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Cement Concrete using Industrial Waste (Glass Powder): A Review

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Abstract - *Production of cement used in concrete is one of the main problems targeted by the industry and academic research institutes, first to protect the environment from CO2 released in the atmosphere by the intensive production of cement to satisfy the increasing demand of this binder over time, on second hand to improve its properties to better meet the new obligations of quality and performance. The environmental and economic obligations imposed in this century, a sincere revision of the methods and materials used in construction has become paramount. In this perspective, the production of cement used in concrete is one of the main problems targeted by the industry and academic research institutes, first to protect the environment from CO2 released in the atmosphere by the intensive production of cement to satisfy the increasing demand of this binder over time, on second hand to improve its properties to better meet the new obligations of quality and performance. On another stage the glass waste began imposing wide discussions on the feasibility and the efficiency of its recycling because this material is non-degradable and possesses very good physical, mechanical, thermal and mineralogical properties which make it possible to be used in large field of production. The way this work is conducted aims to review new scientific approaches of all previous researches.*

Key Words Glass powder, plain concrete, mechanical strength, compressive strength, flexural strength and split tensile strength..

1. INTRODUCTION

Concrete is most widely used construction materials in the world. Due to global warming, the need to cut down energy consumption has increased. The effect of global warming has impacted everyone on the planet and is a well recognized concept. High levels of energy are needed to produce cement, which releases large amounts of carbon dioxide (CO2) and also contributes to the green house gases. Concrete is a construction material composed of Cement, fine aggregate, coarse aggregate, and water with or without admixtures. The concrete industry is one of the heaviest consumers of natural resources due to which sustainability of concrete industry is under threat. The environmental and economic concern is the greatest challenge the concrete industry is confronting. Cement manufacturing industry is one of the carbon dioxide emitting sources besides deforestation and the combustion of fossil fuels. The production of Portland cement, an essential ingredient of concrete, leads to the release of significant amounts of CO2, a greenhouse gas; one ton of Portland cement clinker production is supposed to produce approximately one ton of CO2 and other greenhouse gases. Decomposition of industrial waste is among big problems every country is facing these days. Use of recycled materials in construction is the most convenient option because of the large quantity and due to widespread sites of construction.

2. EARLIER INVESTGATION & SCOPE OF THE STUDY

Today, world faces a serious problem of disposal of large quantities of industrial waste. The disposal of these wastes without proper attention creates hazardous impact on environmental health as the landfills are increasing due to tonnes of industrial. waste disposal. So industrial waste (Glass powder used for various constrution work) is revwewed here, as the addition with cement in concrete it helps to reduce the quantity of industrial waste.

The scope of glass powder as industrial waste can be effective material to enhance concrete strength which will not only explore a way to improve the properties of concrete. It will also explore the use of wastes and restrict the use of conventional material which is environmentally detrimental.

3. NOTEWORTHY CONTRIBUTIONS IN THE FIELD OF CONCRETE USING GlASS POWDER

The brief literature reviews of the latest studies are as follows.

Bui Le Anh Tuan (May 2019) Researched on high strength concretes (HSC) containing manufactured sand (or maybe called crushed sand) as fine aggregate in the presence of fly ash (FA), silica fume (SF) were made. The HSC mixtures were designed to achieve 28-day compressive strength beyond 55 MPa. Compressive strength, drying shrinkage, and sulfate attack tests were conducted to evaluate the feasibility on the production of HSC having crushed sand, FA and SF. The test results indicated that the compressive strength of all HSC mixtures exceeded 55MPa at 28 days. There was an improvement in the compressive strength following the addition of SF in HSC.

Sasikumar & Tamilvanam (2016) performed an experiment investigation on properties of glass powder as a partial replacement of cement. Main parameter investigated in this study is M30 grade concrete with partial replacement of cement by glass powder 0%, 5%, 10%, 20%, 25%.the optimum 7 and 28 days compressive strength has been obtained in the 25% glass powder replacement level.

Keryou and Ibrahim (2016) confirmed a reduction of water requirement as the glass powder content increases and an improvement of compressive strength at the early age followed by a decrease with the age of curing due to the Alkali-Silica Reaction.

Kumar & Dhaka (2016) write a review paper on partial replacement of cement with glass powder and its effect on concrete properties the main parameter investigated in this study M35 concrete with partial replacement of glass powder with varying 0,5, 10, 15, 20, 25% by weight of cement. The paper presents a detailed study on compressive strength, flexural strength and split tensile strength for 7 days and 28 days respectively.

Anwar (2016) used the waste glass powder as replacement of cement in the mix proportion; the waste glass powder was varied in fraction from 0 to 50% per increment of 5% by weight of concrete. Concrete was tested on compression, split and flexure strength, and an appreciable increase in strength was observed with the increase in percentage replacement of cement by glass powder from 5 to 15%. The author estimated that the strength increase has taken place after 28 days be- cause of pozzolanic action of glass powder; however, there was no explanation for the considerable decrease of strength from rate 20 to 50%.

Jain & pawade (2015) studied the characteristics of glass powder concrete. The physical properties of high strength glass powder concrete and their sensitivity of curing procedures were reference Portland cement concrete, having their the same concrete content as the glass powder concrete.

Bhat and Bhavanishankar Rao (2014) concluded that an increase of 27% compressive strength could be achieved when 20% cement was replaced by glass powder in concrete if W/C ratio wasn't maintained, but the results showed a decrease of compressive strength when W/C ratio was maintained.

Raju and Kumar (2014) have conducted a similar study using the glass powder as replacement of cement in the range of 5 to 40% by increment of 5%. Concrete was tested for compressive strength and flexural strength. The results showed that with the increase of glass powder up to 20% strength increases and beyond that it decreases. They interpreted this improvement by the pozzolanic reaction and the increase of concrete's density by the filling of powder in void, while authors didn't give an explanation to results beyond 20% glass powder. Test also showed a decrease on workability as the glass powder increases, this phenomena was interpreted by the reduction in modulus of cementitious material needed for providing a lubricating effect per unit surface area of aggregate, so they used a super plasticizer to maintain workability with restricted water cement ratio. These results are also not far from those of Jangid and Saoji (2014).

Shekhawat and Aggarwal (2014), Gunalaan and Kanapathy Pillary (2013), found that the workability is reduced with the rate of cement replacement, and explained this reduction by the increase in the surface area of the glass powder and also the angular shape of the glass particles.

Er. Manoj Kumar Meena, Er. Jagriti Gupta, Dr. Bharat Nagar (2012) The main parameter investigated in this study is M35 grade concrete with partial replacement of cement by glass powder by 0, 10, 15,20and25%. This paper presents a detailed experimental study on Compressive strength, split tensile strength, flexural strength at age of 7 and 28 day. Test results indicate that use of Glass powder in concrete has improved the performance of concrete in strength.

Sharma & Seema (2012) examined the effect of partial replacement of cement with glass powder on compressive strength of concrete with w/c ratio as 0.5 and percentage replacement was 0%,10%, 15%,20%,25%. The optimum compressive strength is obtained at 20% cement replacement by a glass powder at all levels.

Carles Gibergues, Cyr, Moisson, & Ringot, 2008; Cyr, Rivard, & Labrecque, 2009 Concluded that the pozzolanic activity is usually related to fine particles where the silica is released after the destruction of the silica network by the hydroxide ions, combines with calcium from Portlandite to form C-(N,K)-S-H which improve concrete properties also Pereira de Oliveira, Castro Gomes, and Santos (2012) reported that the glass powders fineness is a fundamental parameter in the glass pozzolan's production to increase their potential reactivity.

Shao, Lefort, Moras, & Rodriguez, 2000; Shayan & Xu, 2006 concluded that the alkali-silica reaction is usually associated with coarse particles containing amorphous silica where a destruction of the silica network occurs to release silica that combines with alkali and cal- cium to form N,K- (C)-S-H gels

which is causing expansion of the concrete. Diversity of results shown for the glass powder doesn't lead to a clear explanation of the glass effects on the concrete's behavior. To overcome this diversity and the difficulty of distinguishing between the effect of glass and the role of cement, a methodology was followed in this paper to investigate the underlying properties of glass powder to improve the workability of fresh concrete and its characteristics after hardening for short and long time.

4. CONCLUSION

The literature review presents the current state of knowledge cement concrete using glass powder on the basis of previous scientific research done. It can be can be concluded that glass powder in concrete if used in correct proportion and manner it is likely a viable option for structural use as it has advantages that construction is greener and environment friendly. Glass powder is an economical and eco-friendly easily available industrial waste to enhance the concrete property.

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