DIFFERENT FIBER MATERIALS AS REINFORCEMENT FOR GEOPOLYMER COMPOSITE

Meital Cahana, NRCN, BGU, Israel
meitalcah@gmail.com
Gabriela Bar Nes, Department of Chemistry, NRCN
Alva Peled, Department of Structural Engineering, Ben Gurion University of the Negev

For the last two centuries, Ordinary Portland Cement (OPC) is the most popular building material in the world due to its high mechanical properties, ease of handling and low cost. However, the concrete industry is known to leave an enormous environmental footprint. Therefore, the development of sustainable materials that could replace the OPC is essential. One of such recent developments is an aluminosilicate based material that can be activated in an alkaline medium to form a hardened sustainable product, known as 'Geopolymer'. Geopolymers exhibit equal or better engineering properties as compared to conventional concrete with better environmental foot print. However, geopolymer's main disadvantage, as concrete, is its brittleness and low tensile properties. One way to overcome this limitation is by addition of fibers, as they can control cracking by crack bridging, resulting in an increase of the tensile properties of the geopolymeric composite.

The purpose of this research was to develop a high performance geopolymer composite by addition of short fibers. Three different types of fibers were added to the matrix with two different fiber contents (0.5% and 1%). The idea was to add fibers of significant difference in their chemical nature and tensile properties: PP and Carbon fibers which are both hydrophobic, but have significant differently tensile behavior, and PVA which is hydrophilic like the geopolymeric matrix, and has moderate tensile properties. Their influence on the geopolymer flexural behavior was examined. The microstructure of the composite at the fracture surface was also studied to better understand the role of the fibers.

The results of this research showed that all fibers improved the ductility and toughness of the matrix. Geopolymeric composites with 1% carbon fibers showed the highest flexural strength, +216% compared to plain matrix, followed by the PVA fiber composites. Different failure modes were observed – fiber pull-out for the PP and carbon composites, and fiber rupture for the PVA fiber composite. This can be explained based on the different chemical nature of the fibers which produce a different matrix-fiber interface.