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Study on High Temperature Resin-based Antifriction Composite

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ABSTRACT: High temperature resin-based antifriction composite was prepared by using bismaleimide resin as matrix resin, asbestos cloth and E-glass colth as friction material and reinforcing material, and molybdenum disulfide as solid -lubricant. The composite features thermo-oxidative stability, good mechanical properties, antifriction and wear resistance. It can be used to fabricate the sliding tracks in PP and PET film stretching machineries.

Key words: bismaleimide resin, high temperature, antifriction composite, sliding track.

1.INTRODUCTION

The resin-based antifriction composites are the materials, with good physico-mechanical properties, antifiction and wear resistance, that are made of matrix resins, lubricants and reinforcing materials. Because of its small specific density, chemical corrosion resistance, low pollution, low energy consumption, good processability and long service life, they have been widely applied to various industries. For example, they have been used as sliding tracks, bearings, gears, piston rings, rotor blades of vacuum pumps, sliding plates of rotating air-compressers, and brake-blocks, etc.

In primary technology, metal materials, such as bronze, brass, and cast iron, were always used to fabricate the sliding tracks in PP and PET film stretching machineries. They were worn easily during sliding against metal parts. Thus the accuracy and service life of the film stretching machineries were affected. However, in advanced technology, high temperature resin- based antifriction composite materials have been utilized to manufacture the sliding tracks as they meet the operation needs for the facilities that perform with long service life, high productivity; and that produce film with equality in thickness.

The aim of this study is to develop a high temperature resin-based antifriction composite which can be used as sliding tracks in film stretching machineries.

2.EXPERIMENTAL

Materials used for preparing high temperature resin-based antifriction composite include 4.4'-diaminodiphenyl methane bismaleimide, 4.4'-diaminodiphenyl methane, N.N'- dimethyl acetamide, toluene, asbestos fiber cloth. E-glass fiber cloth, molybdenum disulfide and graphite.

First, bismaleimide resin was prepolymerized in a reactor, secondly, reinforcing material and solid- lubricant were impregnated with that resin in a tank, And then, they were hung up and dried in air, after several days they were dried again in a oven at elevated temperature. Finally these prepregs were pressed with appropriate processing, by using hot press to prepare a high temperature resin-based antifriction composite.

The friction and wear tests were carried out on a MM-200 ring-block wear tester. The steel ring was made of 45# steel, In this experiment, the friction and wear tests were

performed at room temperature in dry friction condition with a speed 200 r/min, load 9.8N, time 1.0 hour.

The impact strength and flexural strength were measured according to GB/T1043 standard.

3.RESULTS AND DISCUSSION

3.1 Selecting of Matrix Resin

When the film stretching machineries operate, the sliding track made of resin-based antifriction composite will be worked at high temperature 200℃ to 300℃ and high speed 100m/min to 130m/min, and be corroded by hot lubrication -oil. So, in order to meet these requirements, the matrix resin for the antifriction composite must have advantages of high thermal stability, high heat distortion temperature, good chemical corrosion resistance, excellent mechanical properties at high temperature, strong adhesion to the fibre reinforcing material, and good processability.

Bismaleimide resins have been extensively applied to aerospace. eletrical and nuclear industry as matrix resins for fibre comopsites. Reported in some references[6], the thermal-oxidative stability of bismaleimide resins was between that of epoxy resins and polyimides. Its thermal service life was more than 20,000 hours at 180℃ to 200℃, therefore, bismaleimide can be used at high temperature 180℃ to 250℃. The heat distortion temperatare of bismaleimide resin modelings which were combined with glass fibre, astestos and graphite as filler were about 300℃ to 350℃. The residue of its flexural strength at 250℃ compared to that at room temperature was more than 70 percent. And, bismaleimide resins with good processabity can cure at 210℃ to 230℃. Therefore, bismaleimide resin was selected as the matrix for the high temperature resin -based antifriction composite.

3.2 Friction and Wear Properties in Dry Friction Condition

The friction and wear results of the antifriction composite sliding against 45# steel in dry condition are shown in Table Ⅰ.

Table Ⅰ The Friction and Wear Results of High Temperature Resin-based Antifrition Composite

Material	Friction Coefficient	Wear (mg)
no lubricant	0.559	11.0
10% lubricant	0.32	3.4
foreign sample	0.48	16.0

Sliding speed: 200r/min; load 9.8N; time 60min

The results in Table I indicate that friction coefficient and wear are reduced by filling the composite with molybdenum disulfide as lubricant; the content of molybdenum disulfide increases from 0 to 10 percent, the friction coefficient reduced from 0.559 to 0.34 and the wear reduced from 11.0mg to 3.4mg. The results in Table I also have shown that the friction and wear properties of our product were better than that of those from foreign country. It is because of the interaction between composite and steel, and the transfer of composite onto the counterface to form a film.

3.3 Mechanical Properties

The impact strength and flexural strength of the high temperature resin-based antifriction composite are shown in Table Ⅱ.

Table Ⅱ Impact Strength and Flexural Strength of High Temperature Resin-based Antifriction Composite

Material	Impact Strength (KJ/m^2)	Flexural Strength (MPa)
asbestos cloth	4.5～5.8	60～80
asbestos cloth : glass cloth =39 : 1 (wt)	11.3	56.06
Product	29.5	87.8
foreign sample	14.0	96.5

tested by GB/T1043 standard

The results in Table Ⅱ indicate that the impact strength and flexural strength of the antifriction composite with asbestos cloth as single reinforcing material are so low that it can't reach to the requirements of track material in film stretching machineries. To raise the mechanical strength, E-glass cloth was added to be combined with asbestos cloth, but the glass colth must be limited within a proper range of content. The impact strength and flexural strength of our product are 29.5 KJ/m^2 and 87.8MPa respectively. The mechanical properties of the antifriction composite meeted the requirements of sliding track in film stretching machineries.

3.4 Hot Oil Corrosion Resistance

Blocks of the antifriction composite were dipped into the transformer oil at 230℃ to 250℃ about 8 hours, no crack occurs.

4.CONCLUSION

(1) The high temperature resin-based antifriction composite, with excellent thermo-oxidative stability, good mechanical properties, antifriction and wear resistance, which is made of bismaleimide resin as matrix resin, abestos cloth and E-glass cloth as friction material and reinforcing material and molybdenum disulfide as solid- lubricant, is suitable to manufacture sliding track in PP film stretching machineries.

(2) solid-lubricant used as filler reduce the friction coefficient and wear of the resin-based composite.

(3) Mechanical properties of the high temperature resin -based antifriction composite can be increased by E- glass cloth.

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