Accepted Manuscript

Fabrication and thermo-mechanical characterization of glass fiber/vinyl ester wind turbine rotor blade

Umair Javaid, Zaffar M. Khan, M.B. Khan, M. Bassyouni, S.M.-S. Abdel-Hamid, M.H. Abdel-Aziz, Syed W. ul Hasan

PII: S1359-8368(16)00038-X

DOI: 10.1016/j.compositesb.2015.12.034

Reference: JCOMB 3976

To appear in: *Composites Part B*

Received Date: 3 January 2015

Revised Date: 5 September 2015

Accepted Date: 26 December 2015

Please cite this article as: Javaid U, Khan ZM, Khan MB, Bassyouni M, Abdel-Hamid SM-S, Abdel-Aziz MH, ul Hasan SW, Fabrication and thermo-mechanical characterization of glass fiber/vinyl ester wind turbine rotor blade, *Composites Part B* (2016), doi: 10.1016/j.compositesb.2015.12.034.

Fabrication and thermo-mechanical characterization of glass fiber/vinyl ester wind turbine rotor blade

Umair Javaid[1,2], Zaffar M. Khan[3], M.B.Khan[4], M. Bassyouni[1,5*], S. M.-S. Abdel-Hamid[5], M. H. Abdel-Aziz[1,6], Syed W. ul Hasan[1]

[1]Department of Chemical and Materials Engineering, King Abdulaziz University, Rabigh, Saudi Arabia
[2] School of Chemical and Materials Engineering, National University of Sciences and Technology (NUST), Pakistan
[3] Centre for Composite Materials and Smart Structures, Department of Aeronautics and Astronautics Inst. of Space Tech., Islamabad, Pakistan
[4] Centre for Energy Systems (CES), NUST, Islamabad, Pakistan
[5]Department of Chemical Engineering, Higher Technological Institute, Tenth of Ramdan City, Egypt
[6] Chemical Engineering Department, Faculty of Engineering, Alexandria University, Alexandria, Egypt

*Corresponding author: Tel # 00966(0) 59 789 0121
Email: migb2000@hotmail.com

Abstract

In this study, the fabrication and thermo-mechanical characteristics of glass fiber/vinyl ester composite materials for 2.4 m wind turbine rotor blade with tower height of 6 m are investigated. Hand lay-up technique with matching molds was used to produce the wind rotor blades according to National Advisory Committee for Aeronautics (NACA) 4527 aerofoil profile. Bending stiffness was found to be 14.80 KN/m. Results demonstrate the manufactured composite rotors process to manufacture wind turbine blades with structural integrity. Dynamic testing was performed to verify the structural integrity of wind turbine at 400 r.p.m. In dynamic mechanical testing, the storage modulus decreases with increase in temperature. The glass transition temperature of glass fiber/vinyl ester composite was obtained at 73.4 °C based on loss modulus behavior. FT-IR analysis of cured vinyl ester (Hetron 922) showed presence of acrylol double bound confirming proper curing of vinyl ester. FT-IR analysis at temperature 25, 50 and 100 °C does not show significant change in resin chemical structure. Glass fiber / vinyl ester composites exhibit approximately 23° C higher decomposition temperature than neat vinyl ester using thermogravimetric analyzer. Eco audit study showed that the energy and carbon emission are mainly due to use phase. It is found that materials phase has 6.1 % CO_2.

KEY WORDS: Glass fibres; Mechanical properties; Thermal analysis; Damage mechanics; Lay-up