



Study on mechanical properties and phase development of cements mixed with chemically doped calcine clays



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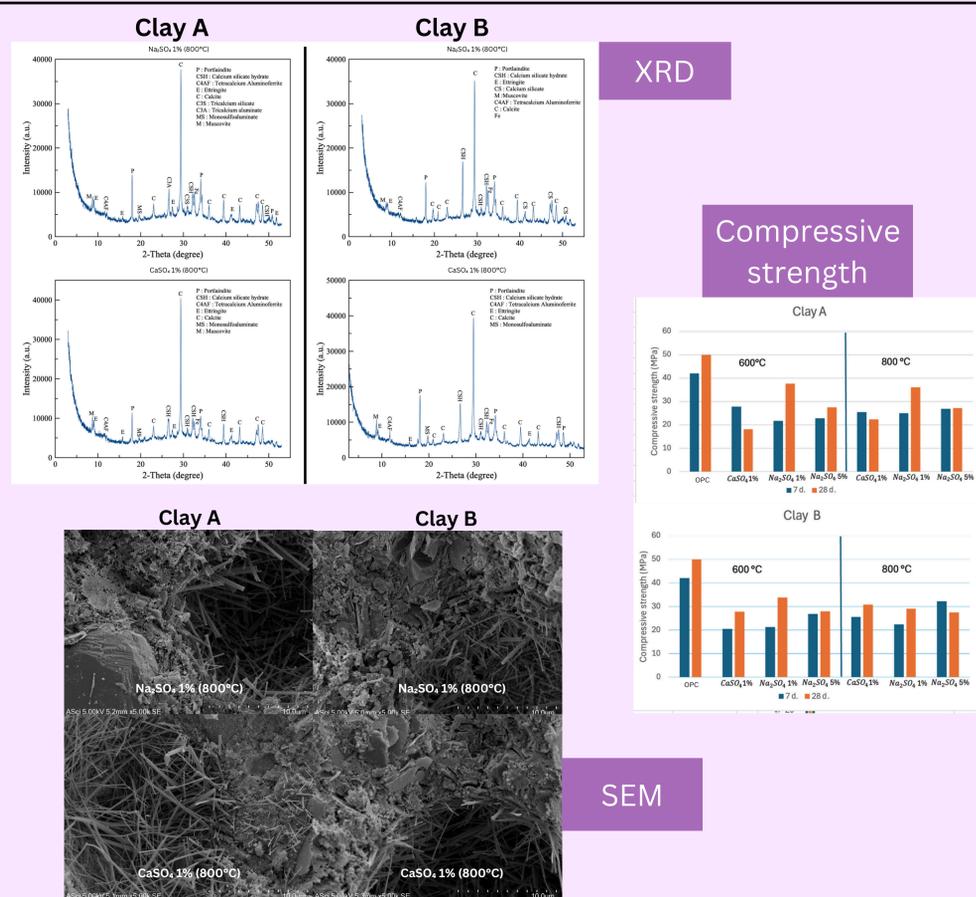
ABSTRACT

This study investigates the effects of chemically doped calcined clays on cement mechanical properties and its phase development. Two clay types (high and low kaolinite contents) are used. Both clays are doped with sulfate compounds at 1 wt% and 5 wt%, and calcined at 600°C and 800°C. The modified characteristics of the chemically doped calcined clays are investigated in terms of mineralogical compositions and size and surface properties. After that, the cement-calcined clay mixtures are studied after their hydration at 3, 7, and 28 days. The hardened cement properties are analyzed by evaluating mechanical strength using compressive strength tester, microstructures using Scanning Electron Microscopy (SEM), phase development using X-ray Diffraction (XRD), and thermal changes using Thermogravimetric Analysis (TGA).

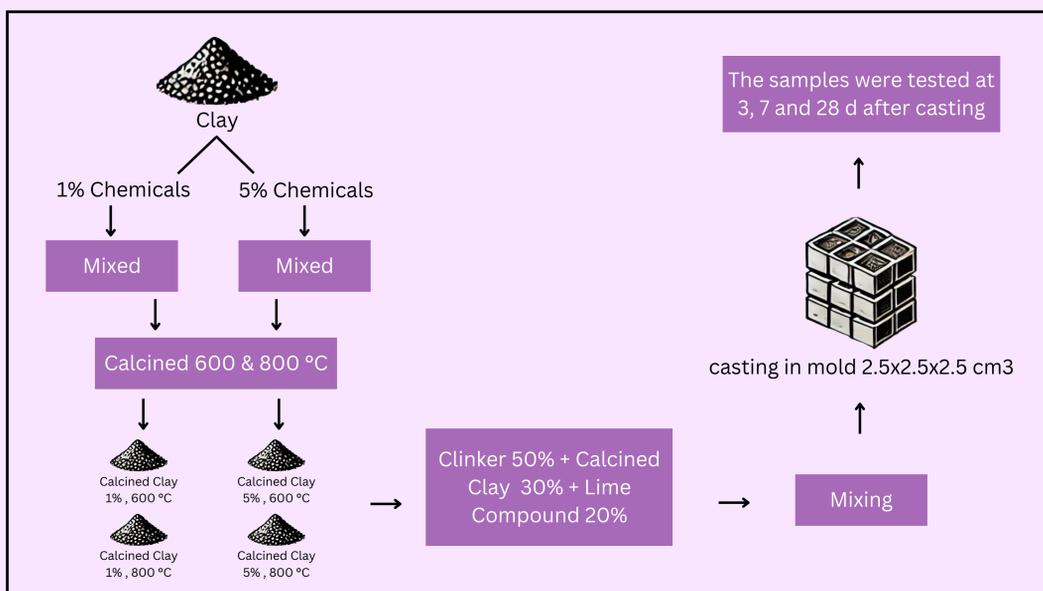
INTRODUCTION

The cement industry is one of the key industrial sectors contributing to the development of a country's infrastructure. However, the traditional production process of Portland cement releases a significant amount of carbon dioxide (CO₂). Therefore, an alternative approach to reducing cement consumption involves replacing part of it with supplementary materials, such as calcined clay, which serves as a pozzolanic additive. This approach has gained increasing interest because calcined clay enhances the microstructure of cement, reduces clinker consumption, and minimizes environmental impact. Calcined clay reacts with cement through the pozzolanic reaction, which depends on its mineral composition and calcination temperature. Additionally, the activation of calcined clay with sulfate compounds can promote hydration reactions, improve the cement's microstructure, enhance its mechanical properties, and influence the phase development of hydration products. This study focuses on investigating the effects of clay type, calcination temperature, and chemical activation on the mechanical properties and phase development of cement incorporating calcined clay. The analysis is conducted after 3, 7, and 28 days of hydration. The cement properties are evaluated through compressive strength testing, microstructural analysis using Scanning Electron Microscopy (SEM), phase development analysis using X-ray Diffraction (XRD), and thermal analysis using Thermogravimetric Analysis (TGA).

RESULT & DISCUSSION



EXPERIMENTAL



CONCLUSIONS

This study demonstrates the effects of chemically doped calcined clays on the mechanical properties and phase development of cement. Two types of calcined clays, high and low kaolinite content, were used. Both clay types were doped with sulfate compounds at 1% and 5% and calcined at 600°C and 800°C. The findings can be summarized as follows:

- Chemically treated kaolinite calcined at 600°C and 800°C influences cement phase development by enhancing hydration reactions and increasing the formation of strengthening hydration products.
- The compressive strength of cement increases when an appropriate amount of calcined clay and sulfate is incorporated. However, excessive sulfate content may lead to porosity and cracking.
- The addition of calcined clay helps reduce porosity and improves the density and strength of the cement structure.

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