Experimental Investigation on Strength and Durability Parameters of Concrete Replacing Cement by Glass Powder in Concrete with Different Dosages for M25 and M30 Concrete

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***Abstract*— Concrete is commonly used as the main component in a building. Concrete is obtained by mixing Portland cement, water, aggregates, and sometimes added ingredients at certain comparisons in the form of chemicals, fibrous materials, and non-chemical materials. Utilization of glass powder waste for concrete mixtures is now being developed. This research is conducted to determine the optimum composition of glass powder as a partial replacement of sand against the compressive strength of concrete. The content of the glass powder mixture used is 10%, 20%, 30% & 40% of the weight of cement in the concrete mixture.**

This research focuses on studying the effect of waste glass on the properties of concrete mixture as a partial replacement of cement large studies undertaken to resolved the alkali silica reaction problems. Replacing cement by material like waste glass powder in concrete is increase the strength and introduces economy but also enhances the durability.

Keywords – Glass powder, Ordinary Portland Cement, Coarse aggregate & Fine aggregates

I. INTRODUCTION

Concrete is one of the world's most used construction material due to its versatility, durability and economy. India uses about 7.3 million cubic meters of ready-mixed concrete each year. It finds application in highways, streets, bridges, high-rise buildings, dams etc. Greenhouse gas like CO2 leads to global warming and it contributes to about 65% of global warming. The global cement industry emits about 7% of greenhouse gas to the atmosphere. To reduce this environmental impact alternative binders are introduced to make concrete.

Concrete is a blend of cement, sand, coarse aggregate and water. The key factor that adds value to concrete is that it can be designed to withstand harshest environments significant role.

Glass is an amorphous & transparent material, which is super-cooled liquid and not a solid. Glass can be made verity of forms and sizes from small fiber to meter-sizes pieces. Primarily glass is produced by melting a mixture of materials such as silica, CaCO3, and soda ash at high temperature followed by cooling during which solidification occurs without crystallization.

Glass Powder

- Glass is an amorphous (non-crystalline) that in essence, a super cooled liquid and not a solid. Glass can be made with excellent homogeneity in a variety of forms and sizes from small fibers to meter-sizes pieces.
- Primarily glass is made up of sand, soda ash, limestone and other additives (Iron, Chromium, Alumina, Lead and Cobalt).
- Glass has been used as aggregates in construction of road, building and masonry materials.

Source of Waste Glass

- Vehicles Auto Glass (Asahi Indian Glass Ltd.(AIS))
- Glass food and beverages container.
- Window repair shops
- Glass decorative items

- Old tube lights, electric bulbs
- Glass polishing and glass window and door manufacturing shop.

III. LITERATURE REVIEW

A. Recycled Glass as a Partial Replacement for Fine Aggregate In Self Compacting Concrete:

1. Esraa Emam Ali, Sherif H. Al-Tersawy 2012 Glass has been indispensable to man's life due to its properties, including pliability to take any shape with ease, bright surface, resistance to abrasion, reasonable safety and durability. Waste glass creates serious environmental problems, mainly due to the inconsistency of waste glass streams. With increasing environmental pressure to reduce solid waste and to recycle as much as possible, the concrete industry has adopted a number of methods to achieve this goal. Self-Compacting Concrete (SCC) may lead to evolution of a more quality controlled concrete, assuring a better workability and avoiding human errors with regard to mixing and workability issues. On the other hand, it resolves the problem of noise and vibration during installation.
2. High-volume natural volcanic pozzolan and limestone powder as partial replacements for portland cement in self-compacting and sustainable concrete.K. Celik , , M.D. Jackson, 2014 A laboratory study demonstrates that high volume, 45% by mass replacement of portland cement (OPC) with 30% finely-ground basaltic ash from Saudi Arabia (NP) and 15% limestone powder (LS) produces concrete with good workability, high 28-day compressive strength (39 MPa), excellent one year strength (57 MPa), and very high resistance to chloride penetration. Conventional OPC is produced by intergrading 95% portland clinker and 5% gypsum, and its clinker factor (CF) thus equals 0.95. With 30% NP and 15% LS portland clinker replacement, the CF of the blended ternary PC equals 0.52 so that 48% CO2 emissions could be avoided, while enhancing strength development and durability in the resulting self-compacting concrete (SCC).
3. Performance of dry cast concrete blocks containing waste glass powder or polyethylene aggregates S.E. Chidiac, , S.N. Mihaljevic 2011

Dry-cast concrete blocks are a popular building material; however, to improve the economic and environmental sustainability of this industry, its dependence on natural aggregate and Portland cement needs to be reduced. To further this goal, blocks with up to 25% of the cement replaced with waste glass powder (WGP) or up to 15% of the sand replaced with high density polyethylene (HDPE) or low density polyethylene (LDPE) polymer pellets were produced in an industrial plant. The physical, mechanical and durability properties of the individual blocks and the mechanical properties of the block assemblages were tested. Based on statistical analyses, the blocks with 10% WGP as cement replacement performed similarly to the

B. Recycled Glass Concrete K. Zheng 2013:
The chapter begins by introducing sources of waste glass and ways of recycling waste glass in concrete. It then summarizes fresh properties and mechanical properties of recycled glass concrete and discusses how recycled waste glass affects these properties. The chapter elaborates on durability of recycled glass concrete, especially on alkali-silica reactivity since this is the main concern for recycled glass concrete. Finally, the chapter presents suggestions for further studies on recycled glass concrete and proposes future trends of using recycled glass in concrete in more economic and eco-efficient.

C. Durability of Mortar Using Waste Glass Powder As Cement Replacement: Ana Mafalda Matos, Joana Sousa-Coutinho2012. It is well known that Portland cement production is an energy-intensive industry, being responsible for about 5% of the global anthropogenic carbon dioxide emissions worldwide. An important contribution to sustainability of concrete and cement industries consists of using pozzolanic additions, especially if obtained from waste such as waste glass. Crushed waste glass was ground (WGP) and used in mortar as a partial cement replacement (0%, 10% and 20%) material to ascertain applicability in concrete. An extensive experimental program was carried out including pozzolanic activity, setting time, soundness, specific gravity, chemical analyses, laser particle size distribution, X-ray diffraction and scanning electron microscopy (SEM) on WGP and resistance to alkali silica reaction (ASR), chloride ion penetration resistance, absorption by capillarity,

accelerated carbonation and external sulphate resistance on mortar containing WGP.Glass particles well encapsulated into dense and mature gel observed by SEM, may help explaining enhanced durability results and thus confirming that waste glass powder can further contribute to sustainability in construction

D. Shilpa Raju, Dr. P. R. Kumar presented the global warming is caused by the emission of greenhouse gases, such as CO2, to the atmosphere. Among the greenhouse gases, CO2contributes about 65% of global warming. The global cement industry contributes about 7% of greenhouse gas emission to the earth's atmosphere. Consequently, efforts have \been made in the concrete industry to use waste materials as partial replacement of coarse or fine aggregates and cement. Waste glass is one material when ground to a very fine powder shows pozzolanic properties which can be used as a partial replacement for cement in concrete. In this paper, an attempt has been made to find out the strength of concrete containing waste glass powder as a partial replacement of cement for concrete. Cement Replacement by glass powder in the range 5% to 40% increment of 5% has been studied. It was tested for compressive strength and flexural strength at the age of 7, 28 and 90 days and compared with those of conventional concrete. Results showed that replacement of 20% cement by glass powder was found to have higher strength. Also, alkalinity test was done to find out resistance to corrosion.

E. J.M. Khatib, E.M. Negim, H.S. Sohl and N. Chileshe were presented in this paper investigates the performance of concrete containing glass powderas partial substitution of cement. Portland cement (PC) was partially replaced with 0-40% glass powder. Testing included ultrasonic pulse velocity, compressive strength and absorption. Specimens were cured in water at 20°C. The results indicate that the maximum strength of concrete occurs at around 10% glass powder. Beyond 10% glass powder the strength of concrete reduces and is lower than that of the control Using ground glass powder can reduce the use of cement and the associated energy demand and impact on air pollution and CO2 emission. The slump of concrete seems to increase with the increase in glass powder in the concrete mix. At 10% glass powder content the compressive strength of concrete is higher than that of substantially decreases

F. Gunalaan Vasudevan, Seri Ganis Kanapathy pillay were presented in this study was conducted to investigate the effect of using waste glass powder in concrete. Laboratory work was conducted to determine the performance of control sample and concrete with used waste glass powder. The performance of these types of concrete was determined by the workability test, density test and compressive strength test. The workability of concrete is determined using slump test and compacting factor test. Meanwhile, compressive strength test is done to determine the strength of concrete. For each type of concrete, a total of six 150mm x 150mm x 150mm cubes were cast. The cubes were tested at the ages of 7, 14 and 28 days to study the development of compressive strength. The results indicate that the concrete with using waste glass powder were able to increase the workability of concrete and also the compressive strength. However, the density is reduced compared to standard mixture of concrete.

G. Dhanaraj mohan patil , Dr. Keshav , K. Sangle were explained the concrete is a construction material composed of cement, aggregates (fine and coarse aggregates) water and admixtures. Today many research are ongoing into the use of Portland cement replacements, using many waste materials like pulverized fly ash (PFA) and ground granulated blast furnace slag (GGBS). Like PFA and GGBS a waste glass powder (GLP) is also used as a binder with partial replacement of cement which take some part of reaction at the time of hydration, also it is act as a filler material. In this study, waste glass powders have been used as replacements to the concrete ingredient i.e. cement and the mechanical properties like compressive strength are measured. Also, we were studied the size effect of glass powder on strength of concrete. For checking strength effect of replacement of cement by glass powder, the cement is replaced at 10%, 20% and 30%. For study of size effect of glass powder the powder is divided in to two grades one is glass powder having size less than 90 micron and another is glass powder having particle size ranges from 90 micron to 150 micron. It is found from study; Initial strength gain is very less due to addition of GLP on 7th day but it increases on the 28th day. It is found

that 20% addition of GLP gives higher strength. And also GLP size less than 90 micron is very effective in enhancement of strength.

IV. CONCLUSION ON LITERATURE REVIEW

The cement is replaced at 10%, 20% ,30 and 40%. For study of size effect of glass powder the powder is divided in to two grades one is glass powder having size less than 90 micron and another is glass powder having particle size ranges from 90 micron to 150 micron. It is found from study; Initial strength gain is very less due to addition of GLP (good laboratory) on 7th day but it increases on the 28th day. It is found that 20% addition of GLP gives higher strength. And also GLP size less than 90 micron is very effective in enhancement of strength.

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