STUDIES IN NONWOVEN AIR FILTER FABRICS

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Abstract: *The problems of air pollution and its influence on human health and nature are of major concern in today's era. Waste emitted from various sources or industrial by-product is mainly considered as the main reason for air pollution. In order to minimize the concentration of noxious dust in the environment, different filter media are used. Needle punched nonwoven fabrics were prepared using 6 denier polyester fibres. The fabrics produced were studied for their air filtration properties and other associated properties like thickness, GSM, bursting strength, air permeability and filtration efficiency. Processing parameters such as punch density was altered to investigate its effect on filtration efficiency and other properties. The filtration behaviour of woven and nonwoven fabrics at different air flow rate and time intervals was also studied. It was observed that with the increase in needle punch density, GSM increased and air permeability decreased. Thickness was found to be increased upto particular level then it was decreased with the increased in punch density. It was reported that filtration efficiency also increases with the increased in punch density then it was decreased. Bursting strength was not significantly affected.*

Keywords: *Air filter, Air pollution, Nonwovens, Textiles*

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1. INTRODUCTION

Pollution of air is broadly due to particulate matter dispersed in air. The emission of pollutants in the atmosphere is a vital and hazardous problem in the rural as well as urban areas. Significant health differences have been reported to exist between people staying in highly polluted areas and low polluted areas. Thus the increasing air pollution in the cities has created an impact on the health of people. In the developing countries the rising air and water pollution levels are creating ill health, premature mortality and other problems in the population. In spinning mills microdust is released in the departments due to trashy cotton being opened in the blowroom and also ample fly fluff is created in the subsequent processes. The generation of fly and fluff is increased with increasing speed of the machines. Dust, smoke and fumes are the different forms of solid particulate matter differing in quality and particle size. Human inhales the dust particles varying in size between 0.25 to 1 microns. Out of these, nearly 55% are retained, creating health hazards to the human being [1, 2].

Filtration can be defined as the separation of one material from another. Therefore, filtration is basically a process of separation. The purpose of the filtration is to improve the purity of filtered material. The porous medium used to retain the solids is known as filter medium [3-6]. Fabric filtration is the use of a textile fabric to separate particles from air stream. The air stream passes unidirectional through the fabric so that the particles are retained on or in the fabric, while the air passes through. Most industrial processes give rise to aerosols in some forms- dusts, fumes or smokes, while the ordinary atmosphere contains a certain amount of particulate material. Some are highly toxic even in small concentrations, very small amounts of even small particles can upset processes and thus the provision of very clean air is necessary for a number of processes.

In terms of growing demand, the most important application of fabric filtration is environmental protection. The main objective of the filter medium is to maximize the possibility of collision and the subsequent retention of the suspended particles in the air stream with the medium's fibrous structure while minimizing the energy loss to the stream of air. There is a problem of particulate removal to make the air is acceptable for breathing by workmen or by general public, or removal to provide clean air for carrying out special processes [7-9].

A number of filter media is used for separating solid particles from air. But the basic advantages in using fabrics for filtration are the wide range of pore size and fibre configuration. The fabric filter media may be woven, knitted or nonwoven. Nonwovens are used as a major media almost 70% of total filter media for air filtration. In nonwovens, mainly needle punched fabrics are preferred. A random arrangement of fibres allow a better dissolution of the carrier phase into individual currents, thus providing more favourable conditions for the trapping and preciitation of particles than the same quantity of tightly bundled fibres made into weft and warp yarn. Besides the other advantages of fabric filter, it is simple in construction and operation, consumes low power and allows easy disposal of collected material [10-14].

2. EXPERIMENTAL

2.1. Materials

Four nonwoven needle punched fabric samples were manufactured using 6 denier polyester fibre were taken for the experiments. The fabrics were manufactured by varying their needle punching density. Fabrics with needle punching density of 200, 400, 600 and 800 were procured and woven polyester fabric which is most commonly used as air filter is taken for study.

2. 1. 1 Details of Raw Material

Woven Fabric

Table 2.1- Properties of Woven Fabric

Sr. No.	Parameters	Values
1.	Type	100 % Polyester
2.	Weave	Plain
3.	Warp Count	33.70 Ne
4.	Weft Count	31.58 Ne
5.	EPI × PPI	58 × 38
6.	GSM (gm/sq. m)	87.60
7.	Thickness (mm)	0.24
8.	Tensile Strength (kgf)	84.00 (warp way) 77.00 (weft way)
9.	Breaking Elongation (%)	23.75 (warp way) 22.50 (weft way)
10.	Bursting Strength (bar)	1.05
11.	Air Permeability ($cm^3/cm^2/s$)	32.95

Nonwoven Fabric

Sr. No.	Parameters	200 Needle Punching Density	400 Needle Punching Density	600 Needle Punching Density	800 Needle Punching Density
1.	GSM (gm/sq. m)	156.10	535	587.6	726.94
2.	Thickness (mm)	2.19	4.71	5.25	4.32
3.	Tensile Strength (kgf)	8.25 (MD) 4.15 (CD)	40.75 (MD) 25.91 (CD)	77.41 (MD) 39.46 (CD)	96.06 (MD) 65.30 (CD)
4.	Breaking Elongation (%)	67.05 (MD) 117.30 (CD)	56.37 (MD) 89.05 (CD)	54.70 (MD) 94.65 (CD)	51.50 (MD) 92.60 (CD)
5.	Bursting Strength (bar)	3.5	29.35	34.27	28.49
6.	Air Permeability ($cm^3/cm^2/s$)	191.60	51.74	42.05	27.46

2.2. Methods

In the filtration experiments, to evaluate filtration efficiency samples were mounted on High Volume Sampler. Samples were fitted in filter holder assembly. Constant weight of dust was fed into the pan and again the dust was weighed after removal of sample from the machine for evaluating filtration efficiency. The filtration efficiency of samples was determined for different time intervals that are 2hrs, 4hrs, 6hrs and 8 hrs for different air flow rate that are 800 lit/min, 1200 lit/min and 1600 lit/min. Filtration efficiency was calculated with the help of following formula,

$$\text{Filtration efficiency (\%)} = \frac{\text{Weight of dust collected on fabric}}{\text{Weight of total dust fed}} \times 100$$

3. TESTING

The fabric is evaluated for the tests includes the strength, thickness, GSM, Bursting strength, air permeability and filtration efficiency according to ISO 9073-3: 1989(E), ISO 9073-2:1995(E), ASTM D-6242-98, ASTM D-6797-02, ASTM D 737 and ASTM D-5744-12 respectively

4. RESULTS AND DISCUSSION

Table 4.1:- Effect of flow rate on GSM of fabric

Time - 2 hrs

Sr. No.	Air Flow Rate (lit/min)	Fabric									
		Woven		200		400		600		800	
		Before	After	Before	After	Before	After	Before	After	Before	After
1.	800	87.60	88.10	156.10	156.60	464.00	464.60	588.00	588.60	726.94	727.69
2.	1200	87.60	88.10	156.10	156.85	464.00	465.00	588.00	589.25	726.94	728.39
3.	1600	87.60	88.20	156.10	157.11	464.00	465.10	588.00	589.45	726.94	728.84

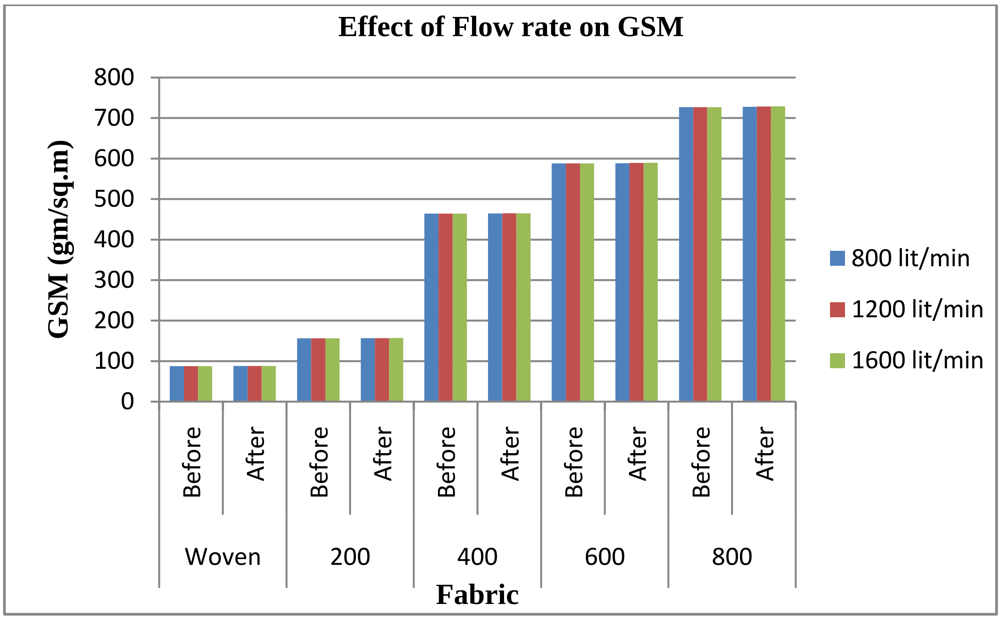

Figure 4.1: Effect of flow rate on GSM values for 2 hrs

The table 4.1 and figure 4.1 indicate that as the needle punching density of non woven fabric increases from 200 to 800, the GSM values of fabric before filtration also increases from 156.10 to 726.94 for 2 hrs filtration. After filtration, the GSM values of fabrics were found to be higher than that before filtration values. The GSM values of woven fabric were found to be lesser than the nonwoven fabric. As the air flow rate increases from 800 lit/min to 1600 lit/min, the trend of the GSM values of woven and nonwoven fabric is of increasing order and the maximum GSM value was found to be 728.84 for 800 punching density and at 1600 lit/min. The increase in GSM values of nonwoven fabric may be due to the increase in punching density which allows more fibre entrapment and causes increase in GSM values. Also increase in air flow rate attribute to the higher GSM values.

Table 4.2:- Effect of flow rate on GSM of fabric

Time - 4 hrs

Sr. No.	Air Flow Rate (lit/min)	Fabric									
		Woven		200		400		600		800	
		Before	After	Before	After	Before	After	Before	After	Before	After
1.	800	87.60	88.10	156.10	156.70	464.00	464.70	588.00	588.75	726.94	727.94
2.	1200	87.60	88.20	156.10	157.10	464.00	465.10	588.00	589.60	726.94	728.69
3.	1600	87.60	88.35	156.10	157.35	464.00	465.50	588.00	589.75	726.94	729.19

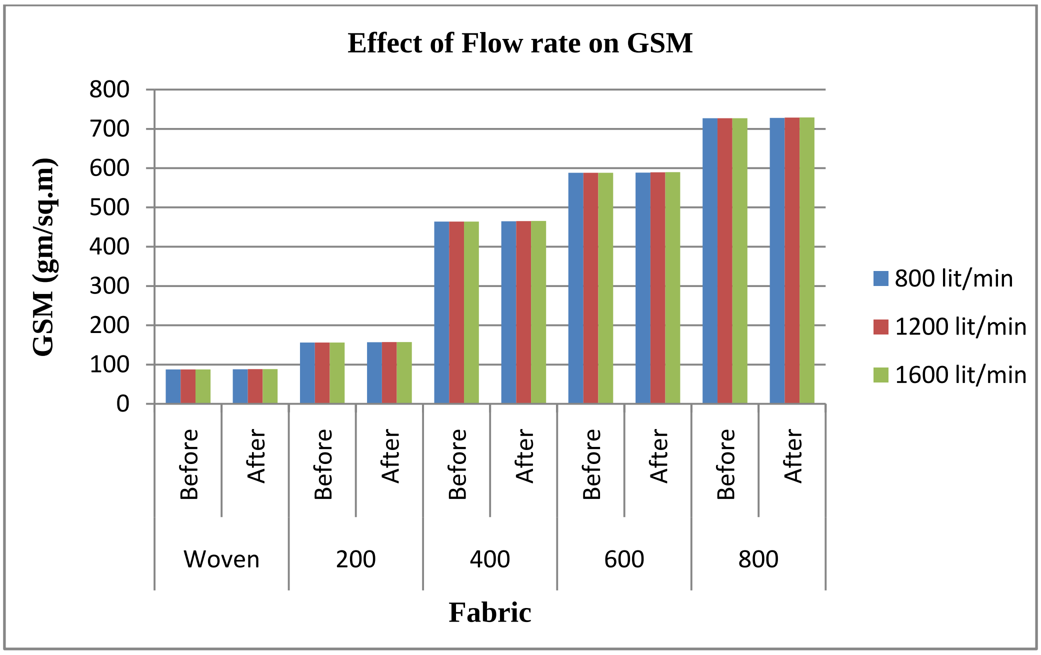

Figure 4.2: Effect of flow rate on GSM values for 4 hrs

The table 4.2 and figure 4.2 indicate that as the needle punching density of non woven fabric increases from 200 to 800, the GSM values of fabric before filtration also increases from 156.10 to 726.94. After filtration, the GSM values of fabrics were found to be higher than that before and for 2 hrs filtration values. The GSM values of woven fabric were found to be lesser than the nonwoven fabric but higher than 2 hrs. As the air flow rate increases from 800 lit/min to 1600 lit/min, the trend of the GSM values of woven and nonwoven fabric is of increasing order and the maximum GSM value was found to be 729.19 for 800 punching density and at 1600 lit/min. The increase in GSM values of nonwoven fabric may be due to the increase in punching density and time for filtration. Also increase in air flow rate attribute to the higher GSM values.

Table 4.3:- Effect of flow rate on GSM of fabric

Time - 6 hrs

Sr. No.	Air Flow Rate (lit/min)	Fabric									
		Woven		200		400		600		800	
		Before	After	Before	After	Before	After	Before	After	Before	After
1.	800	87.60	88.20	156.10	156.85	464.00	464.75	588.00	589.00	726.94	728.24
2.	1200	87.60	88.35	156.10	157.20	464.00	465.45	588.00	589.90	726.94	729.09
3.	1600	87.60	88.60	156.10	157.70	464.00	465.75	588.00	590.10	726.94	729.69

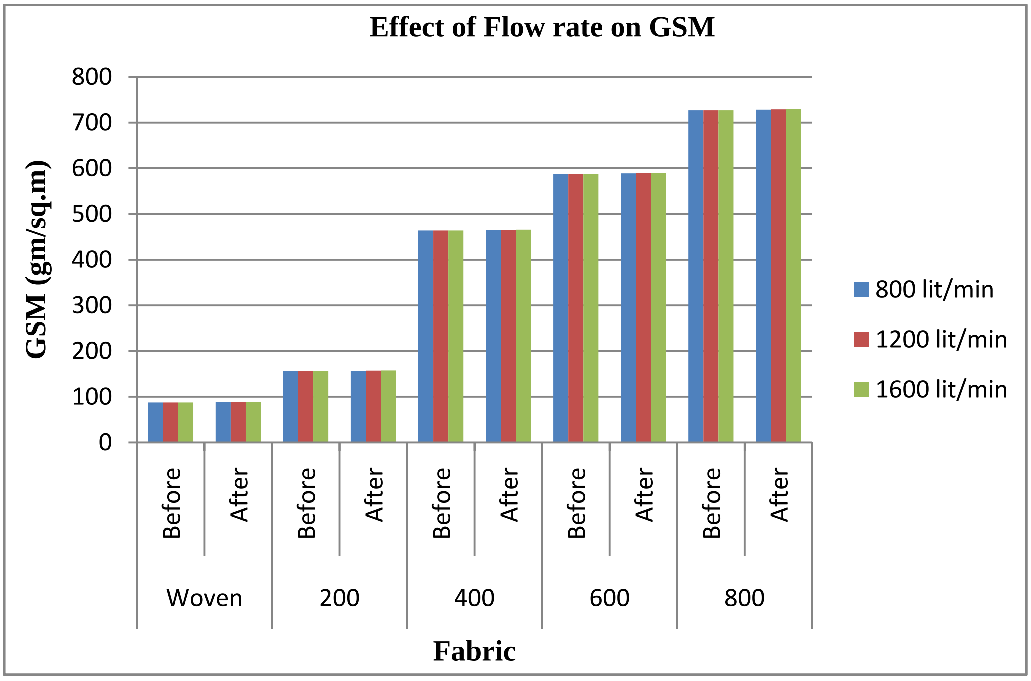

Figure 4.3: Effect of flow rate on GSM values for 6 hrs

The table 4.3 and figure 4.3 indicate that as the needle punching density of non woven fabric increases from 200 to 800, the GSM values of fabric before filtration also increases from 156.10 to 726.94. After filtration, the GSM values of fabrics were found to be higher than that before and for 2, 4 hrs filtration values. The GSM values of woven fabric were found to be lesser than the nonwoven fabric but higher than 2, 4 hrs. As the air flow rate increases from 800 lit/min to 1600 lit/min, the trend of the GSM values of woven and nonwoven fabric is of increasing order and the maximum GSM value was found to be 729.69 for 800 punching density and at 1600 lit/min. The increase in GSM values of nonwoven fabric may be due to the increase in punching density and time for filtration. Also increase in air flow rate attribute to the higher GSM values.

Table 4.4:- Effect of flow rate on GSM of fabric

Time - 8 hrs

Sr. No.	Air Flow Rate (lit/min)	Fabric									
		Woven		200		400		600		800	
		Before	After	Before	After	Before	After	Before	After	Before	After
1.	800	87.60	88.35	156.10	157.10	464.00	465.00	588.00	589.25	726.94	728.44
2.	1200	87.60	88.35	156.10	157.35	464.00	465.60	588.00	590.20	726.94	729.54
3.	1600	87.60	88.70	156.10	157.85	464.00	466.00	588.00	590.25	726.94	730.44

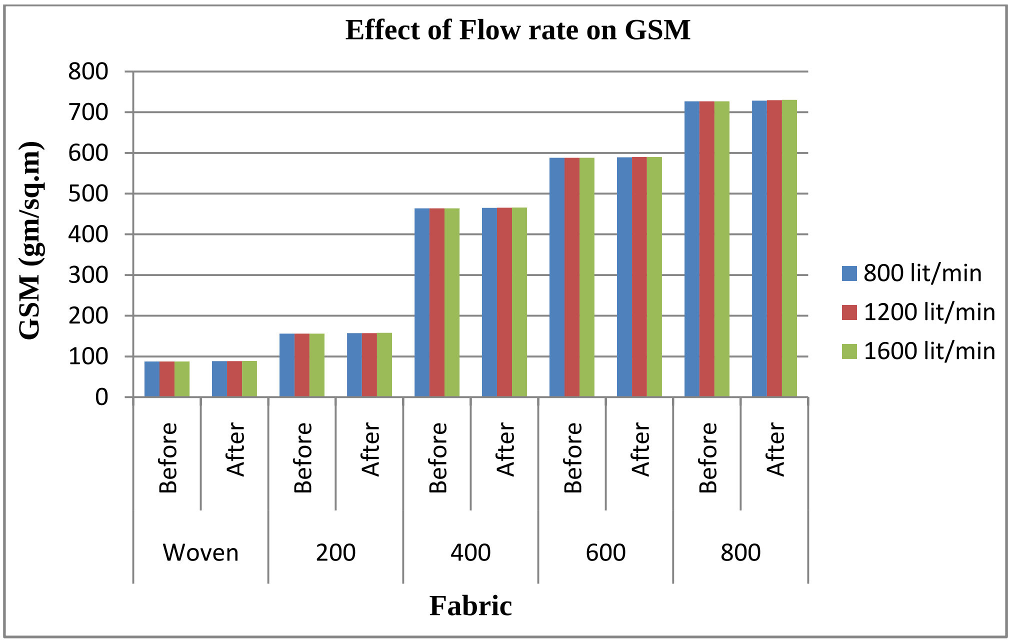

Figure 4.4: Effect of flow rate on GSM values for 8 hrs

The table 4.4 and figure 4.4 indicate that as the needle punching density of non woven fabric increases from 200 to 800, the GSM values of fabric before filtration also increases from 156.10 to 726.94. After filtration, the GSM values of fabrics were found to be higher than that before and other hours of filtration values. The GSM values of woven fabric were found to be lesser than the nonwoven fabric but higher than remaining filtration duration. As the air flow rate increases from 800 lit/min to 1600 lit/min, the trend of the GSM values of woven and nonwoven fabric is of increasing order and the maximum GSM value was found to be 730.44 for 800 punching density and at 1600 lit/min. The increase in GSM values of nonwoven fabric may be due to the increase in punching density and time for filtration. Also increase in air flow rate attribute to the higher GSM values.

Table 4.5:- Effect of flow rate on air permeability of fabric

Time - 2 hrs

Sr. No.	Air Flow Rate (lit/min)	Fabric									
		Woven		200		400		600		800	
		Before	After	Before	After	Before	After	Before	After	Before	After
1.	800	32.95	32.90	191.60	191.33	51.74	51.70	42.05	42.00	27.46	27.40
2.	1200	32.95	32.85	191.60	190.06	51.74	51.50	42.05	41.35	27.46	27.15
3.	1600	32.95	32.81	191.60	188.89	51.74	51.10	42.05	41.30	27.46	26.97

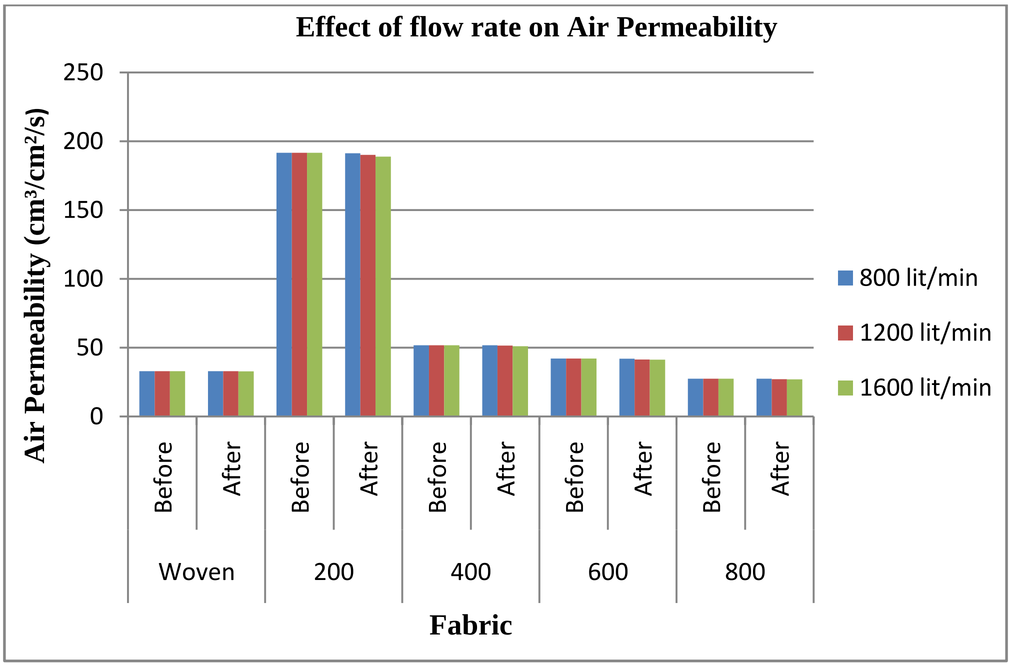

Figure 4.5: Effect of flow rate on air permeability values for 2 hrs

The table 4.5 and figure 4.5 indicate that as the needle punching density of non woven fabric increases from 200 to 800, the air permeability values of fabric before filtration also decreases from 191.60 to 27.46. After filtration, the air permeability values of fabrics were found to be lower than that of before filtration values. The air permeability values of woven fabric were also found to be lower than the nonwoven fabric. As the air flow rate increases from 800 lit/min to 1600 lit/min, the trend of the air permeability values of woven and nonwoven fabric is of decreasing order and the minimum air permeability value for 2 hrs was found to be 26.97 for 800 punching density and at 1600 lit/min. The decrease in air permeability values of nonwoven fabric may be due to the increase in punching density, increase in the punching density makes the fabric more compact, dense which allows less amount of air to pass through. Also increase in air flow rate attribute to the lower air permeability values.

Table 4.6:- Effect of flow rate on air permeability of fabric

Time - 4 hrs

Sr. No.	Air Flow Rate (lit/min)	Fabric									
		Woven		200		400		600		800	
		Before	After	Before	After	Before	After	Before	After	Before	After
1.	800	32.95	32.83	191.60	191.00	51.74	51.59	42.05	41.80	27.46	27.20
2.	1200	32.95	32.78	191.60	189.90	51.74	51.10	42.05	41.25	27.46	27.00
3.	1600	32.95	32.73	191.60	187.00	51.74	49.60	42.05	41.12	27.46	26.85

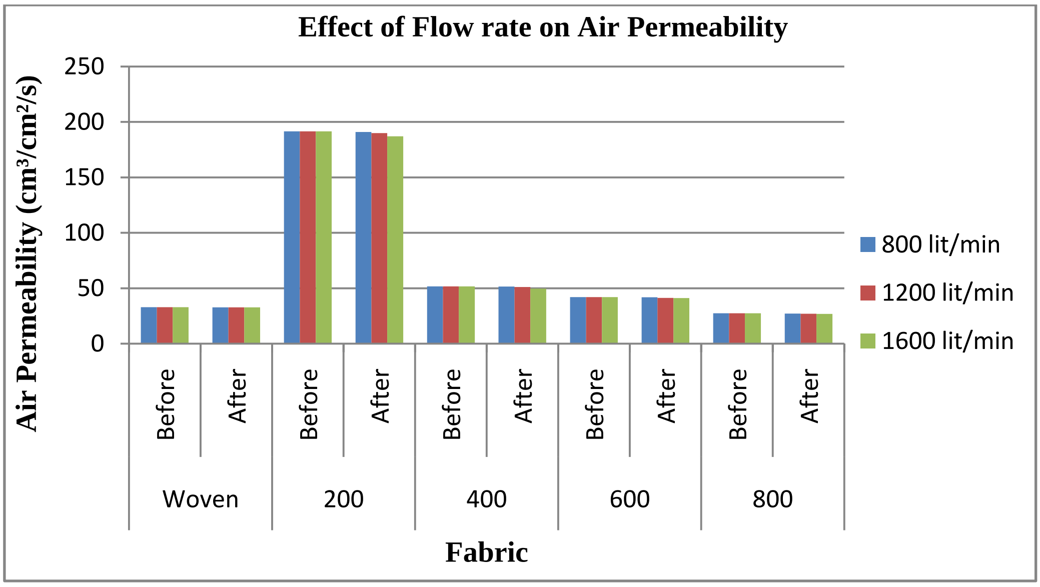

Figure 4.6: Effect of flow rate on air permeability values for 4 hrs

The table 4.6 and figure 4.6 indicate that as the needle punching density of non woven fabric increases from 200 to 800, the air permeability values of fabric before filtration also decreases from 191.60 to 27.46. After filtration, the air permeability values of fabrics were found to be lower than that of before and 2 hrs filtration values. The air permeability values of woven fabric were also found to be lower than the nonwoven fabric. As the air flow rate increases from 800 lit/min to 1600 lit/min, the trend of the air permeability values of woven and nonwoven fabric is of decreasing order and the minimum air permeability value for 4 hrs was found to be 26.85 for 800 punching density and at 1600 lit/min. The decrease in air permeability values of nonwoven fabric may be due to the increase in punching density and time for filtration. Also increase in air flow rate attribute to the lower air permeability values.

Table 4.7:- Effect of flow rate on air permeability of fabric

Time - 6 hrs

Sr. No.	Air Flow Rate (lit/min)	Fabric									
		Woven		200		400		600		800	
		Before	After	Before	After	Before	After	Before	After	Before	After
1.	800	32.95	32.79	191.60	190.06	51.74	51.00	42.05	41.75	27.46	27.15
2.	1200	32.95	32.71	191.60	188.00	51.74	50.00	42.05	41.19	27.46	26.91
3.	1600	32.95	32.65	191.60	186.60	51.74	48.95	42.05	41.05	27.46	26.59

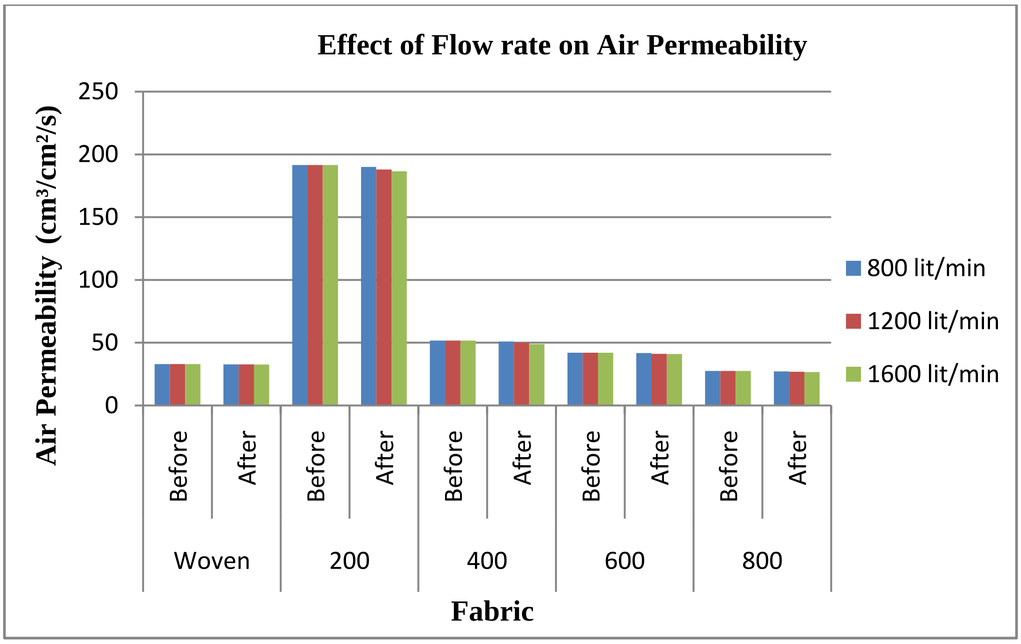

Figure 4.7: Effect of flow rate on air permeability values for 6 hrs

The table 4.7 and figure 4.7 indicate that as the needle punching density of non woven fabric increases from 200 to 800, the air permeability values of fabric before filtration also decreases from 191.60 to 27.46. After filtration, the air permeability values of fabrics were found to be lower than that of before and 2, 4 hrs filtration values. The air permeability values of woven fabric were also found to be lower than the nonwoven fabric. As the air flow rate increases from 800 lit/min to 1600 lit/min, the trend of the air permeability values of woven and nonwoven fabric is of decreasing order and the minimum air permeability value for 6 hrs was found to be 26.59 for 800 punching density and 1600 lit/min. The decrease in air permeability values of nonwoven fabric may be due to the increase in punching density and time for filtration. Also increase in air flow rate attribute to the lower values of air permeability.

Table 4.8:- Effect of flow rate on air permeability of fabric

Time - 8 hrs

Sr. No.	Air Flow Rate (lit/min)	Fabric									
		Woven		200		400		600		800	
		Before	After	Before	After	Before	After	Before	After	Before	After
1.	800	32.95	32.72	191.60	188.90	51.74	50.70	42.05	41.40	27.46	27.05
2.	1200	32.95	32.63	191.60	187.50	51.74	49.80	42.05	41.10	27.46	26.70
3.	1600	32.95	32.56	191.60	186.10	51.74	48.62	42.05	41.00	27.46	26.30

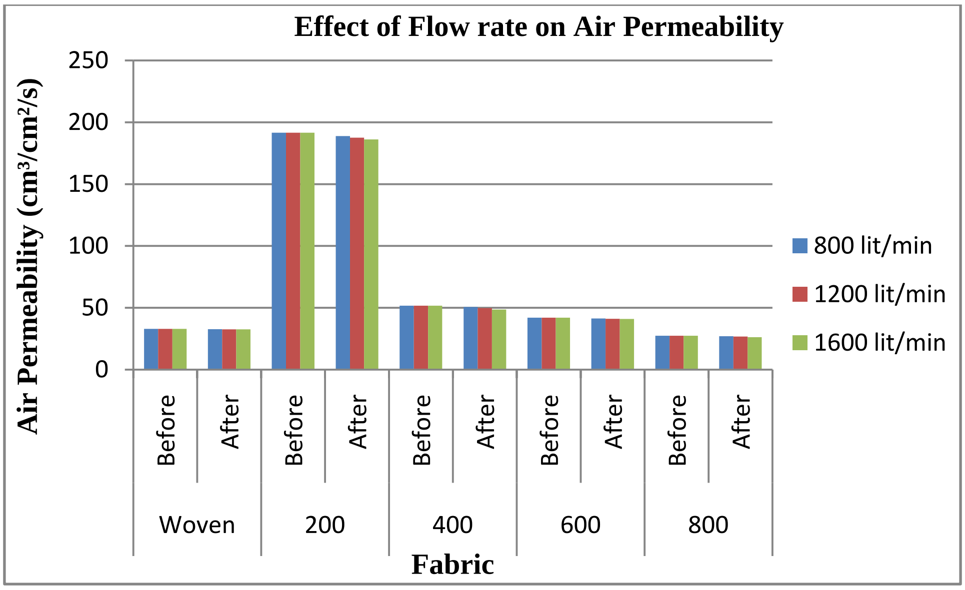

Figure 4.8: Effect of flow rate on air permeability values for 8 hrs

The table 4.8 and figure 4.8 indicate that as the needle punching density of non woven fabric increases from 200 to 800, the air permeability values of fabric before filtration also decreases from 191.60 to 27.46. After filtration, the air permeability values of fabrics were found to be lower than that of before and 2, 4, 6 hrs filtration values. The air permeability values of woven fabric were also found to be lower than the nonwoven fabric. As the air flow rate increases from 800 lit/min to 1600 lit/min, the trend of the air permeability values of woven and nonwoven fabric is of decreasing order and the minimum air permeability value for 8 hrs was found to be 26.30 for 800 punching density and at 1600 lit/min. The decrease in air permeability values of nonwoven fabric may be due to the increase in punching density and time for filtration. Also increase in air flow rate attribute to the lower air permeability values.

Table 4.9:- Effect of flow rate on bursting strength of fabric

Time - 2 hrs

Sr. No.	Air Flow Rate (lit/min)	Fabric									
		Woven		200		400		600		800	
		Before	After	Before	After	Before	After	Before	After	Before	After
1.	800	1.05	1.05	4.82	4.82	29.35	29.37	34.27	34.28	48.87	48.89
2.	1200	1.05	1.07	4.82	4.83	29.35	29.39	34.27	34.32	48.87	48.90
3.	1600	1.05	1.08	4.82	4.85	29.35	29.43	34.27	34.36	48.87	48.92

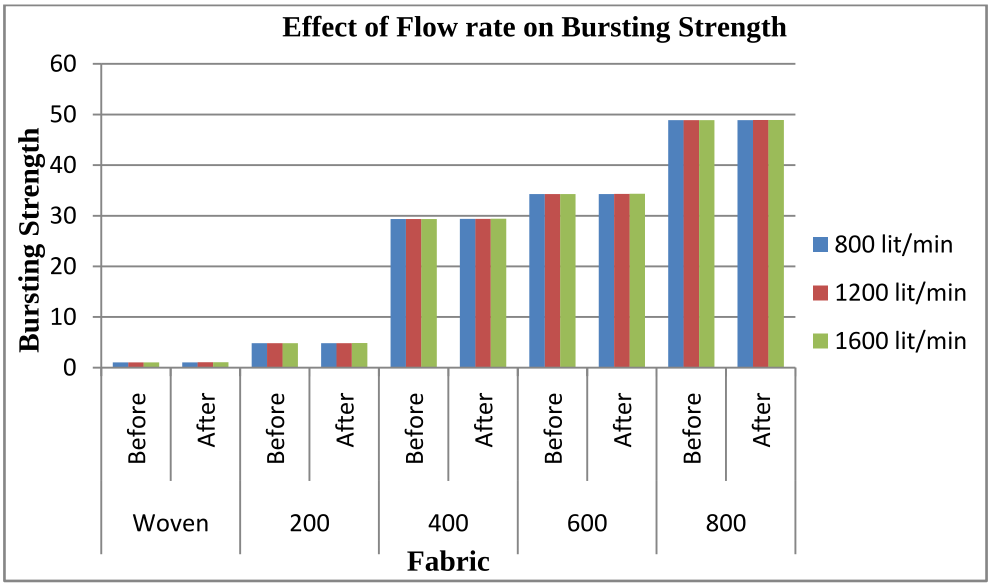

Figure 4.9: Effect of flow rate on bursting strength values for 2 hrs

The table 4.9 and figure 4.9 indicate that as the needle punching density of non woven fabric increases from 200 to 800, the bursting strength values of fabric before filtration also increases from 1.05 to 48.87. After filtration, the bursting strength values of fabrics were found to be higher than that of before filtration values. The bursting strength values of woven fabric were also found to be lower than the nonwoven fabric. As the air flow rate increases from 800 lit/min to 1600 lit/min, the trend of the bursting strength values of woven and nonwoven fabric is of increasing order and the maximum bursting strength value for 2 hrs was found to be 48.92 for 800 punching density and at 1600 lit/min. The increase in bursting strength values of nonwoven fabric may be due to the increase in punching density which makes fabric denser and thus require higher bursting strength. Also increase in air flow rate attribute to the lower bursting strength values.

Table 4.10:- Effect of flow rate on bursting strength of fabric

Time - 4 hrs

Sr. No.	Air Flow Rate (lit/min)	Fabric									
		Woven		200		400		600		800	
		Before	After	Before	After	Before	After	Before	After	Before	After
1.	800	1.05	1.07	4.82	4.84	29.35	29.40	34.27	34.31	48.87	48.93
2.	1200	1.05	1.10	4.82	4.88	29.35	29.42	34.27	34.35	48.87	48.95
3.	1600	1.05	1.11	4.82	4.90	29.35	29.46	34.27	34.38	48.87	48.97

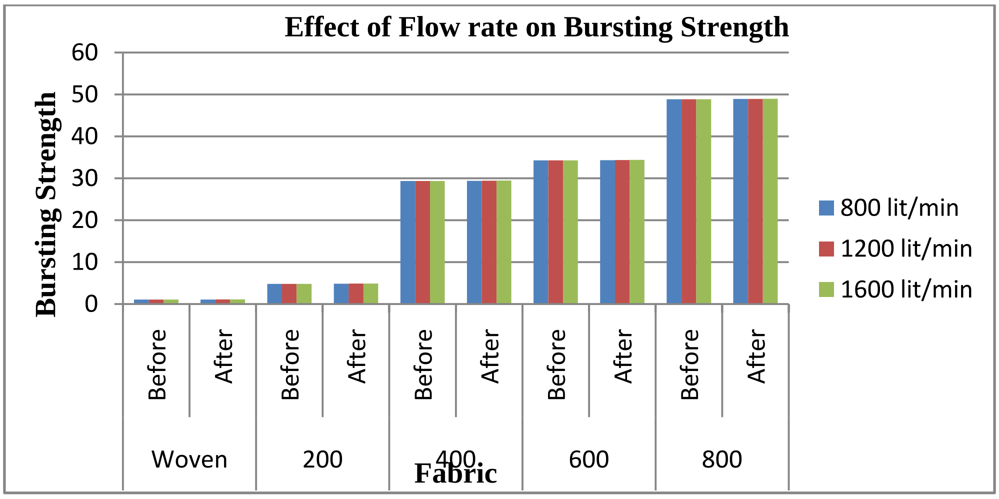

Figure 4.10: Effect of flow rate on bursting strength values for 4 hrs

The table 4.10 and figure 4.10 indicate that as the needle punching density of non woven fabric increases from 200 to 800, the bursting strength values of fabric before filtration also increases from 1.05 to 48.87. After filtration, the bursting strength values of fabrics were found to be higher than that of before and 2 hrs filtration values. The bursting strength values of woven fabric were also found to be lower than the nonwoven fabric. As the air flow rate increases from 800 lit/min to 1600 lit/min, the trend of the bursting strength values of woven and nonwoven fabric is of increasing order and the maximum bursting strength value for 4 hrs was found to be 48.97 for 800 punching density and at 1600 lit/min. The increase in bursting strength values of nonwoven fabric may be due to the increase in punching density which makes fabric denser and thus require higher bursting strength. Also increase in air flow rate and time for filtration attribute to the lower bursting strength values.

Table 4.11:- Effect of flow rate on bursting strength of fabric

Time - 6 hrs

Sr. No.	Air Flow Rate (lit/min)	Fabric									
		Woven		200		400		600		800	
		Before	After	Before	After	Before	After	Before	After	Before	After
1.	800	1.05	1.09	4.82	4.87	29.35	29.42	34.27	34.35	48.87	48.96
2.	1200	1.05	1.11	4.82	4.92	29.35	29.44	34.27	34.39	48.87	49.00
3.	1600	1.05	1.14	4.82	4.93	29.35	29.50	34.27	34.42	48.87	49.04

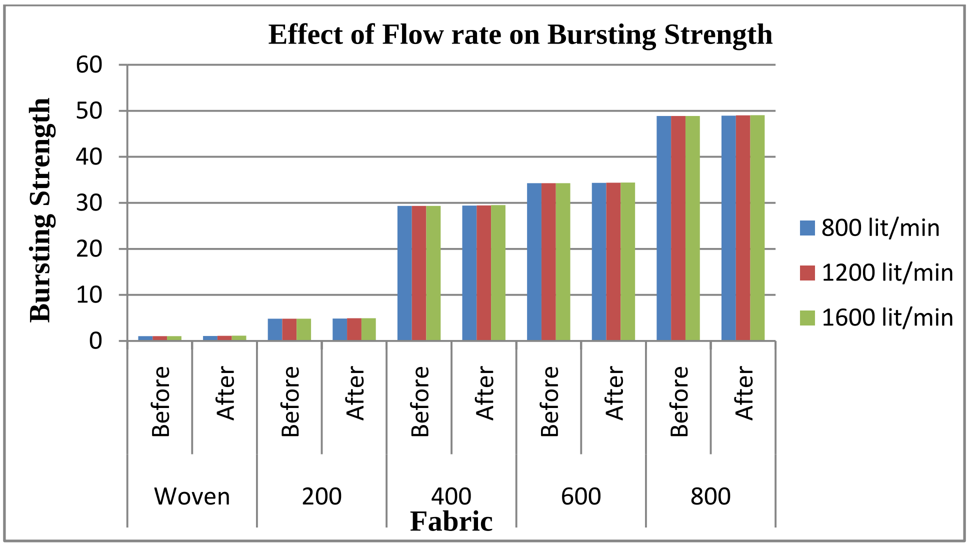

Figure 4.11: Effect of flow rate on bursting strength values for 6 hrs

The table 4.11 and figure 4.11 indicate that as the needle punching density of non woven fabric increases from 200 to 800, the bursting strength values of fabric before filtration also increases from 1.05 to 48.87. After filtration, the bursting strength values of fabrics were found to be higher than that of before and 2, 4 hrs filtration values. The bursting strength values of woven fabric were also found to be lower than the nonwoven fabric. As the air flow rate increases from 800 lit/min to 1600 lit/min, the trend of the bursting strength values of woven and nonwoven fabric is of increasing order and the maximum bursting strength value for 6 hrs was found to be 49.04 for 800 punching density and at 1600 lit/min. The increase in bursting strength values of nonwoven fabric may be due to the increase in punching density which makes fabric denser and thus require higher bursting strength. Also increase in air flow rate and time for filtration attribute to the lower bursting strength values.

Table 4.12:- Effect of flow rate on bursting strength of fabric

Time - 8 hrs

Sr. No.	Air Flow Rate (lit/min)	Fabric									
		Woven		200		400		600		800	
		Before	After	Before	After	Before	After	Before	After	Before	After
1.	800	1.05	1.12	4.82	4.92	29.35	29.45	34.27	34.38	48.87	49.00
2.	1200	1.05	1.16	4.82	4.95	29.35	29.48	34.27	34.43	48.87	49.07
3.	1600	1.05	1.19	4.82	4.98	29.35	29.53	34.27	34.47	48.87	49.10

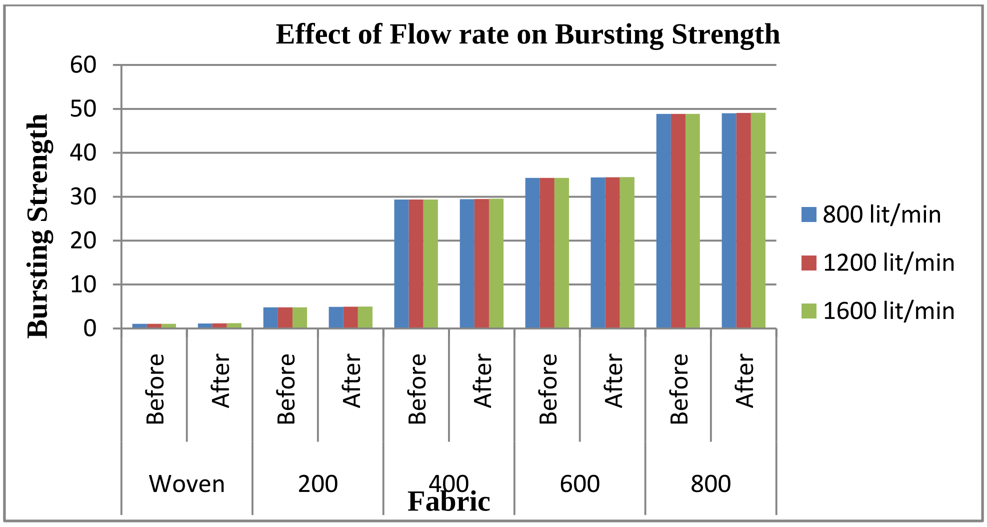

Figure 4.12: Effect of flow rate on bursting strength values for 8 hrs

The table 4.12 and figure 4.12 indicate that as the needle punching density of non woven fabric increases from 200 to 800, the bursting strength values of fabric before filtration also increases from 1.05 to 48.87. After filtration, the bursting strength values of fabrics were found to be higher than that of before filtration values and remaining filtration durations. The bursting strength values of woven fabric were also found to be lower than the nonwoven fabric. As the air flow rate increases from 800 lit/min to 1600 lit/min, the trend of the bursting strength values of woven and nonwoven fabric is of increasing order and the maximum bursting strength value for 8 hrs was found to be 49.10 for 800 punching density and at 1600 lit/min. The increase in bursting strength values of nonwoven fabric may be due to the increase in punching density which makes fabric denser and thus require higher bursting strength. Also increase in air flow rate and time for filtration attribute to the lower bursting strength values.

Table 4.13:- Effect of flow rate on filtration efficiency (%) values

Sr. No	Air Flow Rate (lit/min)	Fabric																			
		Woven				200				400				600				800			
		2 hrs	4 hrs	6 hrs	8 hrs	2 hrs	4 hrs	6 hrs	8 hrs	2 hrs	4 hrs	6 hrs	8 hrs	2 hrs	4 hrs	6 hrs	8 hrs	2 hrs	4 hrs	6 hrs	8 hrs
1.	800	10	10	12	15	10	12	15	20	12	15	15	20	12	15	20	25	15	20	26	30
2.	1200	10	12	15	15	15	20	22	25	20	22	29	32	25	32	38	45	29	35	43	52
3.	1600	12	15	20	22	20	25	32	35	22	30	35	40	29	35	42	50	38	45	55	70

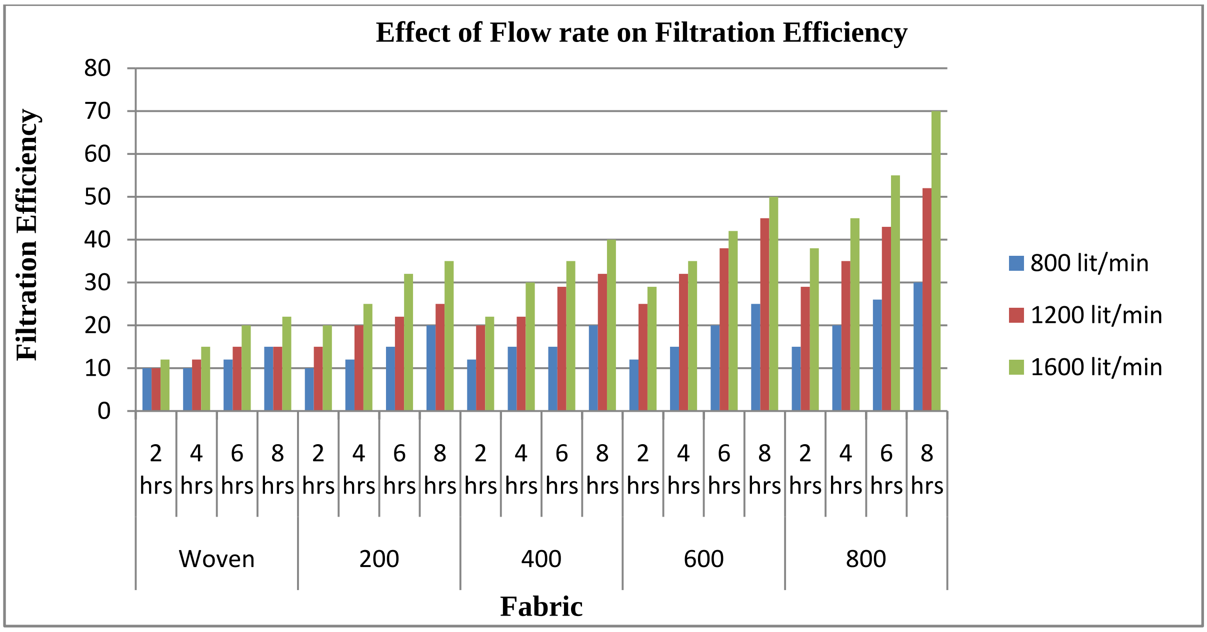

Figure 4.13: Effect of flow rate on filtration efficiency values

The table 4.13 and figure 4.13 indicate that as the needle punching density of non woven fabric increases from 200 to 800, the filtration efficiency values of fabric also increases from 10 % to 70 %. The filtration efficiency values of woven fabric were also found to be lower than the nonwoven fabric. As the air flow rate increases from 800 lit/min to 1600 lit/min, the trend of the filtration efficiency values of woven and nonwoven fabric is of increasing order and the maximum filtration efficiency value for all fabric was found to be 70 % for 800 punching density and at 1600 lit/min. The increase in filtration efficiency values of nonwoven fabric may be due to the increase in punching density which makes fabric denser and thus can retain even small particles on the fabric surface. Also increase in air flow rate and time for filtration attribute to the higher filtration efficiency values.

CONCLUSION

From the results and discussion it was observed that the nonwoven fabric gives better results as compared to the woven fabric, this may be because of instrument of dust particles in compact nonwoven fabric structure, which is not disturbing regular filtration process too.. Also at 800 needle punch density at an air flow rate of 1600 lit/min and for a longer duration i.e. at 8 hrs better efficiency is observed. So nonwoven fabric can be safely used for air filtration without much affecting the other properties of nonwoven fabric.

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