1C1) Filtration Performance Evaluation of Depth Filter Media Cartridges at Different Filtration Velocities

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1. Introduction

Depth filtration filter media must have the ability of retaining the particles inside the layer and provide efficient particle collection at low pressure drop for long period of service. During the process of designing the media for depth filtration, the aim is to reach the optimum of three main parameters, pressure drop, particle collection efficiency and dust holding capacity. More detail explanation about the particulate collection mechanisms which govern the depth filtration can be found in the book references (Hutten, 2007; Hind, 1982). These three above mentioned parameters determine the effectiveness of the depth filter media. The filter media which was used in this study has been developed after a series of tests made with preceding depth filter media. These results have been presented in our previous work (Park et al., 2009). In this study the main focus was to evaluate the filtration performance of the cartridges made of the same depth filter media but different filtration area. The pleating geometry is thus different for all three test cartridges. Even though the filtration are is larger with the increase of the pleat number, the overall filtration performance of the cartridge decreases.

2. Experimental Material and Method

The test was made using cartridges with newly developed depth filter media. Test is conducted under ambient air temperature and humidity conditions. Test dust was the standard ISO A2 Fine. Pressure drop (DP) of the filter cartridge is evaluated by varying the flow rate below and above the values of the nominal flow rate, without dust loading. Dust holding capacity (DHC) test was made by loading the cartridge with dust of high inlet concentration Ci. DHC is expressed in amount of the dust collected during dust loading time which was determined by gravimetric measurements of the cartridge made before and after the test. During the DHC tests, collection efficiency is calculated from the measurements of particle concentration in feed air upstream and downstream of the filter cartridge. Figure 1 shows the experimental setup with main functional units.

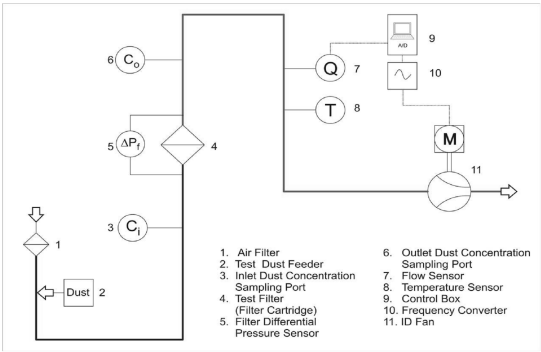

Fig. 1. Flow chart of the gas turbine filter cartridge test unit.

3. Results and Discussion

Initial pressure drop characteristics of all three cartridges are displayed in Figure 2. The highest values exhibits the cartridge with largest filtration area, the cartridge with 190 pleats.

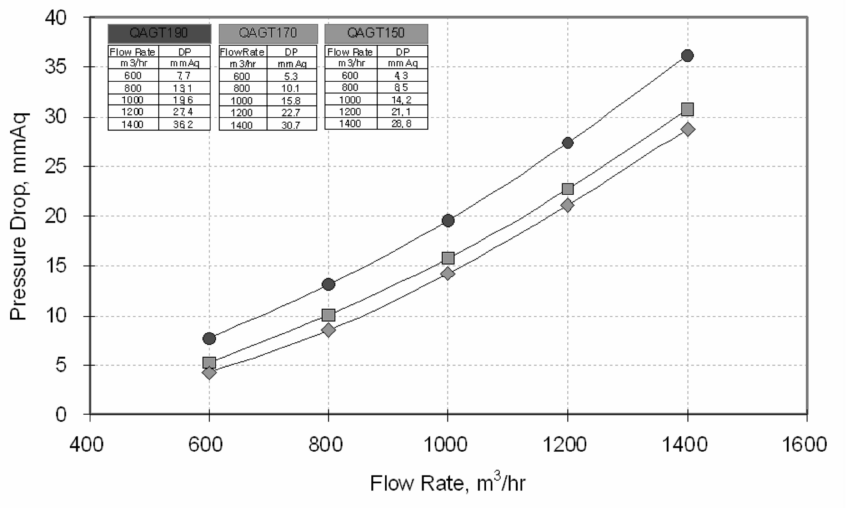

Fig. 2. Initial filter pressure drop characteristics.

Dust holding capacity is the lowest for the cartridge with 190 pleats with 1288.65 g at the final pressure drop of 80.2 mmAq. The highest value was found for the cartridge with 150 pleats, 1774.1 g. The distance between two pleats is too small so that after the pressure drop starts to increase more rapidly the pleats were attached and thus the filtration performance started to deteriorate. The overall collection efficiency at the initial stage was highest for 190 pleat cartridge but in the mean and final stage the collection efficiency for cartridge with 170 and 150 pleats was higher. For particle of the range from 0.5 to 2 microns the fractional collection efficiency for cartridge with 150 pleats is the poorest. This phenomena indicates that the dead zones around the pleat bend are larger for cartridge with 190 pleats thus the effective filtration decreases even more with the increase of pressure drop. To understand and fully confirm the effect of the pleat geometry on filtration performance of the depth media filter cartridges it is necessary to perform further tests with various filter media thickness and layer structure.

References

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