Enhancing Strength and Quantifying Sustainability of Building Blocks Manufactured by Geopolymerization	
Authors	**Khadija Mawra, Khuram Rashid, Muhammad Irfan-ul-Hassan, Idrees Zafar, Mounir Ltifi**
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Abstract: Enhancing the strength of fly ash (FA)-based geopolymer by increasing the alkaline activator content is a costly and unsustainable technique. Therefore, this work was designed to reduce the activator by employing the pressured catalysis (PC) technique, coupled with the use of minerals that have filler and occupying effects. The main objective was to enhance the strength of the mix with a lower alkaline-to-precursor (A/P) ratio and create a sustainable, load-bearing building block from it. Initially, the compressive strength of the FA-based geopolymer was investigated experimentally by varying sodium silicate to sodium hydroxide and A/P ratios with ambient and hot curing. Afterward, PC was applied to the optimized proportion of constituents, and a significant increase in strength (9.6 to 20.0 Mpa) was observed at a 0.25 A/P ratio. By adding clay and dune sand (DS), the compressive strength was 19.5 and 40.4 Mpa at an A/P of 0.25 and 0.16, respectively. The strength gain mechanism was evaluated at the molecular and micro levels by conducting FTIR and SEM analyses. The environmental and economic indices and strength indicated the high sustainability of DS-based geopolymers compared to analogous blocks. The environmental and economic benefits of 23.9% reduced CO2 emissions and 24.2% less cost were provided by the DS-based block compared to the FA–clay-based block. A DS-based geopolymer obtains strength at a low A/P due to its occupying effect and results in sustainable building blocks.