Abrasive wear rate on natural fibre composite

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ABSTRACT – This paper presents an experimental work to determine the effect of kenaf fibre loading in the polyester matrix through dry sliding test. These composites were produced by mixing raw kenaf fibre with polyester resin. The samples were prepared at 5 different weight percentages of fibre namely: (5, 10, 15, 20 and 25 wt%). Abrasion Tester (TR-600) was used to carried out abrasive wear tests in dry sliding conditions. These tests were performed at 10N load and constant sliding velocity of 1.5m/s. The specific wear rates of natural fiber composites were obtained. The morphology of composite surface before and after tests was also examined using 3D microscope imaging.

1. INTRODUCTION

Fiber can be classified into two components; man-made and natural fiber. The natural fiber can come from plant, animal and also mineral. The most common type of plant fiber is kenaf. Usage of natural fibers as a reinforcement for polymer composites are well known for major studies because of their properties such as lightweight, renewability, low density, high specific strength, non-abrasive, combustibility, non-toxicity, low cost and biodegradability [1,2].

Wear was defined as the loss of material from any contacting surface when subjected to relative motion. Other definitions of wear were any form of surface damage due to rubbing process on one surface against another. Abrasive wet test also known as erosion test or slurry test defined as loss of material under lubricating contact. Previous study on dry sliding experiment define Specific wear rate, Ws, as [2-5],

$$Ws = (\Delta m) / (L \times \rho \times F) \quad (1)$$

Where, Ws in (mm3/Nm); Δm is weight loss (g); F is applied load (N), ρ is density (g/mm3) and L is sliding distance (m).

2. EXPERIMENT SETUP

2.1 Kenaf Fibre Composite

Kenaf Fiber with Polyester Composite was supplied by Innovative Pultration Sdn. Bhd. Polyester Resin was supplied by Mostrong Industries Sdn. Bhd. The kenaf fibres loading used in the composite was 5, 10, 15, 20 and 25 wt%. From previous research have been done before, the proses of sample preparation can be summarized as Figure 1.

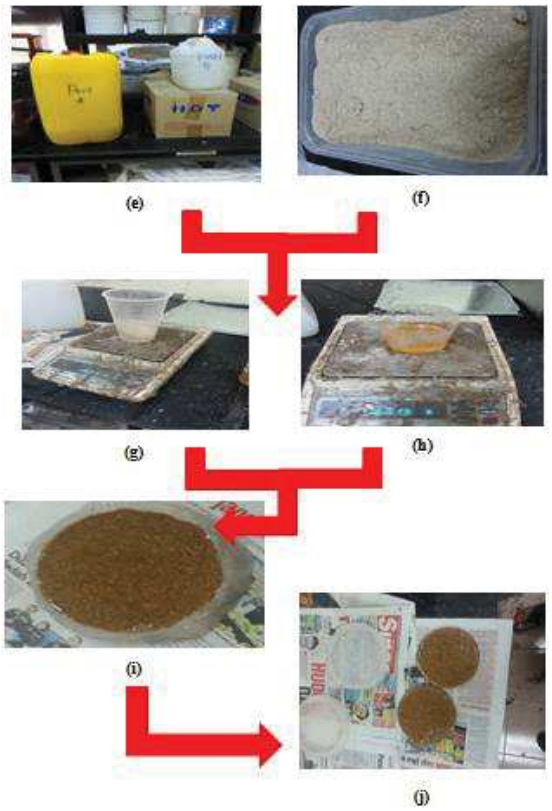

Figure 1 Fabrication of specimen.

2.2 Experimental Setup

Abrasion Resistance Tester (TR-600) was used in this sliding wear test. Kenaf fibre composite sample was attached to the rotational disc and put in contact with two rotating abrasive wheels made of vitrified bonded silicon carbide. Before each test, abrasive wheels were cleansed from any dust using a dry brush. The size of the composite sample is 122 mm in diameter and 5 mm thickness. Summary of the operational conditions was tabulated in Table 1. The amount of weight loss for each specimen was measured before and after the test at suitable intervals by weighing the disc specimen to an accuracy of +0.0001g using a precision balance. Specific wear rate at each operating condition was determined using equation (1).

The surface condition of each material sample was also analyzed using an optical 3D surface measurement device. From the 3D surface measurement, details of the

surface morphology and the surface roughness were obtained. Infrared camera (PTI 160) was used to capture the thermal distribution at the contact of the surface.

Table 1 Operational parameters in abrasion test.

Parameters	Experimental conditions
Contact Geometry	Cylinder on Flat
Applied load (N)	10
Sliding Speed (m/s)	1.5
Sliding distance (m)	2000 to 10000 at interval of 2000

3. RESULTS AND DISCUSSIONS

The results obtained from experiment for specific wear rate was shown in Figure 2. Specific wear rate of 20% and 25% of kenaf had a smaller wear rate after 2000m

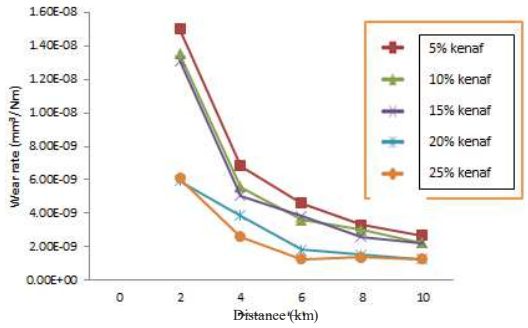

Figure 2 Specific wear rate of Kenaf composite over distance.

Observation on surface morphology gives the surface roughness of kenaf composite. Average surface roughness (R_a) for before and after tests were tabulated in Table 2.

Table 2 Surface roughness before and after test.

Sample	Average Surface Roughness (R_a)	
	Before	After
5%	1.601	1.553
10%	2.350	2.225
15%	2.601	2.373
20%	2.896	2.601
25%	3.366	2.817

Thermal distributions at the abrasive wheel contact were captured for selected samples as shown in Figure 3. The maximum temperature values recorded was 39.2°C. This data enable us to know the composite condition due to friction.

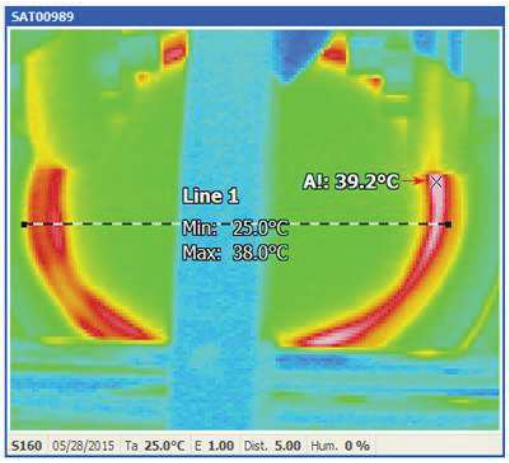

Figure 3 Thermal distribution at abrasion wheel.

4. CONCLUSIONS

From this study it can be concluded that composition of kenaf fibre had an effects to specific wear rate of the composite surface. Besides, surface roughness of test sample is increased with increasing of fiber loading.

5. ACKNOWLEDGEMENT

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