Effect of nanoclay on thermal behavior of jute reinforced composite

The International Journal of Advanced Manufacturing Technology

February 2018, Volume 94, Issue 5–8, pp 1863–1871 | Cite as

- Muhammad Hasibul Hasan (1)
- Md. Sazib Mollik (2)
- Muhammad Mahbubur Rashid (2) Email author (mahbub@iium.edu.my)

1. Department of Mechanical and Industrial Engineering, Ryerson University, Toronto, Canada
2. Department of Mechatronics Engineering, International Islamic University Malaysia, Kuala Lumpur, Malaysia

ORIGINAL ARTICLE
First Online: 31 August 2017
Received: 28 December 2016
Accepted: 24 July 2017

Abstract

Due to enhanced mechanical strength, superior flame resistance, and decreased gas permeability, montmorillonite nanoclay has been introduced to the jute-polyester resin composite materials for structural application. Long-fiber Bangla tossa special jute is being used as reinforcement materials along with 1, 3, and 5% addition of nanoclay within the matrix-fiber mixture to find the optimum percentage of nanoclay. These doped hand lay-up-processed plates are used to made samples for dynamic mechanical analysis and thermogravimetry testing as per ASTM standards. Temperature-induced weight loss due to thermal decomposition was measured and char residue was calculated up to 1000 °C, where 5% added nanoclay samples showed better thermal stability. Viscoelastic properties through storage modulus and loss modulus showed better stability with 1% nanoclay-added composite in dynamic mechanical analysis. Moisture and temperature did not affect the tested samples significantly in diminutive exposure for 1% nanoclay-added samples even though there is a loss of storage modulus 12 to 30% for 3 and 5% nanoclay-added samples, respectively.

Keywords

Jute fiber Nanoclay Dynamic mechanical analysis Viscoelastic property

Preview

References

1. Khan MA, Ganster J, Fink H-P (2009) Hybrid composites of jute and man-made cellulose fibers with polypropylene by injection moulding. Compos A: Appl Sci Manuf 40(6):846–851
CrossRef (https://doi.org/10.1016/j.compositesa.2009.04.015)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Hybrid%20composites%20of%20jute%20and%20man-made%20cellulose%20fibers%20with%20polypropylene%20by%20injection%20moulding&author=MA.%20Khan&author=J.%20Ganster&author=H-P.%20Fink&journal=Compos%20A%3A%20Appl%20Sci%20Manuf&volume=40&issue=6&pages=846-851&publication_year=2009)

2. Ray D et al (2001) Effect of alkali treated jute fibres on composite properties. Bull Mater Sci 24(2):129–135
CrossRef (https://doi.org/10.1007/BF02710089)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Effect%20of%20alkali%20treated%20jute%20fibres%20on%20composite%20properties&author=D.%20Ray&journal=Bull%20Mater%20Sci&volume=24&issue=2&pages=129-135&publication_year=2001)

3. Gon DD, Kousik, Palash P, Subhankar M (2012) Jute composites as wood substitute. Int J Text Sci 1(6):84–93
CrossRef (https://doi.org/10.5923/j.textile.20120106.05)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Jute%20composites%20as%20wood%20substitute&author=DD.%20Gon&author=.%20Kousik&author=P.%20Palash&author=M.%20Subhankar&journal=Int%20J%20Text%20Sci&volume=1&issue=6&pages=84-93&publication_year=2012)

4. Sindhu S et al (2006) Synthesis and characterization of ferrite nanocomposite spheres from hydroxylated polymers. J Magn Magn Mater 296(2):104–113
CrossRef (https://doi.org/10.1016/j.jmmm.2005.02.002)

Google Scholar (http://scholar.google.com/scholar_lookup?title=Synthesis%20and%20characterization%20of%20ferrite%20nanocomposite%20spheres%20from%20hydroxylated%20polymers&author=S.%20Sindhu&journal=J%20Magn%20Magn%20Mater&volume=296&issue=2&pages=104-113&publication_year=2006)

5. Yang HS, Kim HJ, Park HJ, Lee BJ, Hwang TS (2006) Water absorption behavior and mechanical properties of lignocellulosic filler-polyolefin bio-composites. Compos Struct 72:429–437
CrossRef (https://doi.org/10.1016/j.compstruct.2005.01.013)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Water%20absorption%20behavior%20and%20mechanical%20properties%20of%20lignocellulosic%20filler-polyolefin%20bio-composites&author=HS.%20Yang&author=HJ.%20Kim&author=HJ.%20Park&author=BJ.%20Lee&author=TS.%20Hwang&journal=Compos%20Struct&volume=72&pages=429-437&publication_year=2006)

6. Alam J, Riaz U, Ahmad S (2007) Effect of ferrofluid concentration on electrical and magnetic properties of the Fe_3O_4/PANI nanocomposites. J Magn Magn Mater 314(2):93–99
CrossRef (https://doi.org/10.1016/j.jmmm.2007.02.195)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Effect%20of%20ferrofluid%20concentration%20on%20electrical%20and%20magnetic%20properties%20of%20the%20Fe3O4%2FPANI%20nanocomposites&author=J.%20Alam&author=U.%20Riaz&author=S.%20Ahmad&journal=J%20Magn%20Magn%20Mater&volume=314&issue=2&pages=93-99&publication_year=2007)

7. Rahmanian ST, Suraya KS, Shazed AR, Mohd Salleh MA, MA Yusoff HM (2013) Carbon and glass hierarchical fibers: influence of carbon nanotubes on tensile, flexural and impact properties of short fiber reinforced composites. Mater Des 43:10–16
CrossRef (https://doi.org/10.1016/j.matdes.2012.06.025)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Carbon%20and%20glass%20hierarchical%20fibers%3A%20influence%20of%20carbon%20nanotubes%20on%20tensile%2C%20flexural%20and%20impact%20properties%20of%20short%20fiber%20reinforced%20composites&author=ST.%20Rahmanian&author=KS.%20Suraya&author=AR.%20Shazed&author=MA.%20Mohd%20Salleh&author=HM.%20MA%20Yusoff&journal=Mater%20Des&volume=43&pages=10-16&publication_year=2013)

8. Novakova AA, Lanchinskaya VY, Volkov AV, Gendler TS, Kiseleva TY, Moskvina MA et al (2003) Magnetic properties of polymer nanocomposites containing iron oxide nanoparticles. J Magn Magn Mater 258(259):354–357
CrossRef (https://doi.org/10.1016/S0304-8853(02)01062-4)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Magnetic%20properties%20of%20polymer%20nanocomposites%20containing%20iron%20oxide%20nanoparticles&author=AA.%20Novakova&author=VY.%20Lanchinskaya&author=AV.%20Volkov&author=TS.%20Gendler&author=TY.%20Kiseleva&author=MA.%20Moskvina&journal=J%20Magn%20Magn%20Mater&volume=258&issue=259&pages=354-357&publication_year=2003)

9. Nathani H, Gubbala S, Misra RDK (2004) Magnetic behaviour of nickel ferrite–polyethylene nanocomposites synthesized by mechanical milling process. Mater Sci Eng B-Adv 111(2 3):95–100
CrossRef (https://doi.org/10.1016/j.mseb.2004.03.002)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Magnetic%20behaviour%20of%20nickel%20ferrite%E2%80%93polyethylene%20nanocomposites%20synthesized%20by%20mechanical%20milling%20process&author=H.%20Nathani&author=S.%20Gubbala&author=RDK.%20Misra&journal=Mater%20Sci%20Eng%20B-Adv&volume=111&issue=2%203&pages=95-100&publication_year=2004)

10. Voigt A, Heinrich M, Martin C, Llobera A, Gruetzner G, Pérez-Murano F (2007) Improved properties of epoxy nanocomposites for specific applications in the field of MEMS/NEMS. Microelectron Eng 84(5–8):1075–1079
CrossRef (https://doi.org/10.1016/j.mee.2007.01.046)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Improved%20properties%20of%20epoxy%20nanocomposites%20for%20specific%20applications%20in%20the%20field%20of%20MEMS%2FNEMS&author=A.%20Voigt&author=M.%20Heinrich&author=C.%20Martin&author=A.%20Llobera&author=G.%20Gruetzner&author=F.%20P%C3%A9rez-Murano&journal=Microelectron%20Eng&volume=84&issue=5%E2%80%938&pages=1075-1079&publication_year=2007)

11. Sasso C, Pasquale M, Giudici L, Lim SH, Na S (2006) Piezomagnetic coefficients of polymer bonded Co-ferrites. Sensor Actuat A Phys 129(1–2):159–162
CrossRef (https://doi.org/10.1016/j.sna.2005.11.062)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Piezomagnetic%20coefficients%20of%20polymer%20bonded%20Co-ferrites&author=C.%20Sasso&author=M.%20Pasquale&author=L.%20Giudici&author=SH.%20Lim&author=S.%20Na&journal=Sensor%20Actuat%20A%20Phys&volume=129&issue=1%E2%80%932&pages=159-162&publication_year=2006)

12. Dey A, De S, De A, De S (2004) Characterization and dielectric properties of polyaniline–TiO2 nanocomposites. Nanotechnology 15(9):1277–1283
CrossRef (https://doi.org/10.1088/0957-4484/15/9/028)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Characterization%20and%20dielectric%20properties%20of%20polyaniline%E2%80%93TiO2%20nanocomposites&author=A.%20Dey&author=S.%20De&author=A.%20De&author=S.%20De&journal=Nanotechnology&volume=15&issue=9&pages=1277-1283&publication_year=2004)

13. Rout J, Misra M, Mohanty A K, Nayak S K & Tripathy S S (2003) SEM observations of the fractured surfaces of coir composites, J Reinf Plast Compos 22:1083
Google Scholar (https://scholar.google.com/scholar?q=Rout%20J%2C%20Misra%20M%2C%20Mohanty%20A%20K%2C%20Nayak%20S%20K%20%26%20Tripathy%20S%20S%20%282003%29%20SEM%20observations%20of%20the%20fractured%20surfaces%20of%20coir%20composites%2C%20J%20Reinf%20Plast%20Compos%2022%3A1083)

14. Sgriccia N, Hawley MC, Misra M (2008) Characterization of natural fiber surfaces and natural fiber composites. Compos A: Appl Sci Manuf 39(10):1632–1637
CrossRef (https://doi.org/10.1016/j.compositesa.2008.07.007)

Google Scholar (http://scholar.google.com/scholar_lookup?title=Characterization%20of%20natural%20fiber%20surfaces%20and%20natural%20fiber%20composites&author=N.%20Sgriccia&author=MC.%20Hawley&author=M.%20Misra&journal=Compos%20A%3A%20Appl%20Sci%20Manuf&volume=39&issue=10&pages=1632-1637&publication_year=2008)

15. Muhammad Hasibul Hasan and Md. Sazib Mollik (2015) Mechanical Performance of Montmorillonite Dispersed Jute Reinforced Composite MATEC Web of Conferences. https://doi.org/10.1051/matecconf/20153001007 (https://doi.org/10.1051/matecconf/20153001007)

16. Hasan MH, Mollik S (2016) Crystallization kinetics and thermal behaviors of multi-walled carbon nanotube dispersed jute reinforced composite ARPN Journal of Engineering and Applied Sciences. 11(6):4137–4142
Google Scholar (https://scholar.google.com/scholar?q=Hasan%20MH%2C%20Mollik%20S%20%282016%29%20Crystallization%20kinetics%20and%20thermal%20behaviors%20of%20multi-walled%20carbon%20nanotube%20dispersed%20jute%20reinforced%20composite%20ARPN%20Journal%20of%20Engineering%20and%20Applied%20Sciences.%2011%286%29%3A4137%E2%80%934142)

17. Mollik S, Tariq I, Hasan MH (2015) Structural applications and emerging trends of nano-and biocomposites: a review. Adv Mater Res 1115:345–348
CrossRef (https://doi.org/10.4028/www.scientific.net/AMR.1115.345)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Structural%20applications%20and%20emerging%20trends%20of%20nano-and%20biocomposites%3A%20a%20review&author=S.%20Mollik&author=I.%20Tariq&author=MH.%20Hasan&journal=Adv%20Mater%20Res&volume=1115&pages=345-348&publication_year=2015)

18. Ghasemnejad H et al (2009) Experimental studies on fracture characterisation and energy absorption of GFRP composite box structures. Compos Struct 88(2):253–261
CrossRef (https://doi.org/10.1016/j.compstruct.2008.04.006)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Experimental%20studies%20on%20fracture%20characterisation%20and%20energy%20absorption%20of%20GFRP%20composite%20box%20structures&author=H.%20Ghasemnejad&journal=Compos%20Struct&volume=88&issue=2&pages=253-261&publication_year=2009)

19. Yang HS, Kim HJ, Son J, Park HJ, Lee BJ, Hwang TS (2004) Rick-husk flour filled polypropylene composites; mechanical and morphological study. Compos Struct 63:305–312
CrossRef (https://doi.org/10.1016/S0263-8223(03)00179-X)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Rick-husk%20flour%20filled%20polypropylene%20composites%3B%20mechanical%20and%20morphological%20study&author=HS.%20Yang&author=HJ.%20Kim&author=J.%20Son&author=HJ.%20Park&author=BJ.%20Lee&author=TS.%20Hwang&journal=Compos%20Struct&volume=63&pages=305-312&publication_year=2004)

20. Persico P et al (2011) Mechanical and thermal behaviour of ecofriendly composites reinforced by Kenaf and Caroà fibers. Int J Polym Sci.
https://doi.org/10.1155/2011/841812 (https://doi.org/10.1155/2011/841812)

Copyright information

About this article

Cite this article as:
Hasan, M.H., Mollik, M.S. & Rashid, M.M. Int J Adv Manuf Technol (2018) 94: 1863. https://doi.org/10.1007/s00170-017-0883-z

- DOI (Digital Object Identifier) https://doi.org/10.1007/s00170-017-0883-z
- Publisher Name Springer London
- Print ISSN 0268-3768
- Online ISSN 1433-3015

- About this journal
- Reprints and Permissions

Personalised recommendations