

## **EFFECT OF RECYCLED GEOPOLYMER CONCRETE AGGREGATE ON STRENGTH DEVELOPMENT AND CONSISTENCE OF PORTLAND CEMENT CONCRETES**

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Numerous studies have shown that production of geopolymer cement concretes can have lower carbon emissions compared to Portland cement concretes. However, for a full lifecycle assessment of environmental impacts, scenarios for the end of structures' design life of must be considered, including reuse options. The work presented here is part of a wider study investigating the recyclability of fly ash-slag geopolymer cement (GC) concrete as an aggregate in Portland cement (PC) concretes.

Three types of GC concretes with varying  $\text{Na}_2\text{O}$  % per mass of precursor and  $\text{SiO}_2/\text{Na}_2\text{O}$  molar ratio were produced in the laboratory. All other mix design parameters were kept constant. The concretes were investigated thoroughly through physical and mechanical testing and chemical characterization at various ages and then crushed mechanically to form recycled geopolymer concrete aggregates (RGCA).

Two series of PC concretes with 20% aggregate replacement by RGCA were produced – one of S1 consistence class and one of S3 consistence class (design slumps of 10-40mm and 100-150mm). The effect of RGCA on PC concrete fresh properties was investigated. The compressive strength development was assessed by testing at 7, 28 and 90 days. All results were evaluated against concretes with recycled Portland cement concrete aggregates (RCA) and natural limestone aggregates. These results were paired with calorimetric studies of pastes produced with recycled concrete aggregate leachate.

Although mix designs were adapted according to water absorption requirements, the consistence of concretes appeared to be largely dependent on the type of aggregate. The results showed that strength trends remained unaltered between the two concrete series and were mostly influenced by the aggregate type. Mixes with RGCA presented overall higher strengths than the RCA and limestone aggregate concretes. Tests at 90 days showed a continuous increase of compressive strength, while the trends between the concretes remained unaltered. Overall, this study has shown that RGCA affect new concretes in a different way to RCA. However, none of the factors investigated here should prevent the use of RGCA in new concretes.