Experimental Investigation of Hepa filter

Kushal Patel[1], Dr. Kiran Patel[2]

1PG Student, [2]Lecturer
1Mechanical Department
1LDRP-ITR, Gujarat, India

Abstract: Nonwoven filter media in their simplest form are random fiber structures that are used to separate one or more phases from a moving fluid passing through the filter media. Filtration is generally perceived as the removal of particulate phases from the moving fluid by entrapping the particulate matter in the tortuous structure of the filter medium. Particulate air filtration for Collective Protection Systems (CPS) uses High Efficiency Particulate Air (HEPA) filters. This paper delineates a review on the efficacy of HEPA filtration process at removing an extremely high percentage of biological and particulate material from the air, with relatively low pressure drop and energy consumption. These filters have been in use for decades and have proven themselves over the years as a valuable tool in protecting personnel and equipment.

Key Words: Air filtration, filter media, filtration, Surface filtration

I. INTRODUCTION

Nonwoven filter media in their simplest form are random fiber structures that are used to separate one or more phases from a moving fluid passing through the filter media, where filtration is generally perceived as the removal of particulate phases from the moving fluid by entrapping the particulate matter in the tortuous structure of the filter medium.
In their gross structures, these media have the form of nonwoven fabrics, wet- laid papers, or air-laid glass fiber mats spun from continuous fibers or blown from molten glass. Some membranes and open-cell foams also have fibrous structures. The solids content of these media is low, with the fiber volume typically less than 10 % of the volume of the media. These media range in thickness from a fraction of a millimeter to several centimeters. Typically, nonwoven fabric manufacturers supply filtration media having from 1 to 500 Micron Mean Flow Pore (MFP) ratings. Below 10-15 micron, the fabrics must be calendared in order to achieve the finer micron ratings.
The exception being certain wet laid glass fabrics. Micron ratings depend significantly on the test procedure by which the manufacturer rates the media and whether the rating is liquid or air. In addition to the micron pore rating, there are a number of other considerations including dirt holding capacity, flow rates and differential pressure data to name a few. The market for nonwoven fabrics for filtration media on a worldwide basis is approximately $2 billion. The distribution is roughly in thirds across the major territories of North America, Europe and Asia.

II. COMPONENTS OF A HEPA FILTER

1. Media
2. Separators
3. Filter pack
4. Sealant
5. Framing (cell sides)
6. Gasket

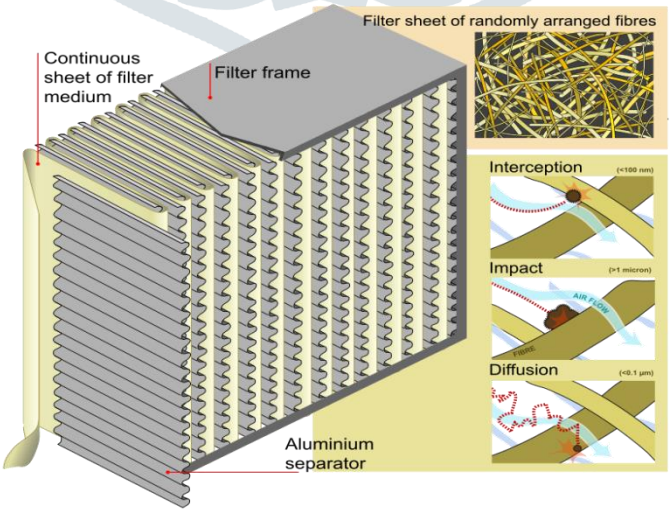

Fig 1. MODEL FOR ANALYSIS

III. DESIGN OF MODEL

Hepa filter
Size- 610 mm x 610 mm x 150 mm
Media – 0.3 micron glass fiber media

Frame MOC – Aluminum
Gasket – Self adhesive

3.1 MODEL OF DESIGN

Fig. 2 3 D MODEL

3.2 TESTING MACHINE OF HEPA FILTER

Fig.3 HEPA TESTING MACHINE

3.3 TESTING SPECIFICATION OF HEPA FILTER MACHINE

1. SS fabricated square ducting of 305x 305mm
2. Ribbing of the duct to avoid collapsing
3. Pneumatic clamping arrangement to the filter
4. Platform for the resting of filter
5. Platform with height adjustment for different sizes of filter
6. Filter mounting ducting size 610x 610mm for clamping other size of filter
7. 305mm x 305mm
8. Test rig will be operated in positive pressure
9. Static pressure tapping to measure the pressure drop across the filter
10. Pressure transducer to measure the pressure drop across the filter
11. Tapping at the upstream and downstream for the measurement of particles
12. The tapping is connected thru 3 way solenoid valve to select upstream and down stream sampling count
13. Aerosol inlet for DOP/PAO feeding
14. Particle counter is not in our scope of supply
15. Flow measuring device
16. Centrifugal blower 2500cfm
17. Static head of blower 75mm of WC

18. Motor shaft mounted blower
19. Dynamically & statically balanced fan
20. SS duct from the discharge of blower cross section of 305x 305mm
21. Provision for dust feeder inlet
22. SS ducting of 610x610mm before & after filter clamping

IV. RESULTS AND DISCUSSION

4.1 TESTING DATA OF HEPA FILTER

Type of Filter	:	HEPA Filter
Type of Frame	:	BOX Type
Frame MOC	:	Aluminum
Size	:	610 mm x 610 mm x 150 mm
Filter Media	:	Micro Glass Fiber
Support Media	:	Aluminum Foil
Air Flow	:	500 CFM
Pleat Detail	:	5 to 6 Nos. per Inch
Suitable Temperature	:	Ambient
Efficiency	:	99.97% Down to 0.3 µ
Initial Pressure Drop	:	25 mmWC
Final Pressure Drop	:	65 mmWC
Qty	:	01
Flow Direction	:	As Mentioned

Table 1. Testing data of hepa filter

V. CONCLUSIONS

All of the HEPA filters tested during this study passed the testing when handled and installed properly, therefore, the null hypothesis was not rejected. However, for the HEPA filters to consistently meet or exceed their capture efficiency of ≥ 99.97% capture of 0.3 micron particle size several processes must be in place. Purchasing, shipping, handling of the filters, installation, and system flow rate must be appropriate for the filters to perform to the level of their rated efficiencies. Purchasing agents responsible for ordering the filters must be aware that the HEPA rated filters must have an efficiency rating ≥ 99.97% capture. Shipping and handling are also critical parts of the process. The filters media are extremely fragile and touching the media during the handling and unpacking of the filter will damage the filter and lower the efficiency below to its rated level. A visual evaluation of the filter is recommended when it is received to examine the conditions of the external packaging and another visual evaluation of the filter is necessary during unpacking the filter to check any damage to the filter media. The conditions of the gasketing, manufacturer air flow rate, and direction of the flow rate checked. Proper installation of the filter is also an important part of maintaining the filter's capture performance. The filter must be installed with consistent tension applied to each of the brackets used to hold the filter in place. Also designing and applying the proper flow rate through the filter important for the filter to perform to the levels as recommended by the manufacturer and perform to the capture efficiencies of ≥ 99.97% capture. 24 By following all of these crucial steps the HEPA filter can achieve its rated efficiency capture of ≥ 99.97%.

REFERENCES

[1] Emeli Dey, Urvashi Choudhary, Swapan Kumar Ghosh. Junior Research Fellow, Department of Jute and Fiber Technology. University of Calcutta, India.

[2] Duane J. Adamson, Michael T. Terry, Dan B. Burns. Westinghouse SRS Building 786-5A Aiken, SC 29808 Los Alamos National. Laboratory P. O. Box 999, MSIN K-9-919 Richland, WA 99352.

[3] Hashim Kabrein, M. Z. M. Yusof and A. M. Leman. Centre for Energy and Industrial Environment, Universiti Tun Hussein Onn Malaysia. Department of Aeronautical Engineering, Universiti Tun Hussein Onn Malaysia.

[4] Sheng-Hsiu Huang, Chun-Wan Chen, Yu-Mei Kuo, Chane-Yu Lai, Roy McKay, Chih-Chieh Chen. National Taiwan University, Taipei 10617, Taiwan. Institute of Occupational Safety and Health, New Taipei City 22143, Taiwan

[5] Wanyi Zhang,Shiming Deng, Yongxiang Wang, Zhongping Lin. School of Mechanical Engineering, Tongji University, Shanghai 20092, China. Department of Building Service Engineering, Hong Kong Polytechnic University, Kowloon, Hong Kong