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To Study on the Physical Properties of Latex Modified Self-Compacting Concrete (M-25) By Partial Replacement of Cement with Glass Powder: A Review

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Abstract: When the construction industry in Japan experienced a decline in the availability of skilled labour in the 1980s, a need was felt for a concrete that could overcome the problems of defective workmanship. This led to the development of self-compacting concrete. To improve the performance of SCC, polymers are mixed with SCC. It has been observed that polymer-modified self-compacting concrete (PMSCC) is more durable than conventional self-compacting concrete due to superior strength and high durability. In this research, effect of Styrene-Butadiene Rubber (SBR) latex on compressive strength and flexural strength of concrete has been studied and also the optimum polymer (SBR-Latex) content for concrete is calculated. In order to address environmental effects associated with cement manufacturing, there is a need to develop alternative binders to make concrete. Extensive research is going on to use of cement replacements, using many waste materials and industrial by products. Efforts have been made in the concrete industry to use waste glass powder as partial replacement of fine aggregates and cement. Glass is commonly used in building / construction industries and large amount of glass is powdered daily. The disposal of waste glass is an environmental issue as waste glass causes disposal problem. Glass powder finer than 600 μ is reported to have pozzolonic behaviour. This paper present literature review on replacement of Cement by Glass Powder in Latex Modified Self-Compacting Concrete which includes current and future trends of research.

Keywords: Self Compacting Concrete, Glass Powder, Compressive Strength.

INTRODUCTION

Self-compacting concrete (SCC) as the name suggest is the concrete which get compacted without vibration. The self-compacting concrete was developed in Japan in late 1980's. By the early 1990's Japan has developed and used SCC that does not required vibration to achieve full compaction. Because of its wide advantages by the year 2000, the SCC has become popular in Japan for prefabricated products and ready mixed concrete. Several European countries recognized the significance and potentials of SCC developed in Japan. During 1989, they founded European federation of natural trade associations representing producers and applicators of specialist building products (EFNARC). To call a SCC successful it must possess following properties:

- Have a fluidity that allows self-compaction without external energy.
- Remain homogeneous in a form during and after the placing process and
- Flow easily through reinforcement.

SBR latex is a carboxylated styrene butadiene copolymer latex admixture that is designed as an integral adhesive for cement bond coats, mortars and concrete to improve bond strength and chemical resistance. SBR is often used as part of cement based sub structural (basement) Waterproofing systems where as a liquid it is mixed with water to form the Gauging solution for mixing the powdered tanking material to a slurry. SBR aids the bond strength, reduces the potential for shrinkage and adds an element of flexibility, its offers better durability, reduced shrinkage and increased flexibility, as well as being resistant to emulsification in damp conditions. SBR is a mixture of approximately 75% butadiene (CH_2=CH-CH=CH_2) and 25% styrene (CH_2=CHC_6H_5).

ADVANTAGE OF SELF COMPACTING CONCRETE

- Improved quality of concrete and reduction of onsite repairs.
- Faster construction times.
- Lower overall costs.
- Facilitation of introduction of automation into concrete construction.
- Improvement of health and safety is also achieved through elimination of handling of vibrators.
- Substantial reduction of environmental noise loading on and around a site.
- Better surface finishes.
- Easier placing.
- Thinner concrete sections.
- Greater Freedom in Design.
- Improved durability, and reliability of concrete structures

GLASS POWDER

Glass is an amorphous solid that has been found in various forms for thousands of year and has been manufactured for human use since 1200 BC. Glass is one the most versatile substance on earth, used in many applications and in a wide variety of forms, from plain clears glass to tempered and tinted varieties, and so forth. After its usage it is generally dumped in landfills. Since glass is a non-biodegradable material, landfills do not provide a friendly environment. As glass powder with particle size less than 75µm possess pozzolanic properties, past investigation reveals that glass powder can be effectively use as partial replacement of cement.

EFFECT OF USING GLASS POWDER IN CONCRETE

WORKABILITY TEST

Shilpa Raju and Dr. P. R. Kumar [2014] concluded that as the percentage of glass powder increases the workability decreases. Use of super plasticizer was found to be necessary to maintain workability with restricted water cement ratio. **A Rajathi and G Portchejian [2014]** presented that the addition of glass powder in SCC mixes reduces the self-compatibility characteristics like filling ability, passing ability and segregation resistance. **Ismail Ansari and Sheetal sahare [2015]** investigated that the workability is found to be decreases in all types of concrete with increase in glass powder, this is due to the increase in the surface area of the glass powder and also the angular shape of the glass particles. **Gunalaan Vasudevan and Seri Ganis Kanapathy pillay [2013]** studied slump property in his research and resulted that compared to control mix, by using waste glass powder will give another benefit which is the workability of concrete which is much higher. **Aniket S. Aphale and sheetal. A.Sahare [2016]** concluded that that increase in glass content as cement replacement material decreases the workability of concrete. **Jangid Jitendra B. and Saoji**
A.C. [2012] resulted that the workability decreases as the percentage glass powder in the mix increases. **Rakesh sakale et al. [2015]** analysed that the workability of concrete reduces monotonically as the replacement percentage of cement by glass powder increases. **Er. Kapil Soni and Dr. Y.P Joshi [2014]** concluded that by the addition of SBR latex, there is an increase in the workability of concrete as the polymer content increased and the presence of SBR-Latex is proved to be effective to reduce the ingress of water in concrete.

COMPRESSIVE STRENGTH

Many works have been done to explore the benefits of using waste glass powder in making and enhancing the properties of concrete. **. Vijayakumar G et al. [2013]** founded that replacement of glass powder in cement by 20%, 30% and 40% increases the compressive strength by 19.6%, 25.3% and 33.7% respectively. **A Rajathi and G Portchejian [2014]** concluded that the compressive strength decreases with even increase in glass powder contents. The average reduction in compressive strength for the grade was around 6%, 15% and 20% for glass powder contents of 5%, 10% and 15%, respectively. **Rakesh sakale et al. [2015]** studied that cement in concrete is replaced by waste glass powder in steps of 10% 20%, 30%& 40% respectively by volume of cement and the compressive strengths of concrete increase initially as the replacement percentage of cement by glass powder increases become maximum at about 20% and later decrease. **Gunalaan Vasudevan and Seri Ganis Kanapathy pillay [2013]** investigated the test results at 7, 14, 28 days of curing of specimens containing waste glass powder as partial replacement of cement and his results showed that the 20% glass powder mix amount shows a positive value of compressive strength at 28 days compare to other ratio which 10% and 15% is not achievable even though have slight increment from 14 days results. **. Shilpa Raju and Dr. P. R. Kumar [2014]** concluded that as the percentage of glass powder increases up to 20% the compressive strength increases and beyond 20% strength decreases. **Mayur B. Vanjare and Shriram H. Mahure [2012]** investigated that compressive strength decreases with even increase in glass powder contents, the average reduction in compressive strength for all grades was around 6%, 15% and 20% for glass powder contents of 5%, 10% and 15% respectively. **Ahmad Shayan [2002]** concluded that 30% GLP could be incorporated as cement or aggregate replacement in concrete without any long-term detrimental effects. Up to 50% of both fine and coarse aggregate could also be replaced in concrete of 32 MPa strength grade with acceptable strength development properties. **. Swarna Dubey et al. [2016]** they concluded that 15% replacement of cement by waste

glass showed a 15 % increase in compressive strength at 7 days and 25% raise in compressive strength at 28 days. **Jangid Jitendra B. and Saoji A.C. [2012]** concluded that the upto 40% replacement of cement, compressive strength increase upto 20% and cement replaced beyond which decreases compressive strength.**Ms. Karthika Kishore Koka et al. [2014]** founded that addition of latex helps in achieving the highest values for 7 days testing of specimens for compression, so it can be said that, latex helps in increasing the early strength of concrete. **Dhanraj Mohan Patil and Dr.Sangle Kehav K. [2013]** studied the test results of waste glass powder particles ranging from size 150µm to 90µm and less than 90µm. He showed that 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.

FLEXURAL STRENGTH

Vijayakumar. G et al [2013] showed that flexural strength increment is achieved upto 40% replacement of cement by waste glass powder. **Jitendra B. and Saoji A.C. [2012]** in their work proposed that flexural strength increases upto 35% replacement of cement by waste glass powder as compared to control mix and the peak % increment is at 20%, beyond which it decreases. **Mayur B. Vanjare and Shriram H. Mahure [2012]** presented that the flexural strengths of the mixes were observed to decrease with increase in glass powder contents. The average reduction in flexural strengths for all grades was around 2%, 3.7% and 6.75% for glass powder contents of 5%, 10% and 15% respectively. **Shilpa Raju and Dr. P. R. Kumar [2014]** flexural strength increases with increase in percentage of glass powder up to 20% replacement and beyond 20% strength drops down. **. Sameer Shaikh et al. [2015],** analysed that replacement of glass powder in cement by 5%, 10%, 15% and 20% increases the flexural strength after 28 days by 5.88%, 30% and 44.85%, and 13.97% respectively. **Ms. Karthika Kishore Koka et al. [2014]** founded that addition of latex helps in achieving the highest values for 7 days testing of specimens for flexural, so it can be said that, latex helps in increasing the early strength of concrete.

SPLIT TENSILE STRENGTH

Aniket S. Aphale and sheetal. A.Sahare [2016] showed that. Recycled glass can be incorporated as cement replacement up to 20%, further increment will decrease the compressive strength, flexural strength and split tensile strength. **Sameer Shaikh et al. [2015]** presented that glass powder concrete increases the split tensile strength effectively at 15% combine replacement when compared with conventional concrete. **Mohammad Shoeb Sayeeduddin and Mr.F.I.Chavan [2016]** concluded that as the percentage of replacement of cement with glass powder increases strength increases up to 20% and beyond that it decreases. The highest percentage increases in the split tensile strength was about 18% at 20% replacement level. **Rakesh sakale et al. [2015**] showed that founded that cement in concrete is replaced by waste glass powder in steps of 10% 20%, 30%& 40% respectively by volume of cement and the split tensile strengths of concrete increase initially as the replacement percentage of cement by glass powder increases become maximum at about 20% and later decrease. **Vijayakumar G. et al [2013]** studied that the glass powder concrete increases the tensile strength effectively when compared with conventional concrete. **Folic R.J. et. al [1998]**, in their study on the "Experiment Research on Polymer Modified Concrete". He tested concretes modified with 2.5%, 5% and 7.5% of polymer (Latex) admixture to the cement. The test results showed that the water

absorption decrease with the increase of polymer - cement ratio. Although it was in the case of capillary water absorption, such a positive change is important as it influences the increase of concrete durability.

CONCLUSION

From the previous studies it can be concluded that latex helps in increasing the early strength of concrete. Latex Modified Concrete overlay for the purpose of protecting the underlying structural concrete from the deterioration caused by absorption of vehicular chemicals, dicing salts and water. On the other hand Self-compacting concrete is a type of concrete that gets under its self-weight. Which can placed and compacted in to every corner of a formwork; purely means of its self-weight by eliminating the need of either external energy input from vibrators or any type of compacting effort. Latex improves the self-compacting properties of concrete in addition it increases the early strength and minimizes the crack. So the present study focus on use of latex in self-compacting concrete with partial replacement of cement by glass powder

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