nines beams (dimension: 150 mm width, 150 mm depth, and 900 mm span length) were used in this study. In addition to the effect of glass powder on flexural behavior, two other parameters were considered: the influence of longitudinal steel reinforcement (2Ø8 mm, $\rho = 0.0049$; 2Ø12 mm, $\rho = 0.013785$) on rebar and the spacing between transverse reinforcement (stirrups; 65 and 170 mm). Beams containing WG powder showed good resistance and satisfactory flexural performance compared with reference beams.

Lee, H., Hanif, A., Usman, M., Sim, J., & Oh, H. (2018)- The purport of this study is to efficiently recycle waste glass, one of silica-based industrial by-products, and use it as a cement substitute for sustainable construction. Waste glass powder (WGP) and waste glass sludge (WGS) were manufactured from the waste glass and their feasibility, for use in concrete as partial replacement of cement, was evaluated. 20% of cement (by weight) was replaced with WGP and WGS and the resulting concretes were tested for mechanical properties and durability. Porosity and phase identification studies were also carried out.

IV. CONCLUSION

Literary sources provide no information about chemical influence of Glass Powder, Pond Ash& Recycled Aggregate on the process of hardening, especially in its early pre-induction hydration period – the duration which

considerably conditions the cement stone structure formation and its properties. It is well known that glass is a material with an amorphous structure, characterized by a large supply of free energy.

Glass Powder, Pond Ash & Recycled Aggregate withstand under any aggressive environment and climatic conditions because of balanced combined physical and chemical properties. In this project flexural strength & cost of modified concrete and controlled concrete is compared.

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