

Durable materials for circular economy - industrial waste-based geopolymers composites with hybrid reinforcement

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Abstract: The building industry is rather conservative when it comes to utilisation of new building materials. Concrete, as the second most used material after water, is the proof. Concrete is connected to approximately 8% of the global carbon footprint, and with a new environmental mindset, the building industry should look for alternatives. Geopolymers (GPs) reduce carbon footprint, made predominantly from wastestreams, compared to traditional concrete and allow the design of cost-effective and durable structures. The main objective of GEOSUMAT is to design and characterize new fiber-reinforced GPs based on industrial and mining waste. The motivating points are the reuse of local waste streams to support the circular economy, CO₂ reductions, and preservation of natural resources. GEOSUMAT strives to develop GPs that can perform in the harsh Arctic and moderate continental climate conditions for both indoor (industrial floor) and outdoor applications (harbour). All partners developed GP mix designs based on various precursors/activators from local waste streams with suitable properties. The mix designs were optimized after the microstructure was observed using several techniques such as SEM and XEDS. Different mixes showed promising results in terms of compressive and flexural strength, durability, fire resistance, adhesion between matrix and basalt/glass minibars, and added functionalities such as self-heating. The prototype of industrial floor tile was developed and tested by CHEMSTR - ŠAFAŘÍK company. Additional environmental analyses proved carbon footprint reduction of newly developed materials. The research was disseminated through 15 publications, 10 conferences, and activities such as workshops, summer school, webinar, etc. The research was promoted by including 13 MSc/PhD students and researchers. The work within GEOSUMAT shows that creative utilization of waste streams leads to the development of new GP materials with technological, economic, and environmental superiority over traditional concrete, which in turn improves the circular economy. The GEOSUMAT partners created strong bonds within the consortium and together submitted a new application to EU Grants call HE EIC Pathfinder Challenges.

From Waste to Worth: By adopting a fresh perspective, we can transform waste into a resource.