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Durability of Styrene-Butadiene Latex Modified Cement Concrete

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Abstract - *Polymer Modified Concrete (P.M.C.) has been discovered to be more potent than conventional cement because of its excellent strength and raised perseverance, so to enhance the performance, certain polymers are blended in with concrete. The impact of Styrene Butadiene Rubber (S.B.R.) over the compressive strengths, tensile strengths and carbonation of cement has been examined in this investigation, and the ideal polymer content for concrete has additionally been resolved. This examination was attempted to decide the impacts of polymer expansion on compressive and tensile strengths utilizing concrete at nearby ambient temperature with a consistent water-cement proportion blend design. The mixes were prepared with a 0 %, 5 %, 10 %, 15 % and 20 % cement-latex ratio of Styrene-Butadiene Rubber. The fresh concrete slump test was performed while the compressive and tensile strengths were analyzed at various ages. S.B.R. latex has been appeared to have an unfavourable effect at an early age, even though applying S.B.R. latex to concrete at 28 days brings about improved compressive and tensile strength. However, In the current paper, workability, impact, carbonation and acid resistance tests are performed.*

Key Words: Carbonation, Impact Factor, Workability, Acid Test, Setting Time

1. INTRODUCTION

Latex is a polymer solution produced by polymerization of monomer emulsion and composed of 50 % solids by weight. The best examples of polymers commonly adopted as latex include styrene-butadiene, acrylic, polyvinyl acetate and natural rubber. Study on the impact on lightweight concrete of polymeric materials found that the flexural and tensile strengths could be increased by applying S.B.R. to concrete. [7]. Ukrainczyk and Rogina recommended that the ideal proportion of latex should be considered to increase the strength of the modified S.B.R. concrete [4]. Generally, latex-modified concrete was better performed than standard concrete against chloride and sulphate attack [6]. Barluengaa et al. found that in PMC, the compressive strength reduced while the water/cement ratio was constant [1]. During the analysis of the strength of the Polymer Concrete, the compressive strength enhanced while the tensile strength was comparatively stable, by increasing the quantity of epoxy-resin [5]. Concrete was commonly used in the past to strengthen mechanical properties, including styrene-butadiene rubber latex.

In the field of civil engineering, cement replacement as a binder is used to strengthen concrete tensile, bending, and compressive capabilities. S.B.R. is a white, dense liquid in appearance with 52.7 % water content, and it has strong viscosity [1,2]. In this current paper, workability, impact, carbonation and acid resistance tests are performed on latex modified concrete and is then compared with standard concrete.

2. MATERIALS USED

The concrete utilized was OPC Grade 43 manufactured by ACC Limited, which conforms to IS 8112:2013. The concrete is in a dry fine structure with great compound creations and actual qualities. Locally accessible waterway sand and squashed stones were utilized as fine aggregate and coarse aggregate. The property of the aggregate used is stated in Table 1.

Locally accessible S.B.R. latex was examined in this investigation, and the arrangement of the S.B.R. Latex utilized as the polymer is stated in Table 2.

Table -1: Properties of aggregate and cement

Property	Fine Aggregate	Coarse Aggregate
Specific Gravity	2.60	2.70
Water Absorption	1.50	0.50
Specific Gravity of Cement	3.15	

Table -2: Properties of Polymer Latex used

Properties	Specifications
Form	White Liquid
Density	1Kg/L at 25^0 C

3. METHODOLOGY

In the current findings, workability, impact, carbonation and acid resistance tests are performed. For the assessment of workability, the experimental design and evaluation protocol shall comply with IS 7320:1974.

3.1 Workability of Concrete

Workability of modified concrete is performed through a slump cone of 100mm upper diameter, 200mm lower diameter, and 300mm height to get its qualitative measurement.

3.2 Impact Test

In this test, both standard and latex modified concrete were put under an aggregate impact testing machine to get the impact factor.

3.3 Carbonation Test

One of the principal reasons for the corrosion of reinforcement is the carbonation of concrete. The carbonation rate depends on the concrete grade, concrete permeability, whether the concrete is protected or not, cover depth, time, etc. In this test rate of carbonation is measured and compared with standard OPC grade cement.

3.4 Acid Resistance Test

In this, test specimens are cured and immersed in a solution containing hydrochloric acid. Care was taken to maintain a 5% concentration of the acidity

4. RESULT AND DISCUSSION

4.1 Workability Test

Workability of modified concrete is performed through a slump cone to get its qualitative measurement as is shown in Fig -1.

Fig -1: Slump Test

Table -3: Slump Test for workability

Sr. No.	Sample Name	Slump Value (mm)
1	L0	10
2	L5	25
3	L10	38
4	L15	54
5	L20	78

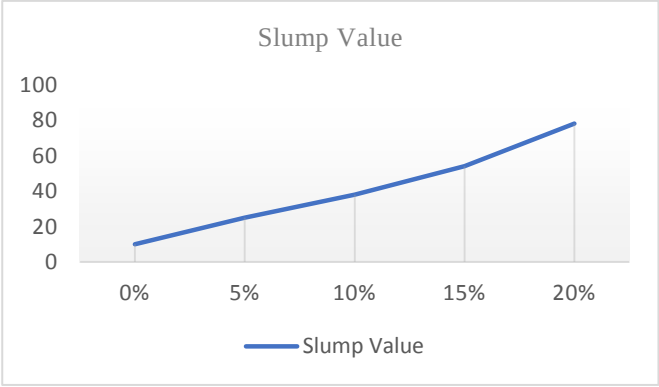

Chart -1: Slump Value Comparison

4.2 Impact Test

In this test, both standard and latex modified concrete were put under an aggregate impact testing machine to get the impact factor.

Table -4: Impact Test Results

Sample	Value
Standard Concrete	0.85
Latex Modified Concrete	0.20

4.3 Carbonation

In the concrete pore fluid, the dissolution of CO_2 results in carbonation that combines with calcium silicate and calcium hydroxide to form calcite. In this test, the liquid phenolphthalein indicator is put on a polymer concrete's cracked surface to detect the carbonation process.

The carbonation process is high in conventional concrete compared to Latex Modified Concrete from the findings. The disappearance of the pink colour indicates the dissolution of CO_2 into the specific specimen

4.4 Acid Resistance Test

The following observations were drawn from the test performed.

Table -5: Acid Resistance Test Results

Characteristics	Remarks
Physical Appearance	Surface turned dark
Weight	Decreased by 156 gm
Edge Deterioration	No
Efflorescence	Some oxide formation on the surface

5. CONCLUSIONS

In light of the outcomes and perceptions made in this test study, the accompanying ends are drawn:

1. The workability of modified concrete is increasing with the introduction of S.B.R. latex as the polymer proportion increases.
2. Modified concrete's impact value was found to be very low (0.20) compared to traditional concrete (0.85).
3. The carbonation process is high in conventional concrete compared to Latex Modified Concrete from the findings.
4. Latex modified concrete has better acid resistance properties as compared to conventional concrete. Hence, it can be used for areas exposed to acid rains.

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