

## Anti-aging Properties of PP & PET Filter Material

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**Abstract.** The aging of the filter material has become a key issue to limit its further development and application. The aging of the filter material is not only made the premature failure of equipment, a huge loss of materials, and waste of resources, but also the aging decomposition of materials caused the environmental pollution. The experimental results showed that the PET / PP ratio has a remarkable effect on the anti-aging properties of PP / PET filter material, and the greater the proportion of PET / PP, the better the anti-aging properties of PP / PET filter material.

### Introduction

Filter material is an important industrial textile in the national economy. Aging filter material has become a very important issue. At present, the study about filter material of science has been a substantial progress<sup>[1-2]</sup>. The polypropylene fiber not only has good mechanical properties, processing performance and electrical insulation properties, non-toxic, good water stability, but also has inexpensive feature which has led that polypropylene becomes one of the largest output, the most widely used species in the world<sup>[3]</sup>. Polyester fiber has a high breaking strength and elastic modulus, resilience moderate, the outstanding performance of setting heat, the good performance of the heat and light fastness<sup>[4]</sup>. The article analysed the performance changes of the sample and understood the aging resistance of PP / PET filter material for the production of PP / PET filter material providing a reference.

### Experiment

#### The Apparatus of the Experiment

CP303 electronic scale, YG9 (B) 141D fabric thickness meter, YG065H electronic fabric strength machine, Straightedge.

#### The Sample of the Experiment

The PP fibers and PET fibers is mixed in proportion 80/20, 70 / 30, 60 / 40 under the same condition through opening, carding, pre-needling, main-spiking, main-spiking, lapping as volume process to prepare three sets of samples. Each set of samples were cut three pieces of the size of 50mm \* 200mm. Experiment with each sample parameters are shown in Table 1.

Table 1 The performance parameters of the sample

Sample	Needling density (needling/cm <sup>2</sup> )	Thickness (mm)	Mass (g)	Breaking strength (N/10cm)
sample 1	10	2.277	0.811	0.0049
sample 2	10	3.446	1.410	0.0193
sample 3	10	3.149	1.700	0.0077

### Experimental Program

The article adopted to experimental methods of artificial environment. Three main factors were considered in the process of exploring PP / PET needled filter material anti-aging properties: PP / PET fiber ratio, aging time and aging temperature. If the interaction was not considered each factor was selected three levels. The article was analyzed the impact of various factors on properties of PP / PET nonwovens anti-aging properties. And L9 (34) orthogonal test program was confirmed, Table 2. If the interaction was not considered, the Specifically orthogonal experiment L9 (34) is shown in Table 3.

Table 2 Orthogonal factor level table

Level	Factor		
	A material ratio (%)	B aging temperature (°C)	C aging time (h)
1	80/20	80	1
2	70/30	100	2.5
3	60/40	120	5

Table 3 Orthogonal test program

Experiment No.	Factor		
	A material ratio (%)	B aging temperature (°C)	C aging time (h)
1	1	1	1
2	1	2	2
3	1	3	3
4	2	1	2
5	2	2	3
6	2	3	1
7	3	1	3
8	3	2	1
9	3	3	2

### Experimental Results and Analysis

According to the orthogonal scheme of the table 3, the performance test results such as the weight, breaking strength and elongation at break and other aging performance of the PP / PET filter material are shown in Table 4.

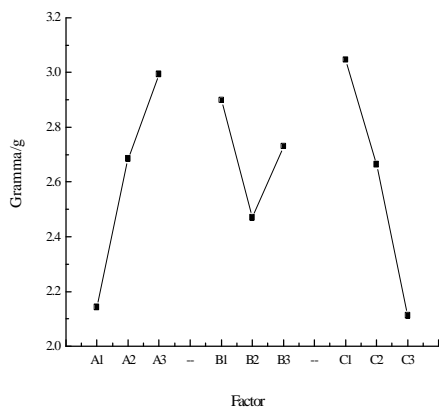
Table4 Orthogonal aging performance test results

Experiment No.	A	B	C	mass(g)	Breaking strength (/N)	Elongation at break (mm)
1	1	1	1	0.8096	77.55	134.00
2	1	2	2	0.7080	75.65	107.60
3	1	3	3	0.6259	67.49	102.29
4	2	1	2	0.9546	142.06	139.50
5	2	2	3	0.6280	136.18	118.90
6	2	3	1	1.1028	140.27	139.26
7	3	1	3	0.8580	142.06	129.20
8	3	2	1	1.1346	135.29	127.89
9	3	3	2	1.0020	127.83	114.23

**Range Analysis of Anti-aging Properties of the Filter Material**

**Range Analysis Gram**

Level of various factor of range analysis for the influence of PP / PET needed filter material grammage on trail are shown in Table 5. Level of various factor of tendency chart for the influence of PP / PET needed filter material grammage are shown in Fig 1. The analysis of table 5 and fig.2.1 by synthesis showed that the effect of weight for PP / PET filter material primary and secondary order is C> A> B. The largest range is the aging time which shows that aging time on the anti-aging properties of the filter material plays a major factor. Because in a short time, temperature aging effects of the sample is not obvious, but as the temperature rises, the aggregate structure of fibers will happen to change, crystal fibers will be falled apart, the orientation will be dropped, the molecular mass will be declined.



	A	B	C
K1	2.1435	2.8988	3.0470
K2	2.6854	2.4706	2.6646
K3	2.9946	2.7307	2.1119
k1	0.7145	0.9663	1.0157
k2	0.8951	0.8235	0.8882
k3	0.9928	0.9102	0.7340
Range R	0.2783	0.1428	0.2817
The major factor	C>A>B		
Optimal combination	C <sub>1</sub> A <sub>3</sub> B <sub>1</sub>		

Fig.1The influence of different factor Table5 Range Analysis Gram

for the gram of the PP/PET needed filter material

## Range Analysis Breaking strength

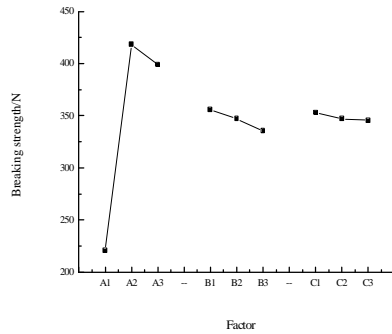


Fig.2The influence of different factor for the breaking strength of the PP/PET needled filter material

Table 6 Range Analysis Breaking strength

	A	B	C
K1	220.69	355.64	353.11
K2	418.51	347.12	347.12
K3	399.15	335.59	345.54
k1	73.56	118.55	117.70
k2	139.50	115.71	115.71
k3	133.05	111.86	115.18
Range R	65.94	6.69	2.52
The major factor	A>B>C		
Optimal combination	A <sub>2</sub> B <sub>1</sub> C <sub>1</sub>		

Level of various factor of range analysis for the influence of PP / PET needled filter material breaking strength on trail are shown in Table 6. Level of various factor of tendency chart for the influence of PP / PET needled filter material breaking strength are shown in fig 2. The analysis of table 6 and fig.2 is showed that the effect of breaking strength for PP / PET filter material primary and secondary order is A>B>C. The largest range is the material ratio which shows that aging time plays a major factor. In the heat treatment process, the polypropylene gradually cleavages double, between fiber molecules thermal motion can be high, macromolecules flex improves, the bonding force between the intermolecular bonding force weakens, initial modulus decreases. So the percentage of PP, PET had a significant effect on the strength of filter material during the filter material aging process .

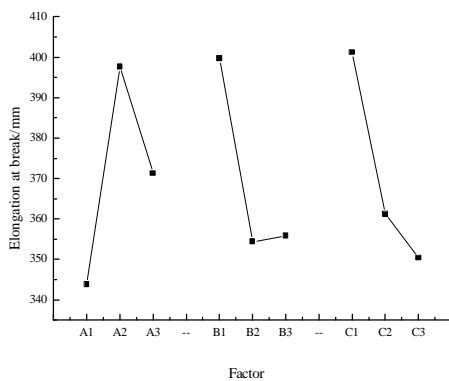
## Range Analysis Elongation at break

Level of various factor of range analysis for the influence of PP / PET needled filter material elongation at break on trail are shown in Table 8. Level of various factor of tendency chart for the influence of PP / PET needled filter material elongation at break are shown in fig 3. The analysis of table 7 and fig.3 is showed that the effect of Elongation at break primary and secondary order is A>C>B. In terms of anti-aging properties of PP / PET needled filter material, the largest range is the material ratio which shows that aging time on the anti-aging properties of the filter material plays a major factor.

Fig.3The influence of different factor for

The elongation at break of the PP/PET needled filter material Table

7 Range Analysis Elongation at break



	A	B	C
K1	343.9	399.7	401.2
K2	397.7	354.4	361.3
K3	371.3	355.8	350.4
k1	114.6	133.2	133.7
k2	132.6	118.1	120.4
k3	123.8	118.6	116.8
Range R	18.0	15.1	16.9
The major factor	A>C>B		
Optimal combination	A <sub>2</sub> C <sub>1</sub> B <sub>1</sub>		

## **Conclusion**

The longer thermal aging treatment time, the higher the temperature, the smaller the weight, thickness, breaking strength, elongation at break of the fabric.

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