Australian Government

ANSTO
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Green geopolymer concretes for Australian construction industry

There has been an increasing pressure on construction industrial sector to utilise innovative materials that not only meet the requirements of ambitious architectural designs, but also reduce CO_2 emissions.

This project aimed to develop novel, sustainable low-CO_2 geopolymer cements based on industrial glass and sand wastes, with enhanced durability and fire-resistance for construction purposes.

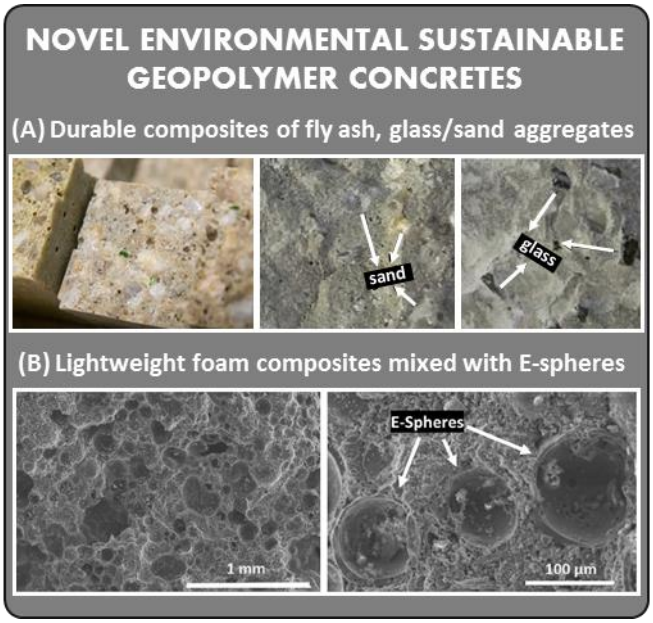
Here, insights into the local chemistry and interaction of geopolymers at the interface with silica (glass) aggregates provided a strong evidence to support the observed enhanced mechanical properties, thereby enabled a large-scale uptake of landfilling silica-rich glass wastes for developing high-performance *green* concrete materials for Australian construction industry.

Research & Outcomes

About 62,000 tonnes of glass is landfilled as glass fines per year. The glass fines are not suitable for recycling, and their current small market cannot accommodate the large amount of this waste. Therefore, the research led by Dr. Hajimohammadi at University of New South Wales, aimed at investigating the advantages of utilising silica-rich recycled glass fines as aggregates in geo-polymer concretes. The cutting-edge synchrotron infrared technique at Infrared Microspectroscopy (IRM) Beamline, ANSTO – Australian Synchrotron, enabled the investigation of interfacial interaction between geo-polymer binders and silica-rich aggregates, advancing the knowledge of the geopolymer technology that in turn supports Australia to maintain leadership in the field of sustainable construction materials.

Benefits & Impacts

The outcomes and knowledge gained from this research have assisted Australia in becoming an international leader in the area of innovative concrete slab technologies



Novel environmental sustainable geopolymer concrete materials developed for enhanced durability (A) and lightweight property (B).

which will benefit not only for the nation, but also globally. In addition to the sustainability benefits, the project has contributed directly to one of the Australia's new strategic research priorities: lifting productivity, creating jobs, and economic growth with the goal of maximising Australia's competitive advantage in critical sectors. By developing techniques to optimise the properties of geopolymers at the interface with other construction materials (e.g. hollow microspheres used in fire resistant composites, glass and tyre wastes used in lightweight concretes and construction materials coated by geopolymers for protection against fire or corrosion), this project can expand the use of geopolymers in a wider range of applications. This leads to new manufacturing technologies and enables sustainable economic growth in Australia through development of new industries and the creation of new jobs.

References

[1] A. Hajimohammadi, et al., *Journal of Cleaner Production*, 2019, **231**, 980-989.
[2] A. Hajimohammadi, et al., *Composites Part B: Engineering*, 2019, **173**, 106908.