ABSTRACT

Concrete is a widely utilized construction material that has been in use for centuries. However, growing environmental concerns have prompted the need for reducing clinker usage in the construction industry. This can be achieved through the use of supplementary cementitious materials, known as mineral admixtures, in concrete production. When introduced into the cement system, mineral admixtures such as micro silica, fly ash, and slag react with calcium hydroxide to form calcium-silicate-hydrate gel, thereby enhancing the strength and reducing the permeability of concrete.

The present study aims to investigate the synergistic effect of combining mineral admixture with superplasticizer, which reduces cement consumption, carbon footprint, and industrial waste byproduct while preserving the desirable properties of concrete. Superplasticizer enhances the workability of concrete by reducing the water content in the mixture without compromising its strength. This study is significant because it explores the potential of mineral admixture and superplasticizer to contribute to the economy and sustainability of concrete production. The findings of this study will aid in developing more eco-friendly and cost-effective methods of producing concrete without compromising its quality. Thus, the use of mineral admixture along with superplasticizer can lead to an overall reduction in the environmental impact of concrete production

In the current study, total 32 mixes are prepared for 0.40, 0.45, 0.50, and 0.55 water-to-binder ratio, including 10% micro silica, 30% fly ash, and 50% GGBS, both with and without SP. The Marsh Cone test was performed on a cementitious paste slurry to determine the optimum dosage of an ether-based polycarboxylate superplasticizer for each water-to-binder (w/b) ratio. The test involves measuring the viscosity of the slurry by filling a cone-shaped container and recording the time it takes for the slurry to flow out of the cone.

The compressive, flexural and split tensile strength tests of the admixed concrete were found out, at the curing age of 7 days, 28 days and 90 days.

The results indicate that the combination of MS and SP was the most effective in increasing the maximum compressive strength of the concrete samples at all water-binder ratios, with an approximately 40% higher strength compared to the control concrete without SP. Additionally, the flexural strength was found to be 26% higher than the control concrete, while the splitting tensile strength was 14% higher than the control concrete. Furthermore, the results indicate that FA with SP also exhibited higher compressive strength, flexural strength, and splitting tensile strength compared to the control concrete without SP. However, GGBS with SP was found to have lower compressive strength, flexural strength, and splitting tensile strength compared to MS admixed with SP and FA admixed with SP. Nevertheless, GGBS with SP exhibited higher compressive strength, flexural strength, and splitting tensile strength than the control concrete with SP.

The durability of concrete received specific attention, and it was determined whether adding mineral admixture to concrete along with SP improved its durability features. It was discovered that adding Mineral additive to SP had greatly improved concrete's defenses against corrosion, acid attack, water permeability, and those that speed up carbonation curing (ACC)

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