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CLADDING TILE PRODUCTION USING SOREL (MAGNESIUM OXYCHLORIDE) CEMENT MORTAR IMPROVED BY DIFFERENT WASTES

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Abstract
Sorel cement (magnesium oxychloride cement, MOC) is an eco-friendly and high-strength binding material with potential applications in the production of cladding tiles. However, its durability and water resistance remain key challenges. This study explores the impact of incorporating different industrial and plastic wastes into MOC mortar to enhance its mechanical and durability properties. Waste materials such as polyethylene (PE), glass powder, and fly ash were introduced into the MOC mixture, and their effects on compressive strength, water resistance, and surface quality were analyzed. The findings indicate that specific waste additives improve the performance of Sorel cement-based cladding tiles, making them more suitable for construction applications.

Keywords: Sorel cement, magnesium oxychloride cement, cladding tiles, polyethylene waste, industrial waste, water resistance, mechanical properties.

Introduction

The construction industry continuously seeks sustainable and cost-effective alternatives to conventional building materials. Sorel cement, or magnesium oxychloride cement (MOC), is a promising binder known for its high early strength, fire resistance, and low carbon footprint. However, its poor water resistance limits its widespread application. Researchers have explored various additives, including waste materials, to enhance MOC properties and make it more competitive for construction applications such as cladding tile production.
This study investigates the effects of incorporating different industrial and plastic wastes into MOC mortar to improve its strength, durability, and water resistance. The aim is to produce high-performance cladding tiles using a more sustainable approach.

Materials and Methods

2.1. Materials

The following materials were used in this study:
Magnesium oxide (MgO): The primary component of Sorel cement, obtained from calcined magnesite.

Magnesium chloride ($MgCl_2$): Used as a reactive component to form MOC.
Waste materials:
Polyethylene (PE) waste: Derived from recycled plastic bags and bottles.

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Glass powder: Crushed waste glass used as a filler.

1 picture Polyethylene (PE) waste

Fly ash: A byproduct of coal combustion, used to improve cementitious properties.
Fine aggregate: Sand with controlled particle size distribution for tile production.

2 picture Fly ash

2.2. Sample Preparation

The MOC mortar was prepared by mixing MgO, $MgCl_2$ solution, fine aggregate, and different waste materials in varying proportions. The mixtures were cast into tile molds and cured under controlled conditions.

2.3. Testing Methods

The produced tiles were tested for:

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Compressive strength (according to ASTM C109)

3 picture ASTM C109 process of testing

Water absorption (ASTM C642)
Surface quality and microstructure (using SEM analysis)

3. Results and Discussion

3.1. Effect of Waste Additives on Compressive Strength

The results showed that polyethylene waste slightly reduced compressive strength but improved impact resistance and flexibility. Glass powder enhanced strength due to its pozzolanic reaction, while fly ash contributed to a denser microstructure.

3.2. Water Resistance Improvement

MOC is highly susceptible to water damage. However, the incorporation of fly ash and glass powder significantly reduced water absorption by filling voids within the matrix. Polyethylene waste also contributed by creating a hydrophobic effect.

3.3. Surface and Aesthetic Properties

Tiles containing glass powder exhibited a smoother surface, making them visually appealing for cladding applications. Polyethylene waste influenced texture and color variations, which could be beneficial for decorative purposes.

Conclusion

The study explored the potential of incorporating different waste materials, including polyethylene (PE) waste, glass powder, and fly ash, into Sorel cement (magnesium oxychloride cement, MOC) mortar for cladding tile production. The results demonstrate that modifying MOC with these waste additives significantly improves its mechanical strength, water resistance, and surface quality, addressing some of the critical limitations of traditional MOC formulations.

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One of the primary challenges of using MOC in construction applications is its poor water resistance, which leads to durability concerns in humid or wet environments. The incorporation of fly ash and glass powder was found to reduce water absorption by refining the microstructure and filling voids within the cement matrix. This enhancement makes MOC-based tiles more resistant to degradation when exposed to moisture, increasing their long-term applicability in both interior and exterior environments. Furthermore, polyethylene waste contributed to improved hydrophobic properties, further protecting the tiles from water infiltration.

The mechanical performance of the modified MOC mortar was also positively influenced by the waste additives. While polyethylene slightly reduced compressive strength, it enhanced the flexibility.

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