Effect of pineapple leaf fiber loading on the properties of pineapple leaf fiber – polypropylene composite

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ABSTRACT – Nowadays, the natural fibers are widely used in FRP composite especially as automotive interior parts because it is much cheaper and natural availability compare to glass fiber and carbon fiber. This paper discusses the effects of pineapple leaf fiber (PLF) loading on the mechanical properties of pineapple leaf fiber/polypropylene (PLF/PP) composite. An alkaline treatment was conducted to enhance the PLF properties before the formation process of PLF/PP composite. The mechanical properties of PLF/PP composite were determined using tensile test, hardness test, density measurement and microstructure analysis. The result of PLF/PP composite with a composition of 30/70 showed the best mechanical properties comparable to others composition ratios.

1. INTRODUCTION

Natural fiber is an alternative to glass fiber in FRP composite materials industry, especially in automotive application. Natural fibers composite give a combination of excellent mechanical property, dielectric property, and environmental advantages such as recyclable, biodegradable and renewability [1-2,7]. Pineapple leaf fiber is one of the most attractive materials as a strengthening natural fiber, and the mechanical properties of PLF are listed in Table 1. Mohamad et al [6], states that in Malaysia the pineapple industry is markable but only the fruit is used and other part such as leaf is thrown away, thus causing pollution and wasting the best potential sources of fiber. Furthermore, this study aims to investigate the effect of PLF loading on the properties of PLF/PP composite and to explore the potential of this composite. The mechanical properties such as tensile stress, hardness, bulk density and microstructure are observed.

Table 1 Properties of pineapple leaf fiber: [5]

Property	Value
Density (g/cm^3)	1.526
Softening Point (°C)	104
Tensile Strength (MPa)	170
Young's Modulus (MPa)	6260
Specific Modulus (MPa)	4070
Elongation at Break (%)	3
Moisture regain (%)	12

2. METHODOLOGY

The materials used in the fabrication of FRP composites are PLF and PP. Figure 1 (a) and (b) shows the image of PLF and PP. Meanwhile, the composition of this composite is listed in Table 2.

(a) (b)

Figure 1 Photograph image: (a) PLF ; (b) PP

Before the PLF can be used as filler, an alkaline treatment was done. The raw pineapple leaf was first cut into small pieces with the length of 10 cm and then rolled used roll mill machine. After that, these small pieces were then immersed in 5% concentration of the NaOH. The 1% concentration of the HCL was used to neutralize the PLF. The functions of chemical treatments are to clean all the impurities, treat the fiber surface and also to stabilize the molecular orientation [2-4]. Vinod and Sudev [3] state that by undergoing the chemical treatments the mechanical properties of the material can be improved. After the formation process by using a hot compression mold, some mechanical testing was conducted that are tensile test (ASTM D 3039/D 3039M-00), shore hardness test, density measurement and microstructure analysis.

Table 2 Composition of PLF/PP composite

PLF (%)	PP (%)
70	30
60	40
50	50
40	60
30	70

3. RESULTS AND DISCUSSION

Figure 2 shows the graph of tensile stress versus composition of PLF/PP composites. The graph shows that the tensile stress, increased with the decrease of PLF contents. The reason for this distinct value is because at the composition of (PLF/PP) 30/70, a higher value of PP has resulted a high plasticity behavior due to the thermoplastic type of polymer. Meanwhile the

microstructure of each composite as shown in Table 3 shows that the voids percentage was reduced as PP content increased and it also shows a good adhesion between the PLF and PP. Hence, it has held the PLF firm and this affected their mechanical properties.

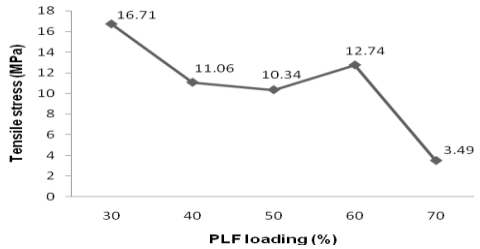


Figure 2 Tensile stress (MPa) versus PLF loading (%)

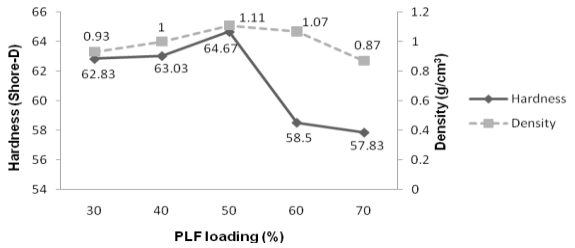
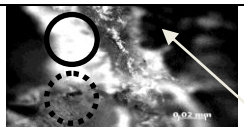
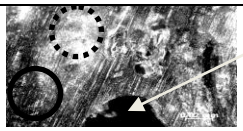
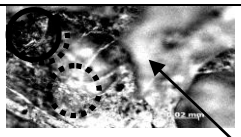
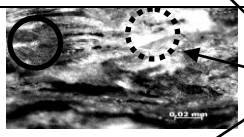
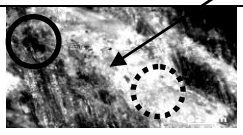


Figure 3 Hardness (Shore-D) and density (g/cm^3) versus PLF loading (%)

Table 3 Microstructure of PLF/PP composites

Ratio (%) PLF/PP	Microstructure view	Remark
70/30		Void
60/40		
50/50		
40/60		Good adhesion
30/70		

PP PLF

Figure 3 shows the graph of hardness (Shore-D) and density (g/cm^3) versus composition of PLF in PLF/PP composites. The results show that the hardness and density has increased with the increasing of PLF until 50%PLF and after that both value has reduced as PLF content has been increased. Based on the mechanical properties test has been conducted, for tensile and density tests the best result is shown by 30%PLF, while for the hardness test for PLF loading 50% up to 30 % the values are almost same. Moreover, for PLF loading 70% up to 60%, all the properties is shown the lowest value is due to less wetted of PP with PLF.

4. CONCLUSIONS

The effects of pineapple leaf fiber loading on the properties of PLF/PP composite have been studied and determined. Based on the results of tensile stress, hardness and density, it can be concluded that the PLF/PP composite with the composition ratio of 30/70 has shown the best mechanical properties comparable to others composition ratios. However, for PLF/PP composites with PLF loading of 60% and 70% is not suitable for composite materials because it shows the lowers mechanical properties.

5. ACKNOWLEDGEMENT

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