Tribological Behavior of Fiber Reinforced PA66 Material under High Contact Pressure, Sliding and Grease Lubricated Conditions

CATEGORY OR KEYWORDS
Composite materials, Wear of materials

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INTRODUCTION

Polyamide66 (PA66) is widely used for sliding parts. Reinforcement fibers are usually added to increase its strength. There are various researches on the tribology of fiber reinforced PA66 in contact with metallic material [1]. However, these works are mostly conducted in dry conditions, and there are few reports on the effect of molecular mass of resin or hardness of metallic counterbody on the tribological properties under grease lubricated conditions. In this work, we investigated the tribological mechanisms of fiber reinforced PA66 in contact with metallic material under grease lubrication.

EXPERIMENTATION

Tribological properties were evaluated in sliding test under grease lubricated conditions, with a rotating composite ring in contact with 4 steel cylinders. Fig.1 shows a schematic view of testing device, and Table 1 presents test conditions. Different values of hardness of steel were obtained by different conditions of heat treatment.

RESULTS AND DISCUSSION

The experiments showed the presence of wear and creep deformation. At first, breakage and dropping out of glass fibers (GF) occurred and micro scratches related to the GF were generated, and finally peeling of resin occurred. Creep deformation was higher just after the peeling; however, wear increased with sliding time. In addition, by increasing molecular mass of resin, wear and creep resistance properties of composite were improved. The breakage energy (which is related to toughness of resin) was increased by increasing molecular mass. Therefore, fatigue properties related to repeated stresses were supposed to be increased and higher wear resistance properties were obtained.

Wear of metallic cylinders was also investigated. A decrease in wear of both composite and metal is observed when the molecular mass of resin is increased. The effect of metal hardness on the wear of PA66 is presented in Fig.2. Metal hardness in the inflection point of deformation coincided with the hardness of fiber itself measured by nano-indentation. Thus, it was supposed that when the hardness of fiber is higher than the hardness of metal, wear of fibers in surface occurred and composite was worn in abrasive wear mode.

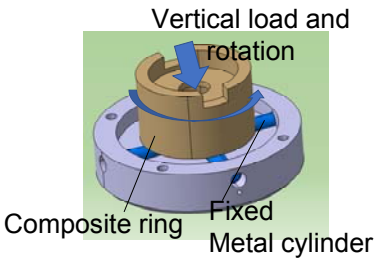

Fig.1 Schematic view of testing

Table 1. Testing conditions

Item		Value
Composite ring	Outer diameter	25.6 mm
	Inner diameter	20 mm
	Height	12 mm
Metal cylinder	Material	S45C (Fe+0.45% C)
	Diameter	φ3.5 mm
	Hardness	HV311-HV660
Grease		Urea grease
Contact pressure		156-198 MPa
Rotation speed		1 m/s
Temperature		RT
Testing time		Total: 4 hr in which 10sec driving and 20sec stopping are repeated

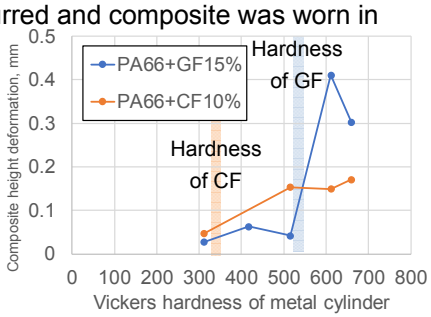

Fig. 2 Relation between hardness of metal and deformation of composite

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