Advances in Materials Research, *Vol.3, No.3 (2014) 151-161*
DOI: http://dx.doi.org/10.12989/amr.2014.3.3.151

Synthesis and mechanical properties of flax fabric reinforced geopolymer composites

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(Received May 3, 2014, Revised Jun 10, 2014, 2013, Accepted Jun 24, 2014)

Abstract. Geopolymer composites reinforced with different layers of woven flax fabric are fabricated using lay- up technique. Mechanical properties, such as flexural strength, flexural modulus and fracture toughness of geopolymer composites reinforced with 2.4, 3 and 4.1 wt% flax fibres are studied. The fracture surfaces of the composites are also examined using scanning electron microscopy. The results show that all the mechanical properties of the composites are improved by increasing the flax fibre contents. It is also found that the mechanical properties of flax fabric reinforced geopolymer composites are superior to pure geopolymer matrix. Micro-structural analysis of fracture surface of the composites indicated evidence of various toughening mechanisms by flax fabrics in the composites.

Keywords: geopolymer composite; flax fibre; mechanical properties

1. Introduction

Ordinary Portland cement concretes are used in many construction applications because of their good mechanical properties. However, the serious greenhouse emissions caused during manufacturing of cement has made it necessary to find an eco-friendly alternative material. A new type of promising materials is the aluminosilicate inorganic polymers (also known as geopolymer). These inorganic compounds exhibit good mechanical performance, durability, inflammability and acid resistance. Furthermore, they can be cured and hardened at room temperature with 80-90% less carbon dioxide emission than Portland cement (Barbosa *et al*. 2000, Li *et al*. 2004, Duxson *et al*. 2007, Pernica *et al*. 2010).

Geopolymers are synthesized by activating a solid aluminosilicate source with alkaline solutions. They are currently attracting widespread attention because of their potential as high performance and environmentally friendly replacements for ordinary Portland cement in many applications (McLellan *et al*. 2011, Pacheco *et al*. 2012). Davidovits (1991) coined the name "Geopolymer" to denote a new material that was prepared by reacting aluminosilicate sources such as fly-ash, volcanic ash, and granulated ground blast furnace slag with alkali silicate solution under highly alkaline conditions. It has been shown that a wide range of waste aluminosilicate materials

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http://www.techno-press.org/?journal=amr&subpage=7 ISSN: 2234-0912 (Print), 2234-179X (Online)

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