

습도와 pH 변화에 따른 PLA 부직포의 분해성

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Degradation of PLA Nonwovens by Changing Humidity and pH Conditions

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1. Introduction

Although degradable polymer occupy a very marginal position among structural materials in the present state of the market, they will probably know significant progress in the next decade.[1]

The PLA fibers has studied actively till now. However, The study of PLA spunlace nonwovens are not much. In this study, we investigate tensile properties of PLA spunlace nonwovens by changing humidity and pH conditions for evaluate degradation of PLA spunlace nonwovens.

2. Experimental

PLA nonwovens were produced by spunlace process. Table 1 shows basic properties of PLA nonwovens. For the investigate of degradation of samples, the samples was dealt with different humidity(40%, 65%, 80%, soak) at constant temperature(50℃) and different pH conditions(pH 3, pH 7, pH 10). Table 2 shows humidity and pH conditions, respectively. The pH treated samples were washed with distilled water and vacuum dried during 6 hours. The morphological structure of samples observed by scanning electron microscope (JSM-7000F, JEOL) and the fiber diameter of PLA nonwovens measured by image analyzing software(IT PRO 3.0, Sometech). The tensile properties carried out by using the tensile test machine(Instron 4467, USA) with ASTM D 4632 method. The thermal properties carried out by using the Differential Scanning Calorimetry (DSC-2910, TA Instrument).

Table 1. Basic properties of PLA nonwovens

Polymer	Process	Basis Weight (g/m ²)	Fiber Diameter (μm)	Thickness (mm)	Tm (℃)
PLA	Spunlace	36.08±0.51	9.42±0.56	0.26±0.02	169.12

Table 2. Humidity and pH conditions

Sample ID	Treatment Time(hour)	RH(%)	Treatment Temp.(℃)	Sample ID	Treatment Time(hour)	pH	Treatment Temp.(℃)
H-1	24	40	50	P-1	24	3	25
H-2		65		P-2		7	
H-3		80		P-3		10	
H-4		Soak		P-4		3	
H-5	36	40		P-5	1	7	100
H-6		65		P-6		10	
H-7		80					
H-8		Soak					

3. Results and discussion

3.1 Morphological structure

Figure 1 shows SEM image of PLA spunlace nonwovens. A crack and sinking phenomenon were observed in treated samples. On the other hand, Untreated sample had generally smooth fiber surface.

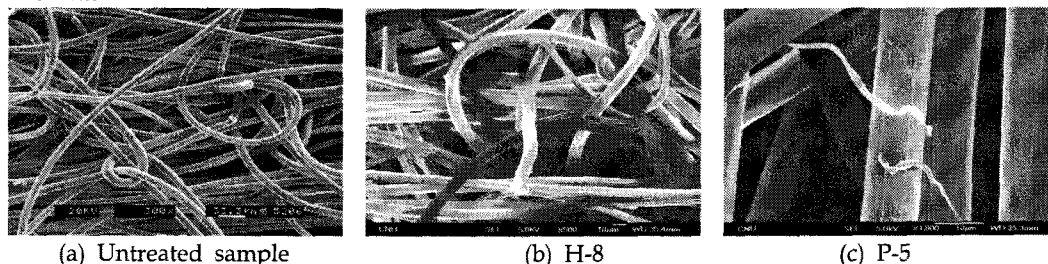


Figure 1. SEM images of PLA nonwovens

3.2 Tensile properties

Figure 2 shows comparison of tensile strength of untreated and treated samples. As humidity and treatment time increased, tensile strength of sample decreased in MD of humidity conditions. On the other hand, CD has constant tensile strength, comparatively. P-1 had bigger decreasing rate(35.10%) of tensile strength than the other samples at 25°C, 24hours. However, Samples had constant tensile strength at 100°C, 1hour.

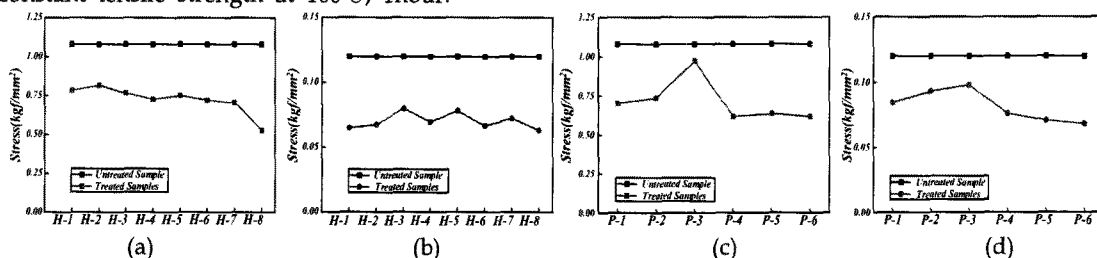


Figure 2. Comparison of tensile strength of samples(a: MD, b: CD, c: MD, d: CD)

3.3 Thermal properties

Figure 3 shows DSC curves of samples. Untreated sample had H_f of 62.15J/g. As humidity and treatment time increased, H_f of the sample treated humidity decreased and sample had H_f of 53.31J/g at condition of pH 3, 100°C and 1hour.

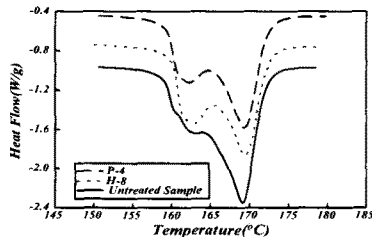


Figure 3. DSC curves of samples

4. Conclusions

From the experiment, As humidity and treatment time increased, tensile strength of PLA spunlace nonwovens generally decreased and pH 3 treated samples had bigger decreasing rate of tensile strength than other samples of pH conditions at 25°C. However, As treatment temperature increased, PLA fibers were more effected to hydrolysis than pH condition.

References

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2. D. Karst and Y. Yang, *polymer*, 47, 4845-4850(2006)