Synthesis of Acrylic based Polycarboxylate Ether High Performance Superplasticizer with Hydroxy Terminated Poly (Ethylene Glycol) Side Chains and its Effects on Cement Hydration

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The challenges we face in the industry on a daily basis include achieving the required high workability and the ability to maintaining concrete in a workable state for a long period with a minimal amount of water. This study focused on the synthesis and characterization of high-performance superplasticizer for concrete admixtures, classified as high slump, longer retention type of polycarboxylate superplasticizers (PCEs) and investigates its effects on cement hydration. The synthesis process involves grafting poly (ethylene glycol) side chains onto the main backbone to enhance dispersibility and water reducing property. The superplasticizers were synthesized through free radical co-polymerization of acrylic acid, hydroxyl ethyl acrylate, and isopentenyl polyoxyethylene glycol ether (TPEG) monomer using Fenton's reagents as the catalyst. The molecular structure of the resulting product was characterized using proton nuclear magnetic resonance spectroscopy (^{1}H NMR), Fourier-transform infrared spectroscopy (FTIR), Gel Permeation Chromatography (GPC) and confirmed the occurrences of polymerization. The comb-type polymer structure provides high fluidity and notable retention properties for cement slurry. The characteristics of this superplasticizer vary in relation to the length of the main chain and side chains. The performance of the novel superplasticizer was evaluated systematically, demonstrating excellent dispersing effects and excellent slump performance. The assessment of hydration heat and setting time indicated that the synthesized polycarboxylate superplasticizer has the capability to delay the hydration process of cement. Subsequent strength tests conducted at 3, 7, and 28 days demonstrated an enhancement in the compressive strength of the concrete.

Keywords: Admixtures, Polycarboxylate Superplasticizers, Co-Polymerization, Dispersibility, Fluidity Retention

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