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Manufacture Technology of Novel Reinforcing Composite Geotextile Made of Recycled Nonwoven Selvages

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Abstract

The nonwoven waste coming from textile industry takes up 5% of the total waste amount, so to recycle and to regenerate the waste is the prior obligation of the factory to reduce the waste. Nonwoven selvages waste can be buried or burnt but these two methods result in environmental pollution. This research proposes to reuse these waste nonwoven selvages effectively, and is designed as follows. Each piece of thermal-bonding material comprised a sandwich structure, with two layers of 7.0d PET matrices enclosing a layer of PP nonwoven selvage and nylon geogrid. After needle-punching and thermal-pressing, it forms a laminate structure of PET nonwoven/ PP selvage/ PET nonwoven in that it decreases the impact by the environmental pollution and protects the environment ultimately. In addition, thermal-bonding reinforces the mechanical properties of the composite fabric structure. The results of the experiment suggest the optimum manufacture parameters (selvage content: 10 %; thermal-bonding temperature: 220℃; needle-punching density: 400 needles/ cm^2). The composite fabric undergoes the burst strength test and permeable coefficient measurement, evaluating its applications in geotextile filed.

Introduction

According to the statistics by Environmental Protection Administration Executive Yuan, the abandoned selvages and fabrics takes up 3% of the total garbage amount since 2005 while plastic wastes takes up 17%. Both items are 1/5 of the total garbage amount. If we recycle and use them well, there would be many additive values. There has been much research on recycle and reuse of nonwoven in the past years. Particularly, some scholars made an attempt to smash the recycle PP selvages to produce reproduce composite [1]. Some of them changed the lamination way to manufacture stab resistant composite woven [2], sound-absorption composite woven [3], or functional ply yarns using a twister machine [4]. In this research, we used the recycle PP selvages to make composite fabrics as a geotextile.

Materials and methods

Each piece of test material comprised a sandwich structure, with two layers of PET nonwovens enclosing a layer of PP selvages and nylon geogrid. 7D PET staples were with a length of 51mm and underwent the nonwoven process of opening, combing and lining. Then they were reinforced and manufactured into PET nonwoven by needle-punching of 400 needles/cm^2. The weight ratio of the PET nonwoven and PP selvages were 10, 20, 30, 40, and 50 wt%. The sandwich structure was needle punched with 400 needles/cm^2 and thermal-bonded at temperature 220°C. The end product was the composite geotextile. Then the water permeability test, tensile strength test, and tear strength test were implemented in order to obtain the optimum parameters.

Results and Discussion

1 The evaluation on the water permeability of the composite geotextile based on the weight ratio of PP selvages and without Nylon geogrid

Fig. 1 shows the influence of the weight ratio of PP selvages on the water permeability. The water permeability of the composite geotextile decreased with the increment of the PP. When PP was melted, it combined the voids among PET fibers tighter. Thus the higher the PP was, the lower the water permeability became. The content of PP influenced the water permeability remarkably.

2 The evaluation on the water permeability of the composite geotextile based on the weight ratio of PP selvages and one layer of Nylon geogrid.

Fig. 2 shows the influence of the weight ratio of PP selvages on water permeability. PP combined the voids among PET fibers tighter and the thickness of thermal press roller was within 0.2 cm. To laminate one layer of Nylon geogrid ed the nonwoven density and the water molecules did not pass easily, so water permeability was lower than that without Nylon geogrid.

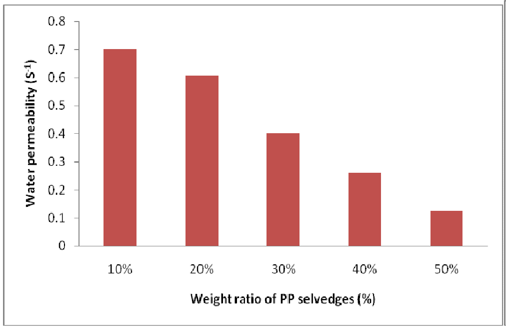

Fig. 1 The influence of the weight ratio of PP selvages on the water permeability of composite geotextile.

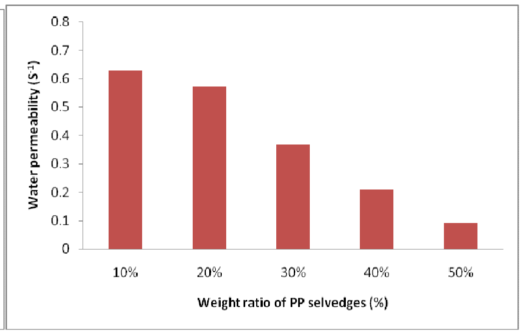

Fig. 2 The influence of the weight ratio of PP selvages and the addition of one layer of Nylon geogrid on the water permeability of the composite geotextile.

3 The burst strength

Figs. 3 and4 display the burst strength of the polypropylene selvages. The burst strength increased when the polypropylene selvages decreased. When polypropylene selvages increased, the calorific capacity which melted the polypropylene selvages increased, too. However, the thermal-bonding refrained calorific capacity and made polypropylene selvages melt incomplete. The density of nonwoven increased with the increment of the polypropylene selvages, enabling nonwoven to endure more strength. To sum, the burst strength of geotextile decreased when the polypropylene selvages increased.

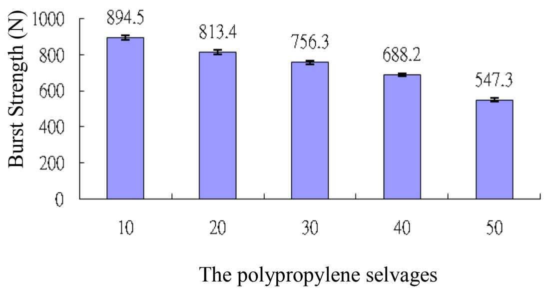

Fig.3. The influence of the weight ratio of PP selvages on the burst strength of composite geotextile.

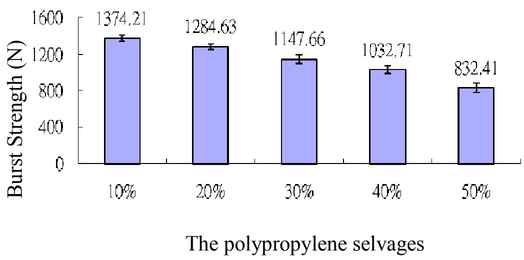

Fig. 4 The influence of the weight ratio of PP selvages and the addition of one ayer of Nylon geogrid on the burst str ength of the composite geotextil

Summary

We used 2 layers of PET nonwoven enclosing recycle PP selvages and Nylon geogrid to manufacture the composite geotextile. The composite geotextile displayed the optimum burst strength when the weight ratio of PP selvages was 10%; meanwhile, its water permeability met the requirement of the geotextile regulations when the PP selvages were at 10 to 50 wt%.

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