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Experiment investigation on two filter medias for air filtration

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Abstract. As the fast development of industry, clean air quality environment are needed in more manufactory fields. Filter media is the key material for high efficiency filtration. In this paper, glass fiber filter and PTFE membrane filter are studied with filtration test. The results show that glass fiber filter has low porosity, lead to lower penetration and higher resistance than PTFE filter. Penetration of filters decrease with mass load increasing and face velocity decreasing. Resistance increase with mass loading and face velocity increasing.

1 Introduction

As the development of industry, air filtration is becoming more and more important. Air filtration is widely used in electron, IC, medicine, vehicle, and other industries, which provide clean air environment for high level product making. Filter media is the key component of the filtration system, which affect the air quality[1-3].

Glass fiber filter media and PTFE filter media are two important materials for ultra efficiency filtration(ULPA). Filter media can be made into filters with different shape used in some industries to capture fine particle below 1um[4-6].

Efficiency, resistance and dust capacity are three key parameters for filter. Research on the relation about the parameters can help to improve the performance of filter media and to help redesign the filter.

In this paper, a serial experiments are made to study the filtration performance of glass fiber and PTFE filter media.

2 Experimental scheme

2.1 Experiment device

In order to study the parameters of efficiency, resistance and dust capacity of filter media, the device of TSI 8130 is used in the experiment. The schematic diagram and device picture are shown in figure 1, and figure 2.

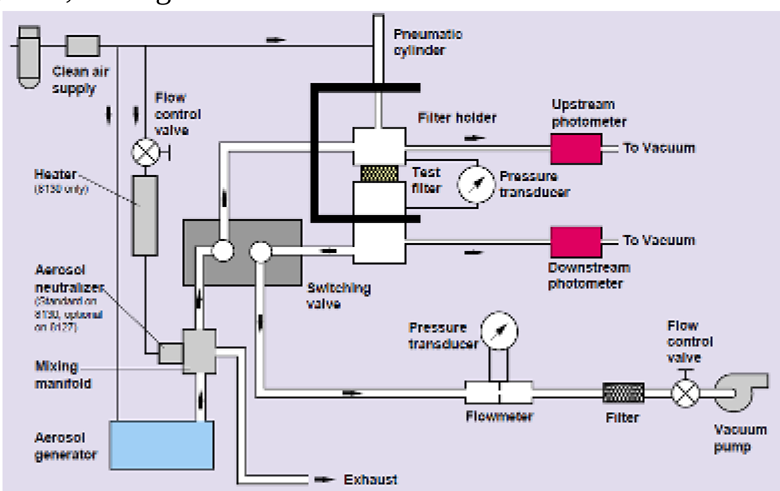

Fig. 1 Schematic diagram of filter test instrument

Fig.2 Test device

When filter samples are holden by the instrument, salt aerosol particles are generated and go through the filter. Photometers are used to measure particle numbers of 0.3um at upstream and downstream to calculate the penetration. Resistance are tested by pressure transducer.

2.2 Filter media sample

The experiment samples are two normal filter media which are glass fiber filter paper and PTFE membrane filter media. The SEM picture of two filter medias are shown in figure 3 and figure 4.

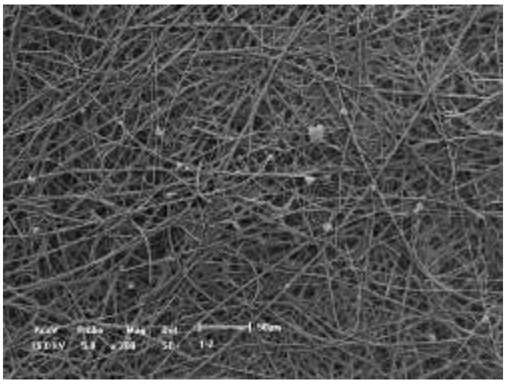

Fig. 3 SEM picture of glass fiber filter

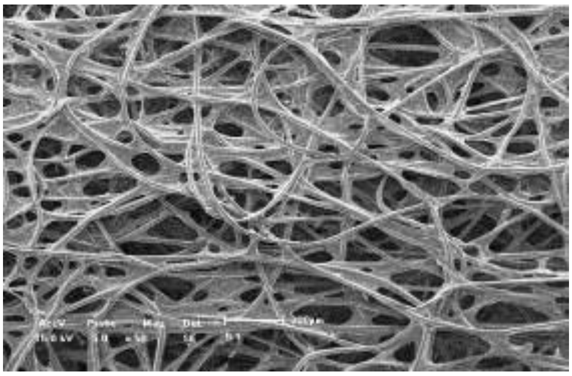

Fig. 4 SEM picture of PTFE filter

The figures show that PTFE filter has large pore with high porosity.

Figure 5 is the resistance character of the two filter media, the resistance of glass fiber filter is higher than PTFE filter , and as the velocity increase, the slope is high also. The reason is that glass fiber has low porosity.

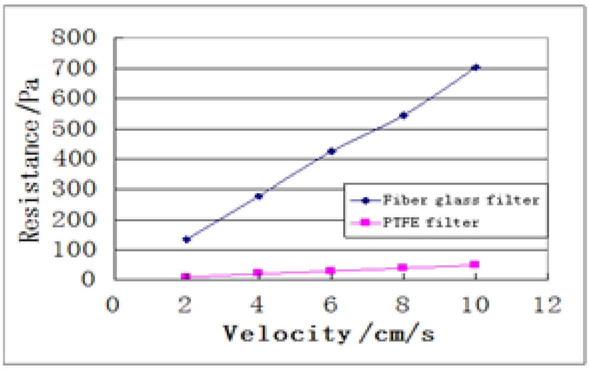

Fig.5 Resistance of two filter media

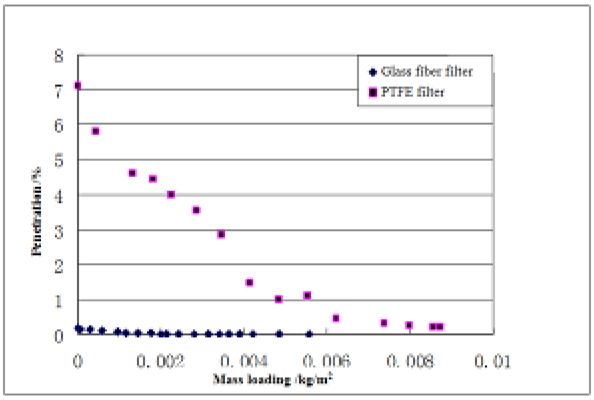

Fig. 6 Penetration of filters vs dust capacity

3 Result and analysis

3.1 Penetration of filters

The efficiency represent the ratio of particles captured, while the penetration show the ratio of particles escaping from filter. For high efficiency filter, penetration is usually used. Figure 6 show the penetration of two filters for 0.3um particles along with mass loading. Figure 7 show the penetration of glass fiber along with mass load at different velocity.

Figure 6 and figure 7 show that as the filtration is going on, salt particle captured and deposited on the filter surface, which make the efficiency increase, and penetration decrease. PTFE has higher penetration than glass fiber filter at beginning, then down and close to glass fiber after 0.006kg/m^2 mass load. The particle layer on the filter help to improve the efficiency. As the velocity increase, the penetration will increase also at beginning, then trend to same at large mass load.

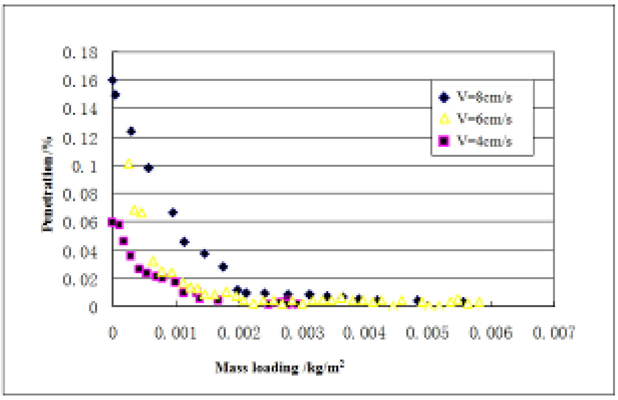

Fig.7 Penetration of glass fiber vs dust capacity

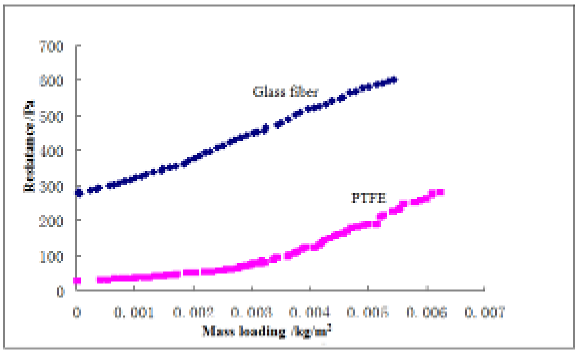

Fig.8 Resistance of two filter at 4cm/s

3.2 Resistance

As the mass load running, the resistance will change also. Figure 8 show the comparison of glass fiber and PTFE filter along with mass loading. The resistance is rising as the mass load increase. While, the resistance of glass fiber is higher than PTFE filter. Figure 9 and figure 10 show the resistance of two filter at different velocity. As the velocity increase, the resistance both glass fiber and PTFE increase also.

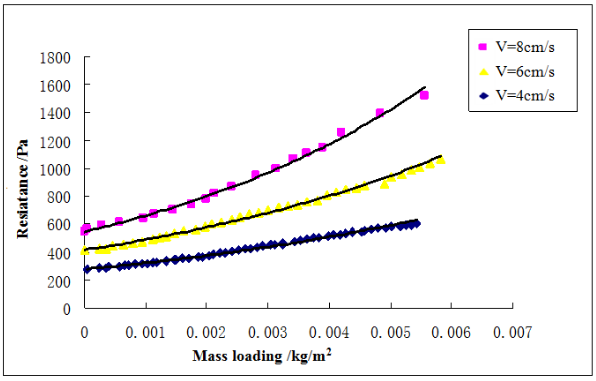

Fig.9 Resistance of glass fiber at different velocity

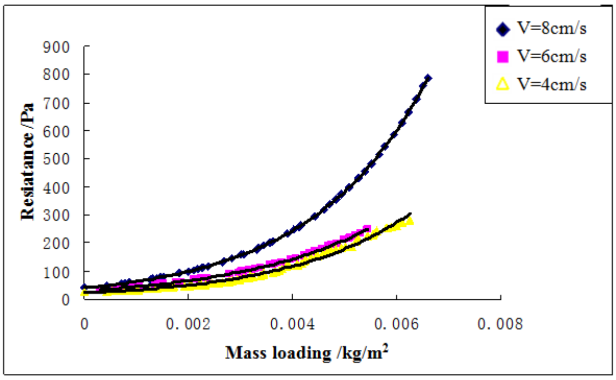

Fig.10 Resistance of PTFE at different velocity

3.3 Particle deposition process

As the filtration process continue, the salt particle captured by filter and deposited in and on the filter, lead the resistance increase and penetration decrease. Figure 11 to figure 14 show the process of particles deposit on glass fiber filter. As the particle deposited on the filter, the fibers are connected each other, which will reduce the porosity.

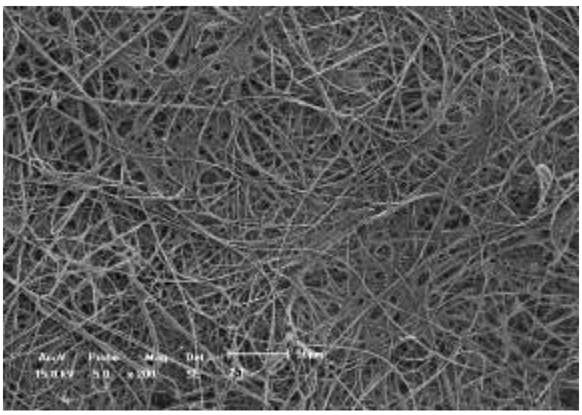

Fig.11 SEM of glass fiber 2 minutes deposition

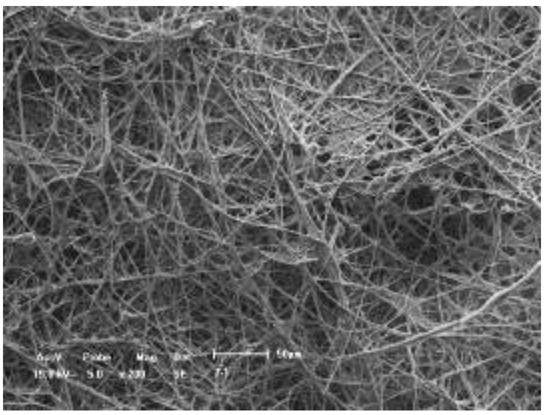

Fig.12 SEM of glass fiber 10 minutes deposition

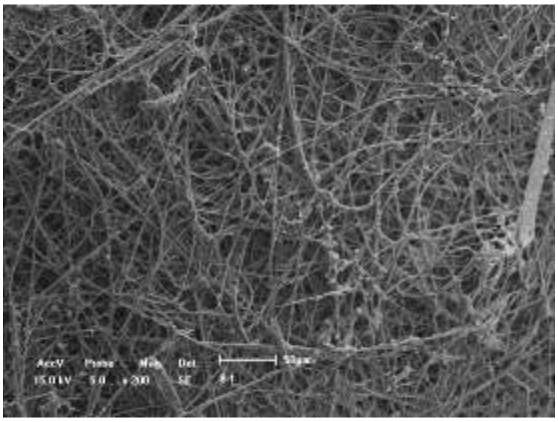

Fig.13 SEM of glass fiber 30 minutes deposition

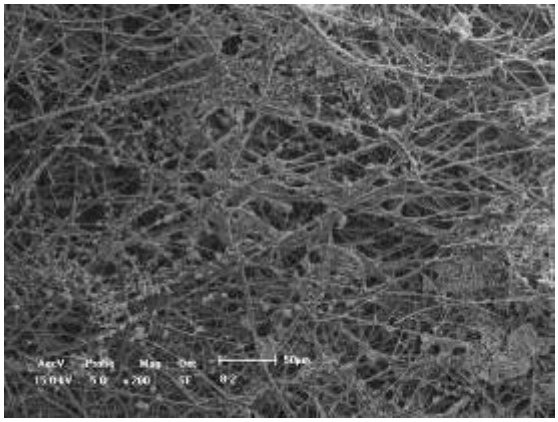

Fig.14 SEM of glass fiber 60 minutes deposition

4 Conclusions

Glass fiber filter and PTFE membrane filter are two filtration materials widely used on a lot of industries. Based on the experiments, conclusions are listed as follows:

(1)Penetration are affected by porosity of filter. Glass fiber filter has low porosity, lead to low penetration.

(2)Penetration decrease with the particle deposition and mass loading process.Lower face velocity, lower penetration.

(3)Glass fiber has high resistance due to the low porosity. As face velocity increasing, resistance increase also.

(4)As the particles deposited in and on filter, the porosity will reduce, the resistance will increase and penetration will decrease.

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