Quantification and in-situ modelling of kaolin-bearing clay to be used in LC3 concrete

James Woodforde[1]
Jiayi Fu[2] and Camille Holt[1]
[1] Boral Innovation
[2] Boral Australia

The use of Supplementary Cementitious Materials (SCMs) to partially replace Ordinary Portland Cement (OPC) is a commonly employed strategy in the reduction of CO2 emissions arising from cement manufacturing. The global availability of established SCMs, namely GGBFS and fly ash, is limited, and declining in proportion to the demand for cement. Kaolinite clay on the other hand is abundant, and composes a large portion of the earth's crust. Calcined into its highly reactive amorphous phase, meta-kaolin is a well-established SCM which plays a crucial role in Limestone Calcined-Clay Cement (LC3) binder systems.

The performance of LC3 concrete is highly dependent on the kaolinite content of the clay, with kaolinite contents lower than 20% unable to achieve satisfactory strength development and durability. Given the importance of kaolinite grade for LC3 performance, it is necessary to estimate the quantity, as well as verify the performance, of concrete-grade (>20%) kaolin clay proposed for use in pilot scale LC3 trials. This paper presents the methodology used to conduct this research as well as its experimental outcomes.

Four drill cores were divided into a set of subsamples and the kaolinite content of each subsample quantified using a furnace-based method. A resource block model was constructed using this data to classify the deposit into five discrete kaolinite grades. Clay taken from the cores was calcined and the performance benchmarked against existing SCMs as well as previously characterised internationally sourced calcined clays.