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Preparation and Characterization of Combi Cabin Air Filter Containing Activated Carbons

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Introduction

Activated carbon(AC) is widely used in air purification as an absorbent which can remove pollutant from air, because it is porous and has large surface. Therefore, Nonwoven-based filter media with AC layer can protect against harmful airborne contaminants as separating both fine solid particles and harmful gases from air. In this study, a combi cabin air filter for passenger car was prepared from nonwoven composite medium consisting of non-woven and porous activated carbon or activated carbon fiber felt. The performance of the cabin filter media prepared under various conditions was evaluated and the applicability for the car cabin filter was studied.

Materials and Methods

The AC layer was prepared by firstly scattering granular AC uniformly in a support nonwoven fabric, secondly covering the AC layer with carded staple fiber(low melting PET) web and finally bonding thermally through heated belts. The meltblown nonwoven which consist of fine fibers with 3~5 μm diameter was adhered to the prepared AC layer by a hot-melt spray method. Finally, a total of seven samples of filter media were prepared under various process conditions. The basic structure and detailed specifications of the filter media are shown in Figure 1 and Table 1, respectively. After evaluating performance of the cabin filter media, based on this results the composite nonwoven filter media containing AC was pleated and fabricated to be a combi cabin filter unit under the optimum condition. Finally, the filter unit were characterized in terms of pore size distribution, air permeability, air flow resistance, particle filtration efficiency, hazardous gas removal, and so on.

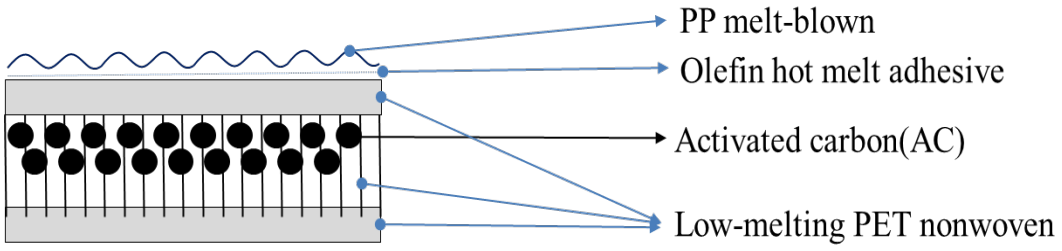

Figure 1. The structure of AC filter media

Table 1. The compositions of the cabin filter media

Sample No.	Nonwoven layer (top)	AC layer (center)	Nonwoven layer (bottom)	Melt-blown
1	LM-PET	AC1(10-30mesh)	LM-PET	PP M/B 15g+S/B 15g(electrostatic)
2		AC2(20-40mesh)		PP M/B 15g(no electrostatic)
3				PP M/B 20g(no electrostatic)
4				PP M/B 15g+S/B 15g(electrostatic)
5				
6				
7		AC3(30-60mesh)		PP M/B 15g+S/B 15g(electrostatic)

Results and Discussion

The sample 7 containing AC3 which contained the smallest activated carbon particle showed excellent dust filtration efficiency, but the differential pressure was higher than sample 5 (AC2). As expected, the filtration efficiency increased with increasing the hot melt adhesion amount, but the adhesion amount did not affect the overall filter media pressure difference because total adhesion amount is low. Samples 2 and 3 with 2 μm average diameter with low air permeability showed very high differential pressure and low filtration efficiency. On the contrary, the sample 5 bonded electrostatic charging melt-blown with higher air permeability showed higher filtration efficiency. This is the data showing that the dust filtration efficiency varies greatly according to the melt-blown electrostatic charging technology. Based on the results of this analysis, it was judged that Sample 5 was the most optimum condition, so that the final filter unit was prepared with Sample 5 manufacturing conditions.

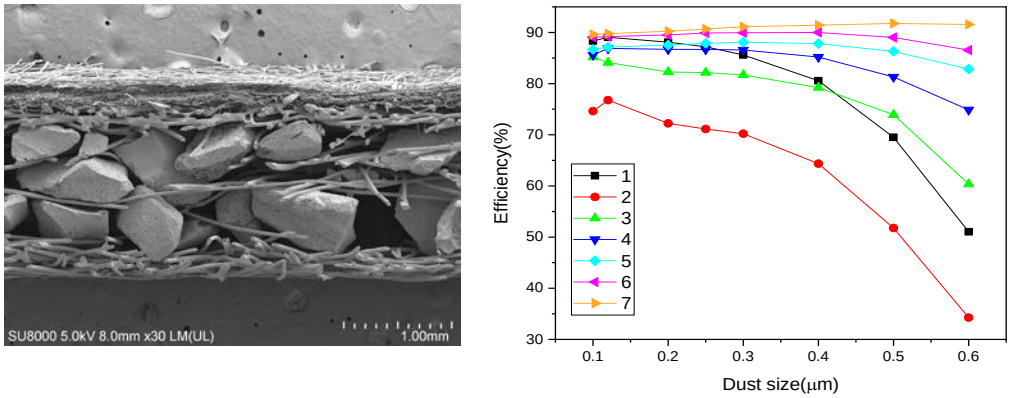

Figure 2. Cross section SEM image and filter efficiency results of the filter media

Conclusions

In this study, the cabin filter media were prepared under various conditions. The filter unit from optimum media showed the high filtration efficiency of 81% @ 0.3μm solid particle, 80.5% toluene removal efficiency and the low air flow resistance of 9.6 mmAq @ 300 m3/h. It was found that the filter unit prepared by containing activated carbons can be applied to automobile cabin

filter.