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EXPERIMENTAL INVESTIGATION ON PARTIAL REPLACEMENT OF CEMENT WITH ALKALI ACTIVATED GLASS POWDER

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Abstract - Efforts have been made in the concrete industry to use waste glass as partial replacement of coarse or fine aggregates and cement. In this project, finely powdered waste glasses are used as a partial replacement of cement in concrete and compared it with conventional concrete. This work extensive study the possibility of using Glass powder as a partial replacement of cement for new concrete. M30 grade was used. Glass powder was partially replaced as 15%, 20% and tested for its compressive, Tensile and flexural strength up to 28 days of curing and were compared with those of conventional concrete, it is found that glass powder can be used as cement replacement material upto particle size less than 75µm. The glass powder is mixed with NaOH solution and metakolin which tends to form gel like structure producing the binding property.

Keywords: Metakolin, NaOH solution, glass powder, split tensile strength, compressive strength.

1. Introduction

Concrete is the second largest material widely used. Cement industry emits 7% of greenhouse gases to the atmosphere. One ton of Carbon-di-oxide is released to the atmosphere for producing one-ton cement in industry. To reduce the emission the alternative materials to be used in concrete.

There are many alternatives like rice husk ash, fly ash, egg shell, glass powder. When we are going for an alternative in construction it should be economical and easily available. Glass is an amorphous material produced by melting a mixture of silica, soda ash, CaCO₃ at high temperature followed by cooling where the solidification occurs without crystallization process. Waste glass is being generated annually all over the world.

Once the glass becomes a waste it is disposed as landfills, which is unsustainable as this does not decompose in the environment. Glass is principally composed of silica. Use of milled (ground) waste glass in concrete as partial replacement of cement could be an important step toward development of sustainable infrastructure systems. When

waste glass is milled down to micro size particles, it is expected to undergo pozzolanic reactions with cement hydrates, forming secondary Calcium Silicate Hydrate (C-S-H). In this research chemical properties of both clear and coloured glass were evaluated. Chemical analysis of glass and cement samples was determined using different composition between clear and coloured glasses. Since the demand in the concrete manufacturing is increasing day by day, the utilization of river sand as fine aggregate leads to exploitation of natural resources, lowering of water table, sinking of the bridge piers, etc as a common treat. Attempts have been made in using crushed glass as fine aggregate in the replacement of river sand.

The crushed glass was also used as coarse aggregate in concrete production but due to its flat and elongated nature which enhances the decrease in the workability and attributed the drop in compressive strength. Glass is non-biodegradable material hence it is not suitable for landfill process. It is an inert material which could be recycled and used many times without changing their chemical properties.

In glass powder the main concern is alkali silica reaction, the chemical reaction takes place between silica rich glass particle and the alkali solution of concrete. Efforts have been made in the concrete industry to use waste glass as partial replacement of coarse or fine aggregates. However, due to the strong reaction between the alkali in cement and the reactive silica in glass, studies for use of glass in concrete as part of the coarse aggregate were not always satisfactory due to reduction and simultaneous excessive expansion.

Efforts have been made in the concrete industry to use waste glass powder as partial replacement of cement. Waste glass when ground to a very fine powder shows pozzolanic properties as it contains SiO₂ and therefore to some extent can replace cement in concrete and contribute in strength development. This paper reports the results of an experimental investigation on the use of glass powder in partially replacement cement in concrete applications and summarized the behavior of concrete.

1.1 Objective

The objective of the research is to study the effect of the use of „Glass Powder“ as a replacement of cement to assess the

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