

## **Using alkali-activated smart concrete for enhanced performance of structures**

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# USING ALKALI-ACTIVATED SMART CONCRETE FOR ENHANCED PERFORMANCE OF STRUCTURES

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An alkali-activated cementitious material (AACM) geopolymer hybrid has been developed that bonds directly to portland cement concrete to provide specific smart features for corrosion, fire and chemical protection to underpin the future resilience of new and existing structures.

This paper provides the background to the research and development characteristics of the materials, implications to concrete mix design with AACM geopolymers and the technical insight to its operation as an impressed current cathodic protection (ICCP) anode for control of corrosion into the future. The intent is to demonstrate the applicability of these materials in structural concrete applications as a development from non-structural forms.

In particular, new construction applications are detailed where a 25m long precast U-beam of similar design to those used at the Mersey Gateway project in the UK received anode installation in box-out and spray forms together with embedded performance monitoring tools to prove compliance with ISO EN 12696:2016 for long-term control of corrosion using ICCP. Data are provided that demonstrates control features and, from corrosion rate evaluation, to provide enhanced and measured performance for a projected service life of over 2000 years. Laboratory evaluation of bond between steel and concrete is used to corroborate this proof of enhanced and sustainable service life. Moreover a fire resistant tunnel ring of similar construction to those used at the Crossrail project in the UK was formed using steel fibre reinforced AACM geopolymer concrete in 6 segments (Figure 1) using industry standard precasting methodology is also discussed.



Figure 1 – Precast steel fibre reinforced AACM geopolymer concrete tunnel segments

Data are also included relating to fire resistance complying with EN1363-1 by resisting direct fire at 1200C for 5 hours without change to the AACM concrete form.

Background manufacturing testing also proves compliance with BSI PAS8820:2016 as a 52.5N concrete with excellent compressive and flexural strengths, workability, very low heat of reaction and little or no shrinkage.

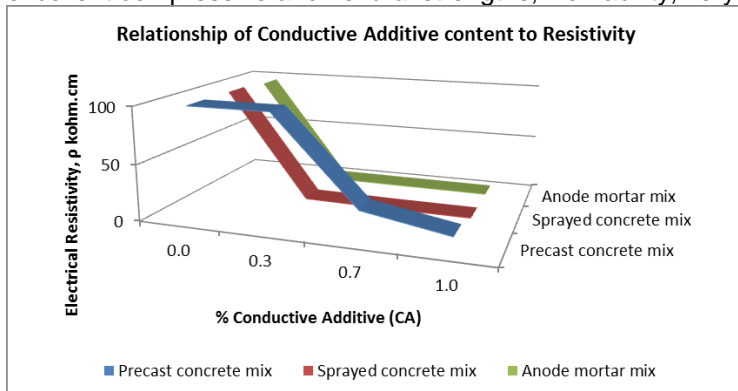


Figure 2 – Data demonstrating the increasing conductivity from different mix designs of AACM concrete that provides a distributed ICCP anode form for long-term corrosion protection of structures