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Effect of Rice Husk Ash on Tensile Strength of Polymer Composites Reinforced Kenaf Fiber

Mohd Fairuz Alias[1], Mohammad Sukri Mustapa[2], Nur Azam Badarulzaman[3], Idayu Nasir[4], Thariq Hameed Sultan[5], Noradila Abdul Latif[6].
[1,2,3,4,6]*Faculty of Mechanical and Manufacturing Engineering, Universiti Tun Hussein Onn Malaysia (UTHM), 86400 Parit Raja, Batu Pahat, Johor, Malaysia.*
[5]*Department of Aerospace Engineering, Faculty of Engineering, Universiti Putra Malaysia, 43400 Serdang, Selangor Darul Ehsan, Malaysia.*
aliasmohdfairuz@gmail.com, sukri@uthm.edu.my,azam@uthm.edu.my, ad150283@siswa.uthm.edu.my, thariq@upm.edu.my, noradila@uthm.edu.my.

Article Info
Volume 81
Page Number: 672 - 678
Publication Issue:
November-December 2019

Article History
Article Received: *3 January 2019*
Revised: *25 March 2019*
Accepted: *28 July 2019*
Publication: *25 November 2019*

Abstract
The development eagerness toward the composites field gives significance, especially foreco- friendly materials and products. Hence, this research is to investigate the mechanical properties and to obtain the optimum tensile strength properties of silica (rice husk ash) and kenaf fibre reinforce polypropylene(pp). This study has two different grades of rice husk silica (79.09 % wt and 95 % wt). Tensile strength from the proportion of 30% kenaf – 70% PP and 40% kenaf - 60% PP with the different percentage of RHA which is 0%, 2%, 6% and 10% have been recorded. PP - kenaf - RHA were mixed and been through injection moulded for further study about their tensile strengths. Overall 30% wtkenaf and 70% wt PP shows the best result of tensile strength at 2% RHA while for 40% wtkenaf and 60% wt PP has best result tensile strength at 10% RHA.

Keywords: *Kenaf Fiber, Polypropylene, Rice Husk Ash, Wood Plastic Composite, Tensile Strength, SEM.*

1. Introduction

Nowadays, increasing of interest in developing material that are from sustainable are so popular to raising awareness of environmental. As we know, natural fibre is renewable resources, environmental friendly, lightweight, good thermal insulation and biodegradability that reinforcing fibres and polymers which good improvement for furniture applications such as chair and wardrobe. For example, natural fibre is usually popular on producing wood plastic composites (WPC) such as decking, ceiling and chair which has proven natural fibre is suitable to reinforce in composite material. Natural fibre can be further classified with three categories which are vegetable, mineral, and animal. Moreover, wood itself is not so expensive and wood is stiffer and tougher than material polymer of synthetic that makes reinforcing them. Nowadays,

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wood plastic composite (WPC) are used in, applications of market sectors that includes : The market for WPCs is wider rapidly in many countries in the world, where WPCs are used for exterior products. There is a need to enhance the mechanisms responsible for the WPC weathering and also, develop improving methods weathering resistance by undergo undesirable color change, chalking, shrinkage and swelling. Rice husk is produced from a process of rice milling which is a agro wastes that has a good thermal insulating because of high amount of silica content (Marti Ferrer et al., 2004). Rice husk naturally contain cellulose, hemi-celluloses and lignin increased the composites modulus. In addition, hemicellulose that content in rice husk can help in biodegradation process.

Kenaf is one of lignocellulose plants that can be created over a good exposure of weather conditions (Nishino et al., 2003). A research by (Rowell et al., 1999) said that the tensile modulus and flexural of 50 wt% of kenaf fibres mixed with polypropylene composites is almost the same or higher than 40 wt% glass fibres mixed with polypropylene composites as well. Polypropylene (PP) is popular that relates with automobiles, house wares and packaging. The characteristic of PP is light in weight and low cost. A research by (Arjmandi, Hassan et al., 2017) said that polypropylene is a good resistance to heat and chemical as well and make it suitable for a lot of applications. The natural fibre polymer composite is fabricated by following the International Standard Organization (ISO) 527.

2.0 Methodology

There are two different grades of rice husk ash which are, grade 1 non chemical (NC A) in amorphous conditionis 79.09%wt of silica content while grade 2 non chemical (NC B) in crystalline is 95%wt of silica content. Each of the grades is dividing into two batches with rice husk ash as stated in Table 2.1, and two batch without rice husk ash as stated in Table 2.2

Table 2.1: Ratio of kenaffiber and rice husk silica reinforced polypropylene with silica.

NC A (79.09% ofsilica content)			NC B (95% of silicacontent)		
KF	PP	RHA	KF	PP	RHA
30%	70%	2%	30%	70%	2%
30%	70%	6%	30%	70%	6%
30%	70%	10%	30%	70%	10%
40%	60%	2%	40%	60%	2%
40%	60%	6%	40%	60%	6%
40%	60%	10%	40%	60%	10%

Table 2.2: Ratio of kenaf fibre and rice husk silica reinforced polypropylene for without silica.

Kenaf fibre	Polypropylene	Rice Husk Ash
30%	70%	0%
40%	60%	0%

After mixing the material by using Plastograph EC machine, the sample have to be in pallet size after mixing process to ensure that the sample can fit nicely in injection moulding machine. The polymer composites then compress by using injection moulding process with a mould size of dog-

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bone to fabricate the specimen with following the ISO 527- 5a standard. Throughout the experiment, the temperature was set up at 190 ºC. Tensile test is used to obtain the properties of tensile such as tensile strength, Young Modulus, tensile strain and maximum force.

3.0 Result and Discussion

For amorphous, the percentage of silica content in the rice husk ash is 79.09%. The data was obtained with cross head rate 1mm/min with 5kNload.

Table 3.1: Results of ultimate tensile strength for amorphous silica, 79.09% of silica content.

Sample	Rice Husk Silica (%)	Ultimate tensile strength (MPa)	Young Modulus, E (MPa)
30% KF +70%PP	0	22.08	446.96
	2	22.75	459.59
	6	22.18	551.74
	10	21.82	491.44
40%KF +60%PP	0	22.05	562.5
	2	23.08	574.13
	6	23.16	560.77
	10	23.93	619.94

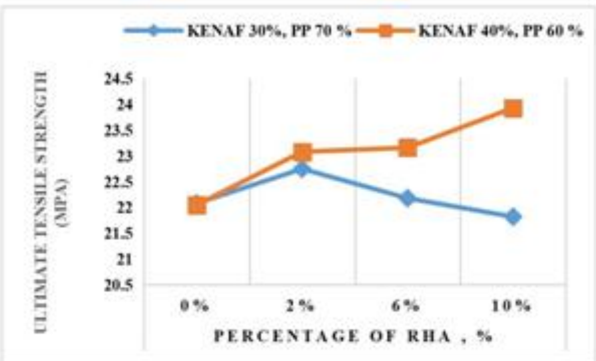


Figure 3.1: The data shows the different of percentage of RHA of amorphous silica (79.09% of silica content).

Table 3.2: Results of ultimate tensile strength for crystalline silica, 95% of silica content.

Sample	Rice Husk Silica (%)	Ultimate tensile strength (MPa)	Young Modulus, E (MPa)
30% KF + 70%PP	0	22.08	446.96
	2	22.66	443.44
	6	21.62	429.82
	10	21.39	460
40%KF + 60%PP	0	22.05	562.5
	2	22.43	535.32
	6	22.61	568.09
	10	23.95	513.94

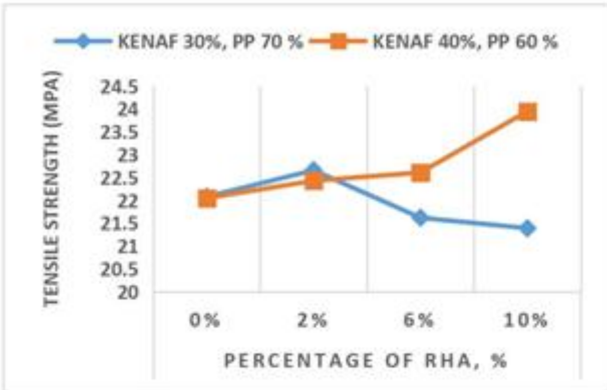
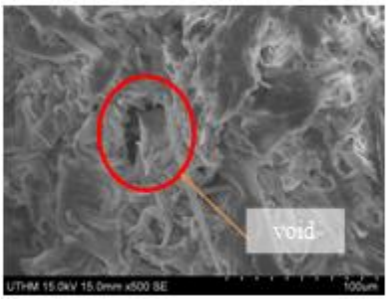


Figure 3.2: The data shows the different of percentage of RHA of crystalline silica (95% of silica content).



(a)

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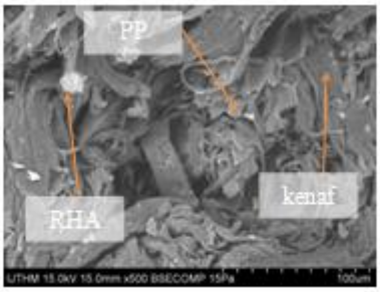
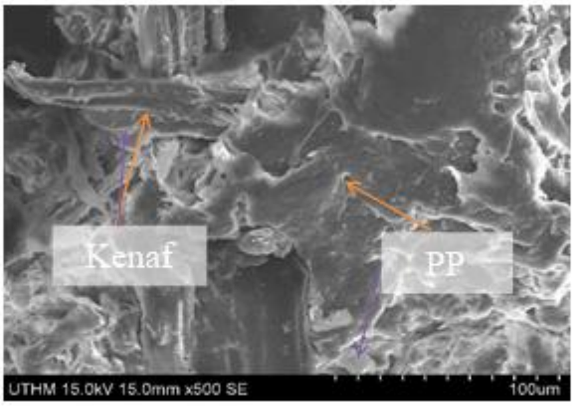
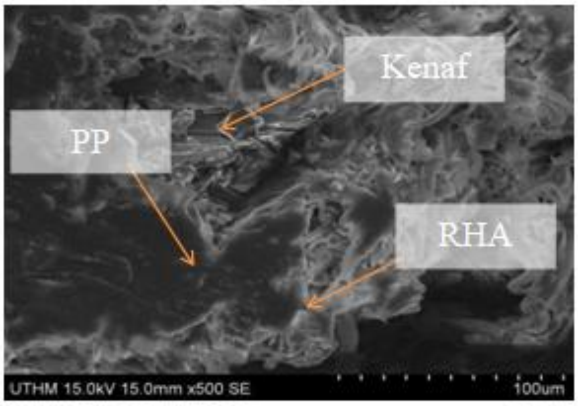


(b)

Figure 3.3: SEM micrographs of sample (a) 30% kenaf, 70% PP with 0% of RHA, (b) 30% kenaf, 70% PP with 2% of RHA(79.09%)

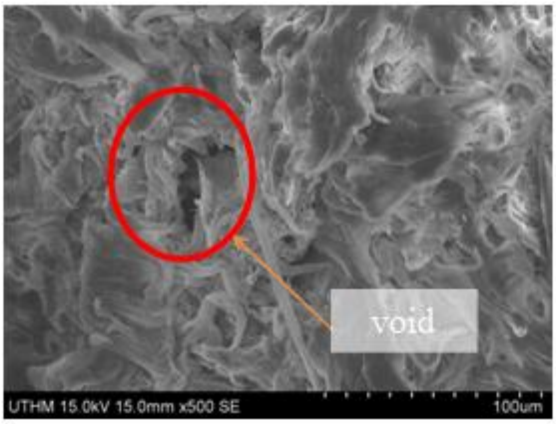


(a)

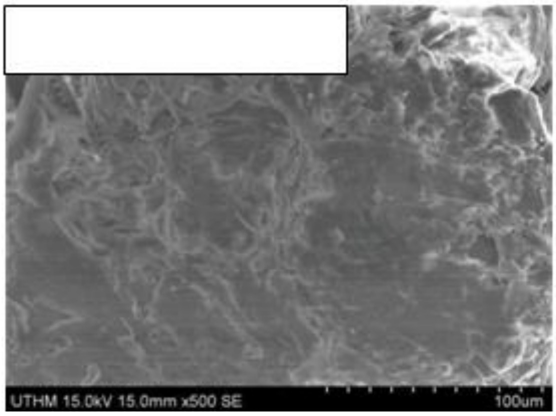


(b)

Figure 3.4: SEM micrographs of sample (a) 40% kenaf, 60% PP with 0% of RHA and (b) 40% kenaf, 60% PP with 10% of RHA(79.09%) at 500x magnification.

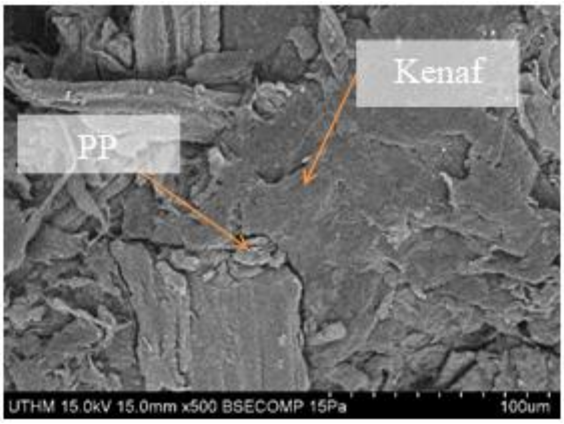


(a)



(b)

Figure 3.5: SEM micrographs of sample (a) 30% kenaf, 70% PP with 0% of RHA, (b) 30% kenaf, 70% PP with 2% of RHA(95%)



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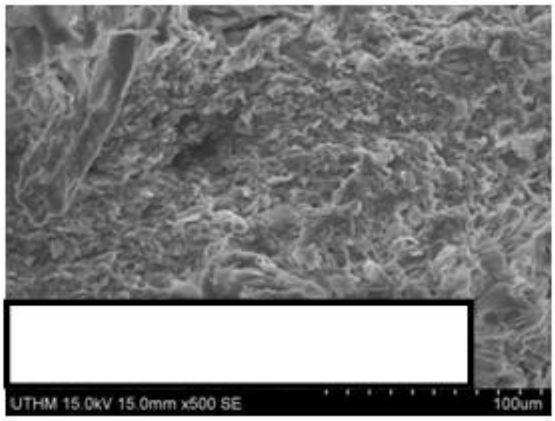

Figure 3.6: SEM micrographs of sample (a) 40% kenaf, 60% PP with 0% of RHA and (b) 40% kenaf, 60% PP with 10% of RHA(95%)

The interfacial bonding for 30% kenaf and 60% polypropylene with and without the additional of RHA shows through SEM stated that there is no present of void, and showed more stable microstructure with the present of RHA. Figure 3.4, shows the micro structure for 40% of kenaf and 60% of PP with addition of RHA 0% and 10%. From the results, the data increases with the additional of RHA and obtained the highest tensile strength with addition of 10% RHA, 23.93 MPa with young's modulus, 619.94 MPa. The results obtained has not reached the optimum tensile strength it shows that the kenaf, rice husk silica and polypropylene were mix well during the process. By referring to the scanning electron microscopy (SEM) images on Figure 3.5(a), the interfacial bonding of 2% of RHA from crystalline silica shows there was no void to be compared with additional of 0% of RHA on Figure 3.5(b). It removed the void with mixing well and having the optimum ultimate tensile strength, 22.66 MPa with Young's modulus, 443.44MPa. While, the stress of RHA degraded when used 6% and 10% of RHA this is because the optimum concentration of kenaf fibre (Suhairil*et al.*, 2012). Figure 3.6 shows images of scanning electron microscopy (SEM) that were observed at 0% and 10% of RHA with 40% kenaf reinforced 60% polypropylene. This observation can be clarified that at this ratio, kenaf fibre are well bonded with polypropylene. Furthermore, with the addition of rice husk ash (RHA), improved the adhesion between polypropylene and kenaf. Based on this research with this ratio of kenaf and polypropylene, the tensile strength still has not reached the optimum tensile strength because the data shows an increasing pattern for 2%, 6% and 10% of RHA.

4.0 Conclusion

Resulting from this study, RHA effects have shown their suitable characteristics upon kenaf fibre in fibre engineering field on fibre reinforced polymer composite. In this study, it can be concluded upon effect of the RHA as follows:

- For amorphous silica type, the RHA with mixing percentage of 30% kenaf fibre and 70% pp has increased the ultimate tensile strength when additional of RHA are reaching 2%. When the mixing percentage are increased to 6% and 10% of RHA, it cause lowering the value of ultimate tensile strength of fibre until it dropped down until below the control sample condition.
- While RHA amorphous silica with mixing percentage of 40% kenaf and 60% of pp, it resulting the tensile strength are getting higher when RHA are added as much as 2%, 6% and 10% rather than control samples at 0% of RHA.
- Mixing percentage of 40% kenaf fibre and 60% pp, has shown the best results on

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polymer composites at tensile strength rather than 30% of kenaf fibre and 70% pp.

- In crystalline silica type for RHA, contents of 30% kenaf fibre, 70% pp when the RHA are added as much as 2% has shown that tensile strength has been increased rather than control sample which have been added with RHA at 6% and 10%
- At portion of 40% kenaf fibre, 60%pp, the tensile strength are increasing when RHA are added in 2%, 6% and 10%.
- It shown that the effects of RHA upon reinforced polymer composites fibres have increased the tensile strength especially for mixing portion at 40% of kenaf fibre and 60% pp.

Acknowledgment: This project has been funded and supported by Universiti Tun Hussein Onn Malaysia via Postgraduate Research Grant (Vot. No.: U965)

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