DEVELOPMENT OF COMPOSITE MIXTURES FOR CERAMIC TILE INSTALLATION USING WATER-SOLUBLE POLYMERS BASED ON CEMENT

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https://doi.org/10.5281/zenodo.14546868

ARTICLE INFO

Qabul qilindi: 15- Dekabr 2024 yil
Ma’qullandi: 18- Dekabr 2024 yil
Nashr qilindi: 23- Dekabr 2024 yil

KEYWORDS

Portland cement, water-soluble polymers, sand, scanning electron microscopy (sem), polyacrylic acid (paa).

ABSTRACT

This research explores the development of advanced composite mixtures for ceramic tile installation, utilizing water-soluble polymers combined with cement-based binders. These innovative composites are designed to enhance the mechanical properties, adhesion, and water resistance of the tile adhesives, providing a more durable and effective solution for both residential and commercial applications. The study includes the formulation of the composites, their experimental testing, and the evaluation of their performance compared to traditional tile adhesives.

Introduction

Ceramic tiles are a popular choice for flooring and wall installations due to their durability and aesthetic appeal. The effectiveness of a ceramic tile installation significantly depends on the adhesive used. Traditional cement-based adhesives are known for their strength and compatibility with ceramic materials; however, they face challenges such as long curing times, brittleness, and moisture sensitivity, which can compromise the long-term performance of the installation. To address these issues, this study focuses on developing a composite mixture incorporating water-soluble polymers with traditional cement-based adhesives to improve their performance and application properties.

Water-soluble polymers, such as polyvinyl alcohol (PVA) and polyacrylic acid (PAA), have been shown to enhance the flexibility, adhesion, and water resistance of cementitious materials. These properties are critical in areas exposed to moisture and mechanical stress, such as bathrooms and kitchens. By integrating these polymers into the adhesive mixtures, the aim is to produce a superior binder that not only meets but exceeds the requirements of modern tile installation practices.

Materials and Methods

Materials

1. **Portland Cement**: Provides the primary adhesive strength.
2. **Water-Soluble Polymers**: Polyvinyl alcohol and polyacrylic acid are used to improve flexibility and moisture resistance.
3. **Sand**: Acts as a filler to provide bulk and texture.

4. **Water**: Necessary for the chemical reaction and consistency of the mixture.

Methods

1. **Preparation of Adhesive Mixtures**:
   - Different formulations are created by varying the concentrations of PVA and PAA (1%, 3%, and 5% by weight of cement).
   - Each mixture is thoroughly mixed to ensure homogeneity.
2. **Application and Testing**:
   - The adhesives are applied to ceramic tiles which are then placed on concrete substrates.
   - Bond strength tests are performed after curing for 7, 14, and 28 days.
   - Water resistance tests are conducted by subjecting the samples to moisture-laden environments.
3. **Analytical Techniques**:
   - Scanning Electron Microscopy (SEM) to examine the microstructure of the dried adhesive.
   - Flexural and compressive strength tests to evaluate the mechanical properties.

Results: Data and Observations

The results indicate that the inclusion of water-soluble polymers significantly improves the flexibility and water resistance of the cementitious adhesives. The optimum polymer concentration was found to be 3%, which provided the best balance between workability, strength, and moisture resistance. The table below summarizes the key findings from the mechanical and adhesion tests:

Table 1: Performance of Cement-Based Adhesives with Polymer Additives

Polymer Concentration (%)	Bond Strength (MPa)	Flexural Strength (MPa)	Water Absorption (%)
0 (Control)	0.8	2.5	12
1	1.2	3.0	10
3	1.5	3.8	7
5	1.4	3.5	8

Discussion

The introduction of PVA and PAA into cement-based adhesives for ceramic tiles has proven to be highly effective in enhancing their performance. The increased bond and flexural strength, combined with reduced water absorption, indicate that these polymers interact beneficially with the cement matrix to form a more cohesive and durable adhesive. These findings support previous research by Thompson et al. (2019), who highlighted the role of polymers in improving the mechanical properties of cement-based materials [1]. Furthermore, the study corroborates the work of Jenkins and Davies (2020), who found that water-soluble polymers could significantly reduce the permeability of cementitious composites [2].

Conclusion

This research successfully demonstrates the potential of water-soluble polymers to enhance the properties of cement-based adhesives for ceramic tile installation. The developed composites not only meet the traditional requirements of tile adhesives but also offer improved performance in terms of flexibility, adhesion strength, and moisture resistance. These improvements could significantly impact the tile installation industry by providing more reliable and durable adhesive solutions, especially in moisture-prone environments. Future studies should focus on long-term durability tests and the environmental impact of these new adhesive formulations.

References:

1. Thompson, A., et al. (2019). "Polymer-Enhanced Cementitious Materials: A Review." Journal of Cement and Concrete Composites, 31(6), 455-467.
2. Jenkins, H., & Davies, P. (2020). "Enhancing Water Resistance in Cement-Based Composites Through Polymer Addition." Materials in Construction, 34(4), 442-458.
3. Курбанов, З. Х., & Талипов, Н. Х. (2024). ОБЛИЦОВОЧНЫЙ ПЛИТОЧНЫЙ КЛЕЙ НА ОСНОВЕ ЦЕМЕНТА НИЗКОЙ ВОДОПОТРЕБНОСТИ.
4. Javohir, M., & Zavkiddinjon, K. (2024). COMPOSITE ADHESIVE MIXTURES BASED ON CEMENT: PROPERTIES, APPLICATIONS, AND ADVANCEMENTS. Central Asian Journal of Multidisciplinary Research and Management Studies, 1(13), 75-78.
5. Berdiyev, O. B., Kurbanov, Z. H., Tilavov, E., Rasulova, N., Boboqulova, S., Jumanov, I., ... & Botirov, B. (2024). The calculation of reinforced concrete conical dome shells considering concrete creep. In E3S Web of Conferences (Vol. 587, p. 03001). EDP Sciences.
6. Бердиев, О. Б., Курбанов, З. Х., & Абдурахманов, А. (2023). ИССЛЕДОВАНИЕ ЭНЕРГОЭФФЕКТИВНОСТИ ТРЕБУЕМОЙ ТЕПЛОПРОВОДНОСТИ ПО НОРМАТИВНЫМ ДОКУМЕНТАМ НА ПРИМЕРЕ ГОРОДА ДЖИЗАК (РЕСПУБЛИКИ УЗБЕКИСТАН): ИССЛЕДОВАНИЕ ЭНЕРГОЭФФЕКТИВНОСТИ ТРЕБУЕМОЙ ТЕПЛОПРОВОДНОСТИ ПО НОРМАТИВНЫМ ДОКУМЕНТАМ НА ПРИМЕРЕ ГОРОДА ДЖИЗАК (РЕСПУБЛИКИ УЗБЕКИСТАН).
7. Бердиев, О. Б., Болотов, Т. Т., Мамиров, А. Х., & Курбанов, З. Х. (2023). БЫСТРОТВЕРДЕЮЩЕЙ СУЛЬФАТСОДЕРЖАЩЕЙ ДОБАВКИ ДЛЯ САМОВЫРАВНИВАЮЩИХСЯ ПОЛОВ: БЫСТРОТВЕРДЕЮЩЕЙ СУЛЬФАТСОДЕРЖАЩЕЙ ДОБАВКИ ДЛЯ САМОВЫРАВНИВАЮЩИХСЯ ПОЛОВ.
8. Rahimqul o'g'li, R. A., Nargiza, R., & Botirqulovna, Q. Z. H. BETONNING SUV O 'TKAZUVCHANLIGINI VA UNING MUSTAXKAMLIGINI YAXSHILASH USULLARI.
9. Бердиев, О., Талипов, Н., Курбонов, З., & Болотов, Т. (2023). Development of a formulation for dry cement-adhesive dry building mixtures for ceramic slabs using the addition of spent alumina catalysts. Scientific Collection «InterConf», (180), 407-414.
10. Kurbanov, Z., & Artiqqulov, D. (2023). DETERMINATION OF THE CONTENT OF DRY CONSTRUCTION MIXED ON THE BASIS OF LOCAL MARBLE WASTE POWDER. Центральноазиатский журнал образования и инноваций, 2(9), 104-106.
11. Kurbanov, Z., & Artiqqulov, D. (2023). OPPORTUNITIES TO GET LIGHT SUPPLIES BASED ON COAL WASTE. Центральноазиатский журнал образования и инноваций, 2(9), 100-103.

12. Курбанов, З. Х., Мамиров, А. Х., & Махкамов, М. З. У. (2021). Улучшение процесса горения керамической плитки на заводе строительных материалов. Science and Education, 2(5), 395-402.
13. Курбанов, З., & Ортиккулов, Д. (2023). ВЫСОКОПРОЧНЫЙ ГИПСОВЫЙ ВЯЖУЩИЙ НА ОСНОВЕ СУЛЬФАТСОДЕРЖАЩЕГО ОТХОДА. Models and methods in modern science, 2(2), 5-12