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ENVIRONMENTAL CONCRETE FOR SUSTAINABLE CONSTRUCTION

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Problem statement. Concrete is a durable and adaptable building material capable of creating long-lasting structures, making it the world's second most utilized substance, only surpassed by water. In 2021, the production of cement reached approximately 4.1 billion tons, with concrete consumption being about 7 times that amount. The construction sector's considerable environmental footprint, particularly through concrete use, underscores the need for sustainable practices in concrete construction. The manufacture of Portland cement, a key ingredient in concrete, accounts for about 7–8 % of the world's CO2 emissions. Such a substantial environmental impact, along with the exhaustion of resources like aggregates and water, has sparked concerns over the sustainability of using concrete and prompted a shift towards achieving climate neutrality globally.

In addressing these environmental challenges, the construction sector is adopting more eco-friendly practices and materials for concrete construction. This evolution focuses on lessening the environmental effects of concrete production, prolonging building lifespans, and reducing the use of resources. Collaborative efforts among researchers, industry experts, and policy makers are underway to introduce and advocate for new technologies, materials, and methods that significantly cut down the carbon footprint, energy consumption, and waste produced by concrete construction. For instance, the Swedish concrete industry unveiled a climate-neutral roadmap in 2018, created by The Concrete Initiative, involving stakeholders from the entire concrete production and construction value chain. Key objectives include halving the climate impact of concrete used in house construction by 2023 (from 1990 levels), introducing climate-neutral concrete to the Swedish market by 2030, and achieving climate neutrality within the concrete industry by 2045. Similarly, the Swedish construction and civil engineering sector has set goals for a 50 % reduction in greenhouse gas emissions by 2030 (from 2015 levels) and achieving net-zero emissions by 2045 [1].

Rapid urbanization and population growth are factors increasing the demand for new infrastructure and housing, further exacerbating the environmental impact of the construction industry. As climate change and resource scarcity continue to pose major challenges, there is an urgent need for more sustainable solutions in concrete construction.

Today, Ukraine is taking significant steps towards sustainable construction in anticipation of the country's future reconstruction. These efforts encompass both the legislative sector, through ensuring the construction industry's compliance with EU standards, and industrial capabilities, aiming for a more environmentally-conscious approach to rebuilding.

The purpose of the work consists in the analysis and systematization of local and modern foreign literature, information about the characteristics of materials on which the results of empirical research depend, such as: chemical composition, physical characteristics and properties of potential materials for testing.

Main part. The building sector is progressively emphasizing sustainable practices and the use of eco-friendly materials, driven by escalating worries about climate change, the exhaustion of resources, and the creation of waste. A key component of this transformation is the integration of sustainable materials into concrete construction. As a result, a range of innovative materials and

technologies has surfaced, seeking to lessen the ecological impact of concrete construction, improve its longevity and efficiency, and support the sustainability of the constructed environment.

Green concrete refers to various concrete mixes that include recycled content, by-products, and eco-friendly ingredients. These mixes are designed to diminish the use of finite natural resources, cut down on the carbon emissions from cement production, and lessen the ecological footprint of concrete construction. Incorporating recycled aggregates, alternative cementitious materials, and industrial leftovers like fly ash and slag exemplifies how green concrete can lead to a more eco-conscious concrete blend. Another eco-friendly strategy is utilizing materials found locally for concrete construction, helping to decrease the environmental repercussions. Local sourcing reduces emissions and energy use tied to transport significantly. Additionally, local substances can offer distinctive qualities that improve the strength and longevity of concrete structures. For instance, limestone calcined clay cement, which can substitute for traditional cement to a certain extent, and natural fibers or aggregates, which can forge more environmentally gentle and economically viable concrete mixes, are notable examples of such materials [2; 3].

Ultra High Performance Concrete (UHPC) is an advanced cement-based composite characterized by outstanding mechanical properties, high durability, improved fire resistance, and superior strength. UHPC's exceptional qualities enable using less material for construction projects, thus lowering the environmental impact associated with concrete structures. Moreover, the enhanced durability of UHPC contributes to prolonging the lifespan of structures, diminishing the frequency of maintenance, repair, and eventual replacement. Additionally, this material may enhance the energy efficiency and thermal management in buildings, attributed to its robust strength and minimal permeability [4].

Conclusion. the construction industry is actively transitioning towards sustainability by embracing green concrete and Ultra High Performance Concrete (UHPC) to address environmental concerns associated with traditional concrete use. These advancements aim to reduce the industry's carbon footprint and resource depletion, enhancing the durability and efficiency of structures. Efforts such as the adoption of recycled materials and the development of materials with lower environmental impacts signify a significant shift towards reducing the ecological footprint of construction. Initiatives like Sweden's climate-neutral roadmap further underscore the industry's commitment to sustainability, setting a precedent for reducing greenhouse gas emissions and achieving climate neutrality. This shift not only confronts the challenges posed by climate change and resource scarcity but also fosters a more sustainable, efficient, and resilient built environment for the future.

References

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