PRELIMINARY STUDIES ON METAKAOLIN PARTICLE SIZE REDUCTION FOR HIGHER STRENGTH GEOPOLYMER

Ruy A. Sá Ribeiro, INPA/UIUC
ruy@desari.com.br
Marilene G. Sá Ribeiro, INPA/UIUC
Patrick F. Keane, UIUC
Mauro R. Sardela, UIUC
Waltraud M. Kriven, UIUC

Key Words: Sustainable construction; sodium silicate; Amazonian kaolin; strength and stiffness.

The objective of this project was to further develop new composites and a testing program on the performance-based specification for Amazonian geopolymer (GP) non-reinforced as well as particle and fiber-reinforced, for use in sustainable construction. While fly ash-based geopolymers are now an established technology, metakaolin-based geopolymers still need to be developed and optimized, based on the knowledge of the specific characteristics and properties of local resources. Kaolin from the Amazon was calcined into metakaolin (MK). MK particle size reduction for better reactive material was evaluated by means of dry and wet ball milling and sieving. Three types of metakaolin were analyzed for particle size distribution, and their d_{50} ranged from 7.9 to 2.8 μm. Further GP characterization followed physical and mechanical properties in 4pt flexural strength tests. At least 6 prismatic samples (10 x 10 x 50 mm; 30-mm support length) per MK type were tested after 3- and 28-days curing in a humidity chamber. In addition, scanning electron microscopy and energy dispersive spectroscopy were used to investigate the microstructure and the nanostructure of the composite materials. X-ray diffraction confirmed the formation of geopolymer. Energy dispersive X-ray fluorescence was used to measure the geopolymer material composition. Analysis of the results revealed that the strength and stiffness of sodium-metakaolin-based geopolymer were inversely proportional to particle size. All distinct particle size geopolymers showed, in general, some increase in strength and stiffness within curing times from 3 to 28 days.