TRIBOLOGICAL BEHAVIOR OF FIBER REINFORCED PA66 UNDER HIGH CONTACT PRESSURE AND GREASE LUBRICATED CONDITIONS

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Wear; Friction; –fiber reinforced polymer material; grease lubrication

ABSTRACT

1.Introduction

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

2.Experimentation

Tribological properties were evaluated in sliding test under grease lubricated conditions, with a rotating resin ring in contact with 4 steel cylinders. Fig.1 shows a schematic view of the testing device. Normal force is applied to obtain high contact pressure. Table 1 shows test conditions. Effects of counterpart metal hardness was also studied. Different values of hardness of steel were obtained by different conditions of heat treatment.

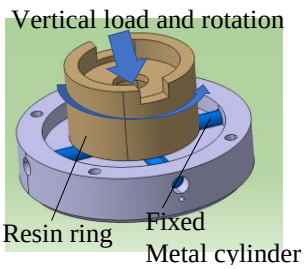

Fig.1 Schematic view of testing device

Table1 Test conditions

Item		Value
Resin ring	Outer diameter	25.6 mm
	Inner diameter	20 mm
	Height	12 mm
Metal cylinder	Material	S45C (Fe+0.45% C)
	Diameter	3.5 mm
	Hardness	HV311-HV660
Grease		Urea grease
Normal load		220-350 N
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

3.Results and discussion

The experiments showed the presence of wear and creep deformation. At first, breakage and dropping of GF occurred and micro cracks related to the GF were generated, and finally peeling of resin occurred. The creep deformation was higher just after the peeling, however the wear increased by increasing sliding time. In addition, by increasing molecular mass of resin, it took longer time for the vertical displacement to start to increase linearly compared to the normal molecular mass sample, and the increasing speed of displacement was lower. The breakage energy (which is related to toughness of resin) was increased by increasing molecular mass. Therefore, fatigue properties related to repeated stress were supposed to be increased and high wear resistance properties were obtained.

Wear of metallic cylinders was also investigated. A decrease in wear of both resin 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 and converted to Vickers hardness. Thus, it was supposed that when the hardness of fiber is higher than the hardness of metal, wear of fibers in surface occurred and resin was worn in abrasive wear mode.

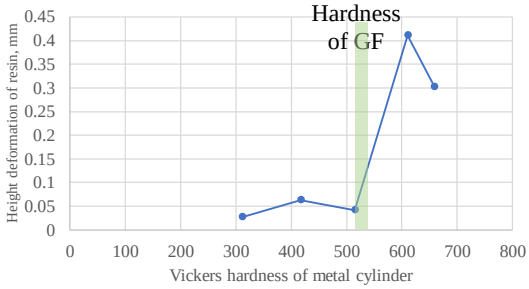

Fig.2 Relation between Vickers hardness of metallic cylinder and height deformation of resin ring reinforced by GF.

REFERENCES

[1] Shin, M. W., Kim, S. S., & Jang, H. (2011). Tribology Letters, 44(2), 151–158.A.