

Concrete Using SBR Latex Polymer: Enhancing Durability and Performance

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Abstract—Styrene-Butadiene Rubber (SBR) latex polymer has emerged as a significant additive in concrete technology, offering improvements in workability, mechanical strength, and durability. This paper explores the effects of incorporating SBR latex into concrete mixes, analyzing its impact on fresh and hardened properties, and discussing optimal usage levels for various applications.

Index Terms—Compressive strength, flexural strength, Latex Polymer, Split tensile strength, Styrene-Butadiene Rubber, SBR

I. INTRODUCTION

Concrete is the most widely used construction material globally, valued for its versatility and compressive strength. However, traditional concrete exhibits limitations such as low tensile strength, susceptibility to cracking, and permeability to aggressive agents. To address these issues, modifiers like polymers have been introduced. Among them, Styrene-Butadiene Rubber (SBR) latex has gained attention for its ability to enhance concrete properties, particularly in repair works and structures exposed to harsh environments.

II. MATERIALS AND METHODS

Incorporating SBR latex into concrete involves replacing a portion of the mixing water with the polymer emulsion. The typical dosage ranges from 5% to 20% by weight of cement. The mix design must account for the water content in the SBR latex to maintain the desired water-cement ratio. Standard mixing procedures are followed, ensuring uniform distribution of the polymer throughout the mix.

Table 1: Mix Proportions

S.No.	Specimen	Description	Grade of concrete	Mix Proportions	SBR polymer (%)
1	M0	POLYMER CONCRETE	M30	1:1.6:2.3	0
2	M1				5
3	M2				5
4	M3				5
5	M4				10
6	M5				10
7	M6				10
8	M7				15
9	M8				15
10	M9				15

III. EFFECTS ON FRESH CONCRETE PROPERTIES

A. Workability

The addition of SBR latex influences the workability of concrete. Studies have shown that increasing SBR content can lead to a reduction in slump, indicating decreased workability. This effect is attributed to the polymer's interaction with cement particles, which can increase cohesion and reduce flowability. Adjustments in mix design, such as the use of superplasticizers, may be necessary to achieve the desired workability levels.

B. Air Content

SBR latex can introduce additional air into the concrete mix, affecting density and strength. Proper control measures, including the use of defoaming agents, are essential to mitigate excessive air entrainment and maintain the structural integrity of the hardened concrete.

IV. RESULTS AND DISCUSSION

Table 2: Compressive Strength, Split Tensile Strength and Flexural Strength of various Concrete Mix

Mix ID	SBR Latex (% by cement)	Compressive Strength (MPa)	Split Tensile Strength (MPa)	Flexural Strength (MPa)
M0	0	28.4	2.4	4.3
M1	5	30	2.6	4.8
M2	5	30.1	2.4	4.6
M3	5	30.2	2.5	4.9
M4	10	32	2.9	5.3
M5	10	32.7	3.2	5.7
M6	10	34	3.1	5.5
M7	15	33.1	3.0	5.4
M8	15	30.8	2.7	5.0
M9	15	32	3.3	5.2

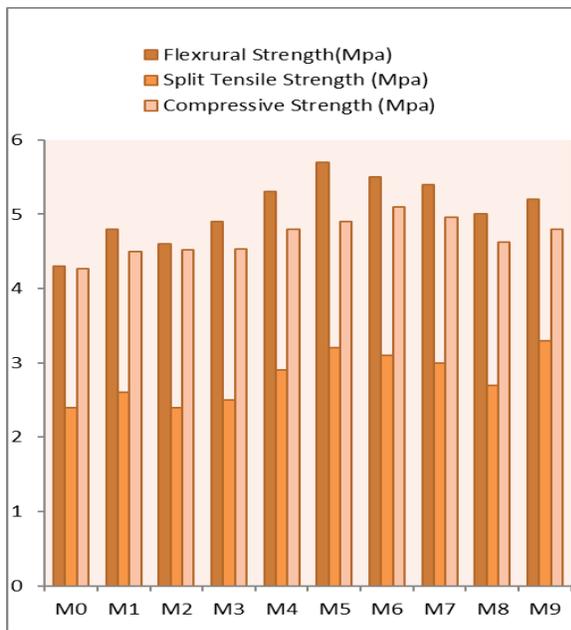


Figure 1: Graph representing the Strength Characteristics with various concrete Mix

Here is the graphical representation of the strength characteristics (compressive strength, split tensile strength, and flexural strength) of polymerized concrete with jute fiber and SBR latex for different mixes (M0 to M9). The plot shows how these strengths vary across the different mix ratios.

A. Compressive Strength

The impact of SBR latex on values of compressive strength varies with the number of dosages. At lower concentrations (up to 10%), SBR-modified concrete can exhibit enhanced compressive strength due to improved particle packing and reduced porosity. However, higher dosages may lead to strength reductions, possibly due to interference with cement hydration and increased air content.

B. Flexural and Tensile Strength

SBR latex significantly improves the flexural and tensile strength of concrete. The polymer forms a film within the cement matrix, bridging microcracks and enhancing ductility. This property is particularly beneficial in applications where resistance to bending and cracking is critical.

C. Durability

SBR-modified concrete demonstrates superior durability characteristics. The polymer reduces permeability, thereby enhancing resistance to water ingress, chloride penetration, and freeze-thaw cycles. These improvements may extend the structures service life, especially in aggressive environments.

V. OPTIMAL DOSAGE AND APPLICATIONS

Determining the optimal SBR latex dosage depends on the specific performance requirements of the concrete. For general improvements in strength and durability, a dosage of 10% by weight of cement is often effective. In repair mortars and overlays, higher dosages may be employed to maximize adhesion and flexibility. It's crucial to balance the benefits against potential drawbacks, such as reduced workability and increased cost.

VI. CONCLUSION

The integration of SBR latex polymer into concrete mixes offers substantial enhancements in mechanical properties and durability. While careful consideration of dosage and mix design is necessary to optimize performance, the benefits of SBR-modified concrete make it a valuable option in modern construction practices, particularly for structures requiring improved resilience and longevity.

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