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Analysis of the Effect of Material Composition on the Mechanical Properties of Unfired *Self-Healing* Bricks Using the Taguchi Method

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Abstract

Unfired bricks are an alternative low-energy construction material developed to reduce the need for high-temperature firing in conventional brick production. However, eliminating the firing process may result in suboptimal mechanical properties, particularly compressive strength, thereby requiring appropriate control of material composition. This study aims to determine the optimal material composition and analyze the effects of clay, sand, and *Bacillus subtilis* on the compressive strength of unfired *self-healing* bricks. The study employs a *Design of Experiments* (DoE) approach using the Taguchi method through an *Orthogonal Array* (OA) L8 (2^3), consisting of three factors at two levels: clay at 1,400 gr and 1,600 gr, sand at 500 gr and 600 gr, and *Bacillus subtilis* at 144 ml and 168 ml.

The study produces eight experimental combinations that undergo a 28-day *curing* process before compressive strength testing. Evaluation is conducted using the *Signal-to-Noise Ratio* (S/N Ratio) with the *Larger the Better* (LTB) characteristic to determine the optimal material composition, while *Analysis of Variance* (ANOVA) is used to analyze the effects of each factor on compressive strength. The test results show that the highest compressive strength obtained is 0.989 MPa. The Taguchi optimization results provide a material composition that can serve as a basis for developing unfired *self-healing* bricks with improved compressive strength characteristics.

Keywords: ***Unfired Bricks*, *Bacillus Subtilis*, *Self-Healing*, *Compressive Strength*, *Taguchi Method*.**