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Preparation of TPU-polyester Coated Fabrics with High Adhesive Performance

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Abstract. In this paper, two kinds of adhesives were introduced into the treatment on polyester fabrics, and all achieved after calendered conjointly with TPU. Then the standing against of water was investigated too.

Introduction

Polyester fiber, as a reinforcing material, is widely used in lots of composites, such as tires, belts, hoses and coated fabrics for its excellent mechanical strength, dimensional stability and heat resistance [1]. Because of low active surface of polyester fiber, the interface can not be formed the strongly adhesion between polyester fiber and other polymer (rubber or TPU and so on) [2-4]. Traditionally two-step dipping process is used to improve the interfacial adhesion between polyester cord and rubber, and after the first step dipping process, such as D-417 of US Dupont, the interfacial adhesion can be much improved [5,6]. In this paper, the first step dipping process, similarly as D-417, was introduced into TPU-polyester coated fabrics firstly, and two kinds of adhesives both achieved excellent interfacial adhesion after calendered conjointly with TPU. As the outstanding materials for water storing tanks, the standing against of water for TPU-polyester coated fabrics was investigated too.

Experiment

Materials and characteristics

The polyester fibers used in this study were 1W72-500D-70f low shrinkage PET industrial fiber, produced by Performance Fibers (Kaiping) Com., Ltd., with linear density 555dtex, breaking strength 41.1N, tenacity 7.4cN/dtex, thermal shrinkage 1.7% and elongation at break 21.0%. The density of fabrics was 235/10cm (T) and 170/10cm (W), and the thickness was 0.37mm.

The first adhesive (sample A) was adopted from EMS, Switzerland, and the content of condensate was 4.84%. The second adhesive (sample B) was homemade, and the content of condensate was 3.3%.

Coated fabric preparation

Firstly, the polyester fabric was cleaned out with alkalescent lotion to wipe off the external dye printing and dyeing.

And then the polyester fabric was immerged into the adhesives for adequate time. In succession, the polyester fabric was heat treated at 150 ºC and 190 ºC in turn for about 2 minutes.

Finally, the pretreated polyester fabric was calendered conjointly with TPU.

Determination of performance

The determination of adhesive strength conformed to GB/T2791-1995, Adhesives T peel strength test method for a flexible-to-flexible test specimen assembly.

The determination of water resistance is listed as follows: firstly the coated fabrics are immerged into distilled water in 70 ºC, and take out it after six weeks and test the adhesive strength, finally calculate the ratio of the final strength to the primal strength.

Results and discussion

As is shown in Table 1, two kinds of adhesives, sample A and sample B, was used as bond to improve the interfacial strength. For sample A, the maximum and average adhesive strength of is 84.32N/5cm and 68.36N/5cm respectively. At the same time, the maximum and average adhesive strength of the homemade sample B reaches 93.68N/5cm, 74.84N/5cm. Hereby we can conclude that the first-step dipping process, traditionally used to improve the interfacial adhesion between polyester cord and rubber, can be used as adhesive to enhance the interfacial performance of polyester fabric and TPU films.

Table 1 Adhesive strength of TPU-polyester coated fabrics after treated with the two adhesives

Sample	Adhesive strength[N/5cm]	
	Max	Average
A	84.32	68.36
B	93.68	74.84

Of course, as one of the most important application, TPU-polyester coated fabric was used as tanks for drinking water storing extensively. Thus the standing against of water for TPU-polyester coated fabrics was important. As shown in Fig. 1, after six-week dipping, the final adhesive strength of TPU-polyester was 63.78 N/5cm. In relation to the primal 82.36 N/5cm, the depressed ratio was just 22.56%.

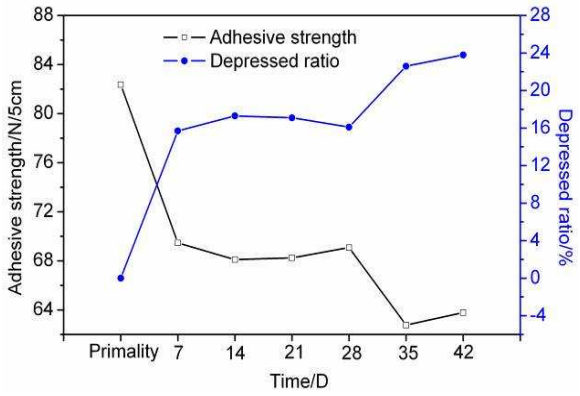

Fig. 1 Adhesive strength of coated fabrics after water-resistant experiment

Through the anterior analysis and study, we can conclude that the two kinds of adhesives are the better bond to improve the interfacial strength. Furthermore the TPU-polyester coated fabric has favorable water resistance, and thus it is suited to use as tanks for water or water-solubility liquid storing.

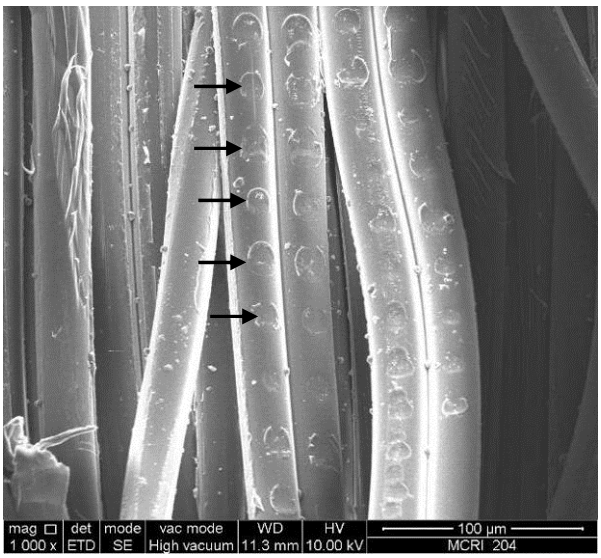

Fig. 2 SEM of TPU-polyester coated fabrics after the TPU film was peeled off

Certainly the high performance of TPU-polyester coated fabrics took its source at the outstanding interfacial coalescent between TPU and polyester. The interfacial coalescent didn't only include physical action, but also chemical action. Especially the effect of the chemical action on interfacial strength was enormous. Fig. 2 was the SEM of TPU-polyester coated fabrics after the TPU film was peeled off. The dot, just as the arrow point to on the surface of polyester fibers, was the best proof for chemical action between TPU and polyester.

Fig. 3 was the EDXA precinct of polyester fabrics after the TPU film was peeled off. Three precinct on the surface of polyester fabrics was studied, and the EDXA results were shown in Table 2.

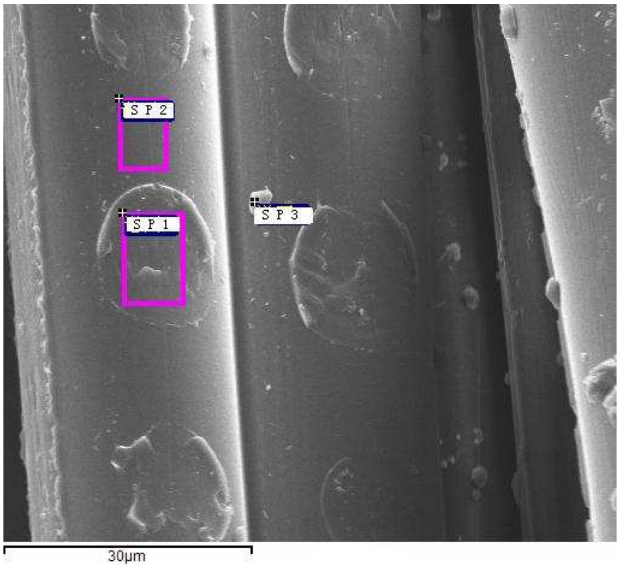

Fig. 3 EDXA precinct of coated fabrics

Table 2 EDXA results of polyester fabrics after the TPU film was peeled off

Precinct	C	N	O	Na	K	Ca	Zn	Total
1	58.45		41.73	0.08	0.02	0.01	0.11	100
2	58.18	0.11	41.94	0.09	0.03	0.04	0.25	100
3	73.80		27.62	0.10	0.53	0.05	0.94	100

The precinct 2 lies in the "slippery" polyester surface, differentiated from precinct 1 and 3, which lie in the convexity of the polyester. As is well known, polyester is mostly composed of carbon and oxygen, thus the content of N was just from the adhesives, and the element N in the precinct 1 and 3 were exhausted during the calendaring process via the chemical action between TPU and polyester.

Conclusion

The first dipping process, traditionally used as the adhesives between polyester cord and rubber, is effective on improving the adhesive strength for TPU-polyester coated fabrics. The TPU-polyester coated fabric, pretreated by the first dipping process, has good water resistance. And the high performance come of better physical and chemical action.

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