Performance of PrekotAC Filter Aids on Pressure Drop across Two Different Filter Media

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Abstract. A study on the performance of formulated PrekotAC filter aids on pressure drop across two different types of filter media, i.e polytetrafluoroethylene (PTFE) and polyimide (P84) was carried out in a laboratory scale fabric filtration system. Filter aids is applied in order to prolong the lifespan of the fabric filter by reducing the pressure drop across a filter cake. PrekotAC which is a combination of 90%wt activated carbon and 10%wt PreKot™ was tested under various material loadings of 0.2, 0.4, and 0.6 mg/mm² at a constant filtration velocity of 5 m/min across its cake and filter media. The results showed that PrekotAC presents a lower pressure drop across the P84 compared to PTFE filter media under various material loadings. This is because of its different characteristics that effect the porosity of the filter media and allow a higher volumetric airflow passing through, resulting in lower pressure drop compared to PTFE filter media. In addition, the diversity in terms of particle size distribution of the formulated PrekotAC that increase its permeability property helps to reduce the pressure drop across the media and its filter cake. Thus, PrekotAC has a promising characteristic as a two in one filter aids, a pre-coating and adsorbent material for fabric filtration system.

1 Introduction

Filter aids is applied in fabric filtration system to reduce and prolong the lifespan of the fabric filter by reducing pressure drop across filter cake during filtration system. Pressure drop is one of the factors that need to be considered when evaluating a performance of a fabric filter system. Pressure drop is defined as the differential pressure across the system where it was reported that for a very well designed fabric filter, the maximum pressure is reached after a long period of filtration process before the fabric is being cleaned or replaced [1].

Cleaning frequency of a filter media is depending on the increment of the pressure drop across the filter cake during filtration process. As the frequency of cleaning increases, the maintenance cost also increases due to the higher probability of mechanical damages to the filter media during the process [2, 3].

Filter aids that applied in fabric filtration process works as a pre-coating material that coats the filter media during the process. In addition, filter aids helps to form a porous filter cake allowing a uniform airflow passing through it, resulting in low pressure drop [4, 5]. Filter aids has the capability to increase the porosity and reduce the compressibility of the accumulated filter cake [6]. It also improves the collection efficiency of particles and contaminants during filtration process [7].

The performance of fabric filter is characterized based on its pressure drop [8]. Thus, by using an appropriate filter media with a good filter aids material, helps to form a porous cake with low pressure drop across a filter cake.

In this study the performance of PrekotAC in terms of its pressure drop on two different filter media (PTFE and P84), under various material loadings of 0.2, 0.4 and 0.6 mg/mm² as well as a constant filtration velocity of 5 m/min was investigated. PrekotAC is a two in one filter aids material that consists of a combination of two different types of filter aids, i.e. activated carbon and PreKot™ that has the potential to form a porous filter cake due to its wide disparities in particle size distribution [9]. PrekotAC was tested under three different material loadings since these influence the pressure drop across the filtration process [10].

Hence, this study discussed on the effect of material loading and porosity of the filter aids on pressure drop across the filter cake. PrekotAC is a combination of two different types of material that will work as a two in one filter aids material (as an adsorbent and a pre-coating material) in fabric filtration system. By applying this material in the system, the all in one spray system can be introduced since these materials can work as a two in one filter aids material.

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2 Methodology

2.1 Filter Aids Material

PrekotAC filter aids was formulated by mixing two different types of filter aids material which is 90%wt of activated carbon with 10%wt of PreKot™ that works as an adsorbent and a pre-coating material, respectively. The properties of both materials used in this study are given elsewhere [9].

2.2 Experimental Procedures

The experiment was carried out in a fabricated laboratory scale filtration test system that consists of dust feeder, filter media holder, pressure manometer, particle counter, rotameter and a vacuum pump [7]. Pressure manometer (Extech Instrument Model HD755) were installed in the system in order to measure the pressure drop across filter media and cake during each run.

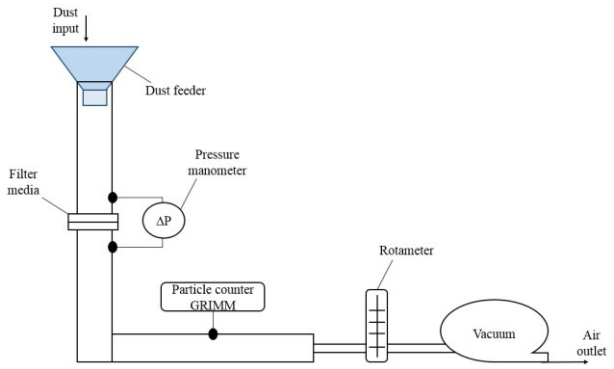


Fig. 1. Schematic diagram of the filtration test system

The performance of PrekotAC material on pressure drop across PTFE and P84 filter media under various material loading of 0.2, 0.4, and 0.6 mg/mm² and a constant filtration velocity of 5 m/min was observed in each run. Details on the specifications of both filter aids media are presented in Table 1.

Table 1. Specifications of PTFE and P84 filter media.

Material	PTFE	P84
Basic weight (g/m²)	800	550
Thickness (mm)	1.3	2.4
Working temperature (°C)	<200	

3 Results and Discussions

3.1 Effect of Different Filter Media on Pressure Drop

Figure 2 presents the results on pressure drop across two different filter media, PTFE and P84, under various material loading of 0.2, 0.4 and 0.6 mg/mm² and a constant filtration velocity of 5 m/min, which showed that P84 experienced a lower pressure drop compared to PTFE filter media in all conditions.

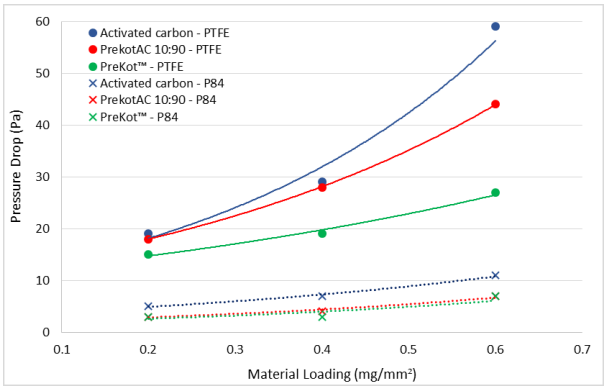
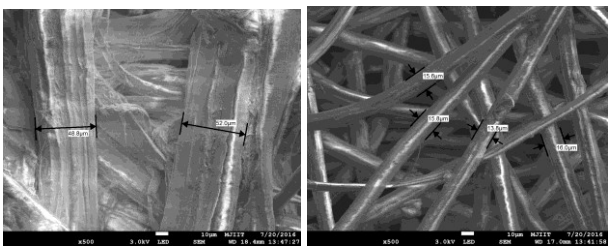


Fig. 2. Pressure drop across PTFE and P84 filter media.

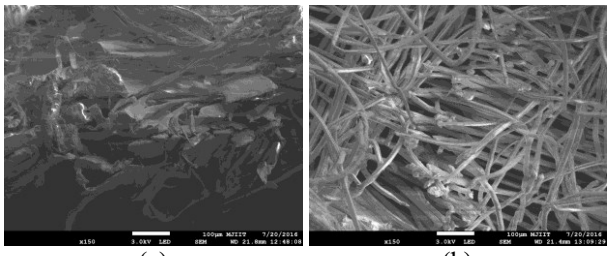
This is due to the characteristics of the filter media where they have different structure and fiber diameter. As shown in Figure 3, it is found that P84 has a smaller fiber diameter of 15.3 µm compared to PTFE filter media (i.e. 75.0 µm). The average diameter of fiber in P84 is five times smaller than PTFE which gives a better airflow characteristic across the filter media.



(a) (b)

Fig. 3. Structure and fiber diameter of, (a) PTFE and (b) P84 filter media.

Figure 4 presents the cross section microphotograph of the filter media which showed that P84 is characterized with loose structure compare to PTFE that explained the finding. Previous researcher reported that fibre arrangement in conventional PTFE filter media is dense and very thin that cause clogging of particles, resulting in high pressure drop across the filter media [11].



(a) (b)

Fig. 4. Cross section structure, (a) PTFE, (b) P84 filter media.

As in figure 2, it was also found that pressure drop across the filtration process increases with different amount of material loading of filter aids for both filter

media where higher material loading leads to a thicker filter cake that reduces the volumetric air flow that passing through, resulting in higher pressure drop across the filter cake [12-14]. This finding suggests that pressure drop across the filtration process depends on the characteristics of the filter media and filter aids [15].

It was reported that the root of pressure drop in fabric filtration process is the structure of the filter cake that denominated by the porosity [16]. The rise of material loading experiences a higher pressure drop which indicates the dependence of pressure drop on the porosity of the accumulated filter cake [17]. It was found that, as the dust cake thicken, it increases the resistance and reduce the porosity of the filter cake during the filtration process [2].

Thus, it can be concluded that pressure drop is highly dependent on the characteristics of the filter media and accumulated filter cake. Results showed that pressure drop across P84 is lower due to its structure where it has loose and porous filter media compared to PTFE. However, both filter media marked the highest pressure drop across the filter media at the highest amount material loading of 0.6 mg/mm² since higher material loading leads to thicker filter cake resulting in higher pressure drop.

3.2. PrekotAC as a Filter Aids

As in figure 2, the formulated filter aids material, PrekotAC, exhibits a lower pressure drop compared to the original material, activated carbon, even at the highest material loading of 0.6 mg/mm². The characteristics of the filter aids having a wide disparities particle size distribution that form a porous filter cake which allowed easy passage of air flow leads to low pressure drop across filter cake [18].

Particle size distribution of filter aids plays an important role in its performance as a filter aids which effect the performance in terms of its pressure drop in filtration system. Activated carbon has a lot finer particle size (80% of particles ≤75 μm) compared to PreKot™ (25% of particles ≤75 μm) which make it an ideal formulation for a good filter aids [19].

It was reported that pressure drop entailed by aerosol filtration is smaller for higher particle size. This is likely due to the fact that larger particles have a smaller specific area entailing a smaller pressure drop across the filter cake [20]. It was also found that pressure drop increased with a decreasing average particle diameter. The permeability that also referring to its porosity increases with the particle size since larger particles give rise to larger pores and channels for better air flow [21].

The newly formulated filter aids material PrekotAC has the capability to reduce its pressure drop across the filter cake due to its non-uniform particle size fractions which help to form a porous filter cake and allow a uniform airflow passing through the filter media. As pressure drop is one of the most important criteria that influences the operating cost a filtration system, it appears that a considerably amount of savings could be achieved with the use of PrekotAC.

4 Conclusions

Performance of PrekotAC filter aids on pressure drop across two different filter media had been investigated and reported in this paper. Results showed that P84 exhibits lower pressure drop compared to PTFE filter media due to their different fiber structure. The findings suggests that PrekotAC is a potential filter aids material for filtration system for its ability to reduce pressure drop across the filter cake even under high material loading.

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