



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

IJIRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 11, Issue 2, February 2022

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 7.569

9940 572 462

6381 907 438

ijirset@gmail.com

www.ijirset.com



Experimental Investigation on the Behaviour of Styrene Acrylic Polymer Concrete

Infant Kishore G¹, Vetri Selvi P², Mohan Das Gandhi A³

II Year M.E (Structural), RVS Technical Campus, Coimbatore, Tamil Nadu, India ¹

Assistant Professor, Department of Civil Engineering, RVS Technical Campus, Coimbatore, Tamil Nadu, India ²

Head of the Department, Department of Civil Engineering, RVS Technical Campus, Coimbatore, Tamil Nadu, India ³

ABSTRACT: This paper describes how the properties of plain cement concrete can be improved by making use of epoxy styrene acrylic polymer. Most of the water based polymer systems re-emulsify in alkaline conditions. To overcome this problem an epoxy emulsion based polymer system is developed. The process allows building up of composite polymer cement microstructures on a nanoscale, which can avoid the negative influences of the polymer – admixture-cement interactions on shape and distribution of the cement hydrate crystal and on the transition zones between cementitious binder matrix and aggregates. This modified cement concrete contains two types of binder: the system based on hydraulic cement and polymer system. Styrene acrylic polymer is added in different percentages to plain cement concrete and its optimum dosage with respect to flow and strength characteristics are found.

KEYWORDS: admixture-cement, epoxy styrene acrylic polymer, cement hydrate crystal

I. INTRODUCTION

In modern concrete construction and repair works the role of polymers is increasing day by day. Polymers are either incorporated in a cement aggregate mix or used as a single binder. The composites made by using polymer along with cement and aggregates are called polymer modified concrete. Polymer modified concrete composites are environment conscious and confirm to concerns of saving natural resources, the longevity of infrastructures and environmental protection.

The incorporation of polymers greatly improves strength, adhesion, resilience, impermeability, chemical resistance and durability properties of concrete. These properties make PMC a suitable material for making various structural and non-structural pre-cast products, repair of structural members, waterproofing, anticorrosive and decorative finishes, overlaying of pavements, bridges and industrial floors.

A number of thermoplastic or thermosetting polymers are used in modifying mortars and concrete. These are used in various forms like: liquid resins, latexes, re-dispersible powders and water-soluble homo-polymers or copolymers. The choice of the polymer depends upon the intended use, and requirement of performances like strength, durability and chemical resistance. Moreover, the polymer systems can also be modified by use of additives like surfactants, stabilizers, Anti-foaming agents and coloring pigments.

For making PMM, most of the researchers use latexes of a single or combinations of polymers like polyvinyl acetate, copolymers of vinyl acetate– ethylene, styrene–butadiene, styrene–acrylic, and acrylic. Latex can also be made by using epoxy resin, which comes under the non-re-emulsifiable category. The non-re-emulsifiable latexes are expected to have greater resistant to chemical, alkaline and humid environment. However, very little information is available on the use of epoxy emulsion in making PMM.

II. LITERATURE REVIEW

Pranab Ghosh et.al. (2011). Studied that styrene incorporation enhances the thermal stability of this acrylate copolymer used as performance additive in construction materials. It tends to increase the workability and inhibit water absorption in epoxy form. They have excellent bond strength, are not re-wettable, and have good water resistance characteristics. They also have the best UV resistance of any polymer and for this reason are best suited for decorative overlays. A minimum 10% addition of acrylic solids (by weight of cement) is required to produce a complete film in concrete. If the dosage is increased to 15%, good waterproof characteristics can be achieved; at 20%, maximum flexibility is obtained.



SalimaBoutt et.al. (2007). Studied the role of the different structural parameter of the latex on some properties of latex-modified mortars. The first part of the study showed that, independently of the particle surface charge density, sterically stabilised latexes remain stable for several hours in cement interstitial medium. This makes latex-modified mortars workable. It also appeared that in the conditions of the study ester linkages do not undergo hydrolysis and no evidence of a latex-cement interaction could be seen. Then, for a fraction of about 5 wt.-% of polymer with respect to the amount of cement, no significant influence of the presence of the latex was observed on the end-use properties of the mortars. However, it clearly appears that the use of a fraction of anionic stabiliser is highly detrimental to the paste workability, whereas this latter property is improved by the presence of non-ionic surfactant due to steric repulsion forces.

S. Straus et.al. (2009). Studied that styrene acrylic when used as an admixture by 5% wgt enhances the water resistivity and in uniform dispersion of the mix. Finally, the microstructure analysis confirms that the particles are homogeneously dispersed in the mineral matrix and that they remain smooth and spherical in the experimental conditions studied. These observations are consistent with the conclusions of the first part according to which the latexes remain stable during fresh mortar manipulation and no interaction takes place between polymer and mineral phases.

M.A. Islam, et.al. (2011). Studied that polymer concrete might initially seem a bit more expensive when compared to conventional materials because of the monetary cost per unit weight, it will appear extremely feasible when judged on its low maintenance requirements, its durability and other parameters. Polymer - modified concrete materials are a very promising group of new building materials. They possess remarkable potential due to a wide variety of interesting features, properties and applications. Such materials can respond to the many needs of current and future construction works. Structures in hostile environments, inaccessible for repair, or subject to impact, cyclic, or dynamic loading could benefit from PMC. Aging infrastructure can be repaired using PMC.

Muhammad Aamer et.al. (2011), Studied that the concrete-polymer composites with high performance, multifunctionality and sustainability are expected to become the promising construction materials in Japan in the 21st century. Recently, environment-conscious concrete-polymer composites are arduously developed for sustainable development in the construction industry. Many national and institutional standards for them have been published in Japan.

Sivakumar.M.V.N. (2010). Studied that the styrene acrylic polymer has shown its superiority over latex polymer because of its fine particle size and relatively less viscous. The important feature of this material is that a large proportion of the void volume is filled with polymer, which forms a continuous reinforcing network. The concrete structure may be impregnated to varying depths or in the surface layer only, depending on whether increased strength and/or durability is sought. This results in a remarkable improvement in tensile, compressive and flexural strength of polymer modified Portland cement concrete.

Joe Nasvik. (2012). Studied that the best adhesion to the base slab results when a bonding agent is first applied. This involves scrubbing or brushing a polymer into the surface. A preferred method is to scrub a mix of portland cement, polymer, and a small amount of silica sand into the surface. If you are not using a re-wettable polymer, the bond coat must not be allowed to dry before the overlay cement is applied, or else the polymers themselves become bond-breakers.

L.K. Aggarwal, et.al. (2007). Studied that the addition of polymer to cement mortar improves workability, increases flexural and compressive strengths, and decreases water absorption, carbonation and chloride ion penetration. However, at the same amount of polymer-cement ratio epoxy emulsion showed slightly better properties than acrylic emulsion. In addition, the epoxy emulsion based mortars have several advantages over solvent-based epoxy mortars. Thus, epoxy emulsion based mortar is a potential material that can be used for repair works in humid and industrial environments.

III. MATERIALS USED

The materials which used are,

- Cement
- Fine aggregate
- Coarse aggregate



- Styrene acrylic polymer

CEMENT

Portland pozzolana cement is manufactured by blending pozzolanic materials, OPC clinker, and gypsum either together or separately. Today Portland Pozzolana Cement is widely in demand for industrial and residential buildings, roads, dams, and machine foundations. Pozzolana is important ingredient in PPC which is commonly used in the form of

- Fly ash
- Volcanic ash
- Silica fumes
- Calcite clay

PPC resistant to harsh water attacks and prevents the formation of calcium hydroxide at the time of cement setting and hydration. It withstands aggressive gases, thermal cracking, etc. The BIS quality specifications for pozzolana materials used in PPC are mentioned below

- Fly ash-IS3812:1981
- Calcite clay-IS1344:1981

PPC is used in heavy load infrastructure and construction such as marine structures, hydraulic structures, mass concreting works, plastering, masonry mortars, and all the applications of ordinary Portland cement. Portland Pozzolana Cement is highly popular in India and with many plants setting up jetties for transportation, initial costs would gradually decrease as well.

WATER

It is the ingredient, which when mixed with cement, forms a paste that binds the aggregates together. The water causes the hardening of concrete through the process called hydration. Hydration is the chemical reaction in which the major compounds in cement form chemical bonds with water molecules to become hydrates or hydration products. The role of water is important because the water to cement ratio is the most critical factor in the production of "perfect" concrete. Too much water reduces concrete strength, while too little will make concrete unworkable.

Portable tap water available in the laboratory with pH value of 7 and conforming to the requirements

FINE AGGREGATES

Natural river sand with fraction passing through 2.36mm sieves was used and tested as per IS2386 (part 1)-1963. The fineness modulus of sand used is 2.04 with a specific gravity of 2.25

COARSE AGGREGATES

Cube specimens were cast for M20 control mix using coarse aggregate of maximum size is 20mm. The physical properties were tested as per IS2386 (part 1)-1963. The fineness modulus of coarse aggregate is 6.09 with a specific gravity of 2.68.

IV. CONCLUSIONS

The conclusions made from this project are:

- Air curing is to be done for polymer concrete.
- For styrene acrylic polymer concrete the optimum water cement ratio obtained was 0.35 which is within



the limits for polymerconcrete.

- The workability of styrene acrylic polymer concrete was good when compared with conventionalconcrete.
- An improvement in compressive strength is seen for every percentage of styrene acrylic polymers concrete. 15% seems optimum and maximum of 54% strength got increased in 15% of SAPconcrete.
- A marginal improvement of flexural strength has been achieved on addition of 10% of styrene acrylic polymer but no changes on 15% of styrene acrylic polymer concrete. Thus 10% of SAP concrete seems optimum for flexuralstrength.
- Improvement of tensile strength has been achieved and 15% is the optimum value where 40% of tensile strength has been increased.

REFERENCES

1. Agarwal .L.K, “Experimental research on polymer modified concrete in the commonwealth of independent states”2012
2. Chandra, S., and Ohama, Y., “Polymers in Concrete”1994
3. Dikeou, J. T., “Polymers in concrete: new construction achievements on the horizon”2001.
4. Geist, J. M., Amagna, S. V. and Mellor, B. B., “Improved Portland cement mortars with polyvinyl acetate emulsions” 1994.
5. Islam. M. A, Rahman. M. M and Ahmed. M. “Polymer-modified Concrete: World Experience and Potential for Bangladesh”.2011.
6. Joe Nasvik, “Compatibility of polyester-styrene polymer”2012
7. Muhammad Aamer and Yoshihiko Ohama. “Recent Status of Research and Development of Concrete-Polymer Composites in Japan”2010.
8. Ohama, Y. “Principle of latex modification and some typical properties of - latex modified mortars and concretes adhesion; binders (materials); bond (paste to aggregate); carbonation; chlorides; curing and diffusion”1987.
9. Ohama, Y., Demura, K., Hamatsu, M. and Kakegawa, M., “Properties of the polymer-modified mortars with styrene-butyl acrylate latexes with the monomer ratios”.1991.
10. Pranab Ghosh and Tapan Das, “Copolymer of Decyl acrylate and Styrene: Synthesis, Characterization and Viscometric Studies in Different Base stocks”.2011
11. SalimaBouttand Marie Irvoy. “Influence of Low Fractions of Styrene/Butyl Acrylate Polymer Latexes on Some Properties of Ordinary Portland Cement Mortars”2007
12. Sivakumar .M.V.N, “Effect of Polymer modification on mechanical and structural properties of concrete – An experimental investigation”2010
13. Solovjov, G. K., Trambovetsky, V. and Kruger, D., “Furan resin polymer concrete overlays and Portland cement concrete bridge decks”1990
14. Stauss . S, “Latex processes and potentialities”2007
15. Sujjavanich,S.andLundy,J.R.,“DevelopmentofStrengthandFractureProperties of Styrene-Butadiene Copolymer Latex-ModifiedConcrete”1998
16. Vipulanandan, C. and Dharmarajan,N. “Analysisof Fracture Parameters ofEpoxy-Polymer Concrete” 1989
17. Vipulanandian, C. and Paul, E., “Performance of epoxy and polyester polymer concrete”1990
18. Wahby, W. S., “History of polymer in concrete in Review”2003
19. You-Yun, W., “Research and application of polymer concrete”2008



**Impact Factor:
7.569**



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  ijirset@gmail.com



www.ijirset.com

Scan to save the contact details