QUALITY ASPECTS OF NONWOVEN NEEDLE-PUNCHED POLYESTER FILTER FABRICS FOR DUST CONTROL

R. P. Jamdagni[1]; **K. N. Chatterjee**
The Technological Institute of Textile and Sciences, Bhiwani, Haryana, India
e-mail: [1]rjamdagni@hotmail.com

Abstract

Needle-punched non-woven filter fabrics made of polyester fibres have been studied for dust filtration by measuring the filtration properties on a fabricated filtration apparatus. The effect of fabric gsm, needle density and needle penetration on filtration characteristics has been studied. The fabrics with higher gsm show higher filtration efficiency and collection capacity but at the cost of increased pressure drop. With the increased needle density and needle penetration value, the filtration properties improved initially up to a certain extent and thereafter reduction takes place.

Introduction

Over the last decades, the environmental issue has become a major subject, affecting science and technology of the entire world due to serious environmental impacts caused by air pollution. Environmental pollution has negative influences on human health, ecological systems, the greenhouse effect and the ozone layer depletion, etc. Filtration plays a critical role in our day-to-day life by providing healthier and cleaner products and environment. Textile materials are used in the filtration of air, liquids, food particles and industrial production. Filter fabrics are used widely in vacuum cleaners, power stations, petrochemical plants, cement plants, etc. Textile materials, particularly woven and nonwoven filter fabrics, are suitable for filtration because of their complicated structure and thickness, dust particles have to follow a tortuous path around textile fibres.

The choice of material to be used in filters is often the most important factor that must be considered if optimum performance is desired. The filter medium should be selected primarily for its capability to retain the solids that must be separated from the fluid, with an acceptable length of life. The filtration conditions (whether involving hot acids, extreme heat, etc.) and the type of filtration (whether gas or liquid) are also important considerations. Both woven and non-woven fabrics are used for filtration purposes but non-woven fabrics are preferred to woven fabrics for improved performance in case of air filtration. Among the non-woven, the needle-punched filter fabrics are the fastest growing of all types of filter media.

Many researchers have carried out extensive work on filtration and mechanical properties of filter fabrics which are governed by many factors [1-8]. Fibre length and fibre fineness plays an important role in filtration and mechanical characteristics of filter fabrics. In order to secure high strength to the needled fabric, it is necessary to use long fibres. Finer fibres will yield greater strength to the fabric provided that the fibre damage is avoided1. The permeability and hence the filtration properties are greatly influenced by the fibre fineness. If fabric weight and density are kept constant, air-permeability varies linearly with the fibre diameter and hence fineness. When a very dilute aerosol of submicron particles are filtered, the capture efficiency varies linearly with d/s, where d is the effective particle diameter and s is the inter-fibre spacing. A decrease in fibre linear density at constant fabric weight results in an increase in both capture efficiency and pressure drop [2].

At higher needling densities, the fabric weight decreases with increasing depths of needle penetration [7]. Increase in needle penetration also leads to decreased thickness of the fabric.

The above changes in fabric weight and thickness cause the fabric density increase with an increase in needle penetration. Filtration efficiency depends on needle dimension and needle density as these cause more opening for dust to flow through. Filter having higher permeability will have less resistance compared with filters having lower permeability and so will collect more dust.

The objectives of the present study were to prepare a range of nonwoven needle-punched filter fabrics and study their quality aspects in terms of filtration properties.

- To fabricate an instrument for measuring the filtration parameters i.e., filtration efficiency, air permeability, pressure drop, etc.
- To optimize fabric and needle parameters i.e., gsm, needling density and needle penetration on the filtration properties of nonwoven needle-punched filter fabrics using factorial design techniques.

1 Designing a filtration apparatus

It is often difficult to study the filtration performance primarily because the emission processes in surface filter media are transient in nature. Further, there are difficulties in developing standard test apparatus simulating the practical situation as design of filter unit, and aerosol characteristics vary widely even in the same application at different places.

The standard testing of filters and filter media is important for the design and development, manufacturing and selection of filter media, as well as for quality assurance during the production process. Particle-size dependent filtration efficiency, differential pressure drop, dust loading capacity, and life of the filter media are the most required parameters for filter material characterization.

1.1 Description of fabricated filtration apparatus at TITS

It consists of a compressor line, dust feeder, filter cloth holder, absolute filter, orifice meter, and suction pump, as well as digital timer and solenoid valve for controlling filtration and cleaning cycles of filter fabrics.

1.2 Measurement of filtration efficiency and pressure drop by the fabricated apparatus

Filtration efficiency and pressure drop of the samples were measured in the experimental set-up. Filtration efficiency is defined as a ratio of amount of dust collected by the fabric to the amount of dust fed expressed as a percentage.

$$Filtration\ efficiency\ [\%] = \frac{weight\ of\ dust\ collected}{weight\ of\ dust\ fed} \times 100 \qquad (1)$$

Cement dust having a particle size range of 3.89 microns to 118 microns was used.

The actual pressure drop ΔP was calculated in the following way:

$$\Delta P = P_1 - P_2, \qquad (2)$$

where

P_1 = Pressure drop across the filter holder with fabric placed in proper position and

P_2 = Pressure drop across the empty fabric holder.

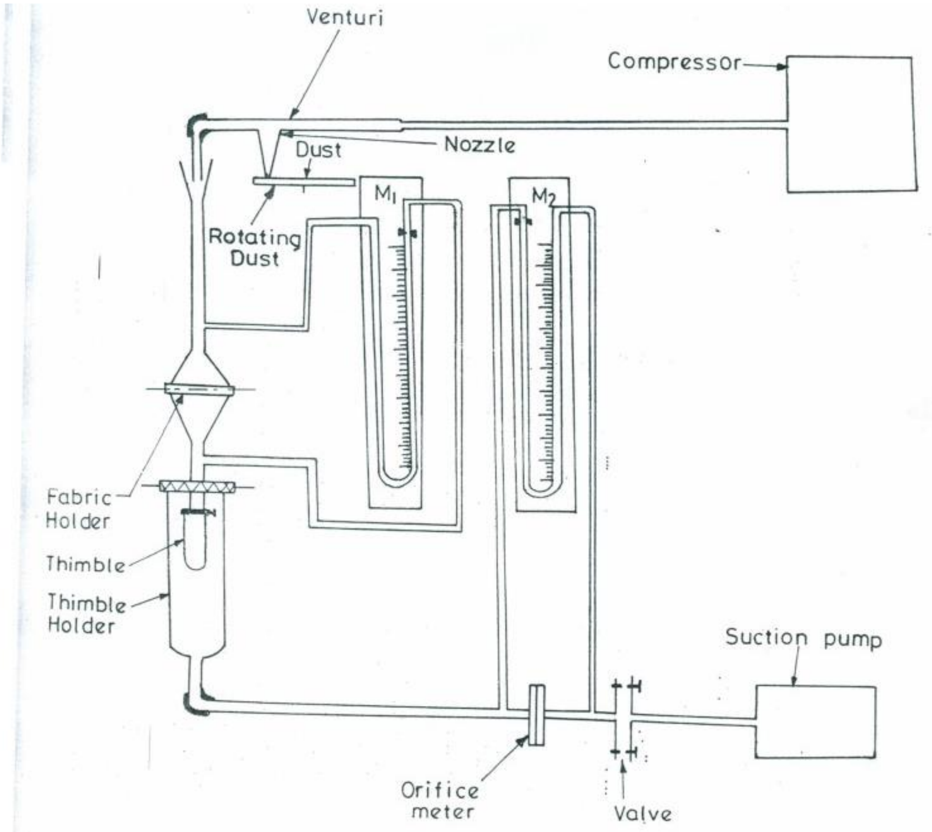

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Fig. 1: *Device for dust generation*

2 Materials and methods

Twenty nonwoven needle-punched fabric samples were prepared from 100% polyester fiber of 3.0 denier and staple length of 5l mm., with varying constructional parameters viz., Fabric Weight (gsm), Needling Density (punches/ sq.cm), Needle Penetration (mm). The values of different variables were chosen according to the “Factorial Design of Experiments” (Table 1).

The fabrics were made from parallel laid web which was obtained by feeding opened fibers in the “DILO” Laboratory model card. The carded web was fed to “DILO” Needle loom type OD -II/6.

Experiments were conducted with dust free air to estimate the effect of variables on the permeability. The physical properties of the fabrics made were measured. The results of the experiment on permeability and physical properties are given in Table 1. Experiments were also conducted to estimate filtration efficiency and pressure drop by using cement dust. Table 1 gives the experimental values of filtration efficiency and pressure drop.

Tab. 1: *Coded and Actual Levels of Fabric Weight, Needling Density and Depth of Needle Penetration*

	Levels of variables					
	X_1		X_2		X_3	
Sl. no	CODED LEVEL	ACTUAL LEVEL	CODED LEVEL	ACTUAL LEVEL	CODED LEVEL	ACTUAL LEVEL
1	-1.000	300	-1.000	300	-1.000	8
2	+1.000	500	-1.000	300	-1.000	8
3	-1.000	300	+1.000	500	-1.000	8
4	+1.000	500	+1.000	500	-1.000	8
5	-1.000	300	-1.000	300	+1.000	14
6	+1.000	500	-1.000	300	+1.000	14
7	-1.000	300	+1.000	500	+1.000	14
8	+1.000	500	+1.000	500	+1.000	14
9	-1.682	232	0.000	400	0.000	11
10	+1.682	568	0.000	400	0.000	11
11	0.000	400	-1.682	232	0.000	11
12	0.000	400	+1.682	568	0.000	11
13	0.000	400	0.000	400	-1.682	6
14	0.000	400	0.000	400	+1.682	16
15	0.000	400	0.000	400	0.000	11
16	0.000	400	0.000	400	0.000	11
17	0.000	400	0.000	400	0.000	11
18	0.000	400	0.000	400	0.000	11
19	0.000	400	0.000	400	0.000	11
20	0.000	400	0.000	400	0.000	11

Source: Own

3 Experimental analysis

The results of all the responses for the various experimental combinations were fed to a computer. Suitable computer program (SYSTAT) was used for calculating the regression coefficients. The response surface equations for different fabric characteristics along with the correlation coefficients between the experimental values and the calculated ones obtained from the response surface equations are given in Table 2.

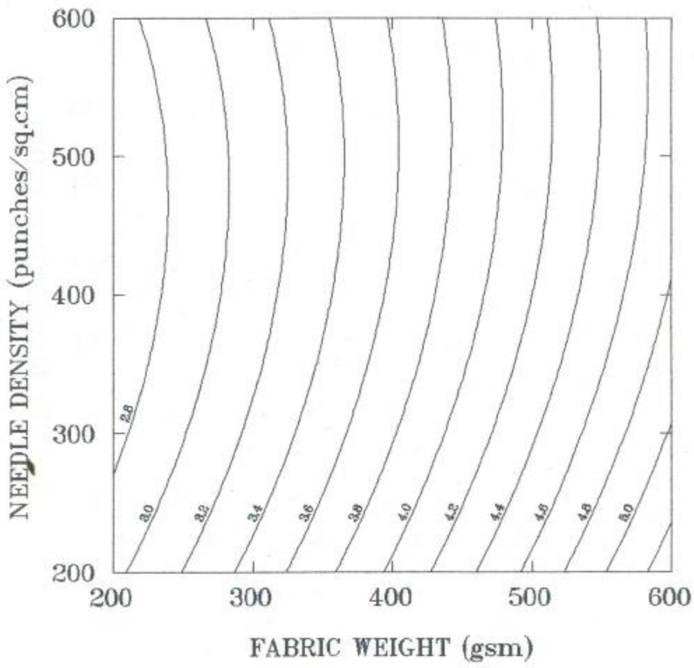

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Fig. 2: *Effect of FW and ND on THK*

Tab. 2: *Thickness, Density, Porosity, Air permeability and Sectional permeability*

Fab. Ref.no	Actual fabric weight (gsm)	Fabric Thickness (mm)	Fabric Density (gms/cc)	Porosity (%)	Air Permeability (cc/sq.cm/sec)	Sectional Air Permeability (cc/cm/sec)
F1	311.96	4.324	0.0721	94.78	65.90	28.49
F2	508.57	5.158	0.0986	92.86	43.43	22.40
F3	315.93	3.910	0.0808	94.14	58.96	23.05
F4	524.35	5.254	0.0998	92.77	36.87	19.37
F5	276.13	2.746	0.1005	92.72	54.66	15.00
F6	497.88	3.824	0.1302	90.56	28.82	11.02
F7	278.99	2.936	0.0950	93.12	50.97	14.96
F8	492.85	3.314	0.1487	89.22	22.46	7.44
F9	247.35	2.486	0.0995	92.79	50.74	12.61
F10	607.45	4.742	0.1281	90.72	22.94	10.88
F11	377.66	3.914	0.0965	93.00	40.65	15.91
F12	381.54	3.450	0.0991	92.82	30.98	10.69
F13	453.70	4.844	0.1106	91.98	46.39	22.47
F14	371.28	3.198	0.1161	91.59	28.56	9.13
F15	412.86	3.584	0.1152	91.65	36.85	13.21
F16	404.63	3.628	0.1115	91.92	34.73	12.60
F17	398.71	3.626	0.1099	92.04	34.56	12.53
F18	406.48	3.702	0.1098	92.04	32.76	12.13
F19	404.87	3.596	0.1126	91.84	37.24	13.39
F20	401.32	3.664	0.1095	92.07	35.87	13.14

Source: Own

With the help of regression coefficients, the canonic surface plots were developed by using SYSTAT package. The plot of fabric weight (FW) and needle density (ND) on fabric thickness. Figures show the results of fabric density for the two independent variables at a time, i.e., FW & ND, FW & NP and ND & NP respectively.

3.1 Air Permeability

Air permeability was measured by the instrument developed in the laboratory. The reading was taken for 10 mm-WG pressure drop across the fabric and air permeability values were calculated in cc/sq.cm/sec from the calibration curve and the area of the fabric.

The permeability data and conditions of the variables given in Table 1 are processed in software 'SYSTAT' for regression analysis. The coefficients of the regression analysis obtained are given in equation (3).

$$P_a = 197.8 - 0.24\, m_a - 0.2\, N_d - 7.24\, N_p + 0.0002\, m_a^2 + 0.0002\, N_d^2 + 0.29\, N_p^2 - 0.00003\, m_a\, N_d + 0.0014\, N_d\, N_p - 0.0041\, m_a\, N_p \quad (3)$$

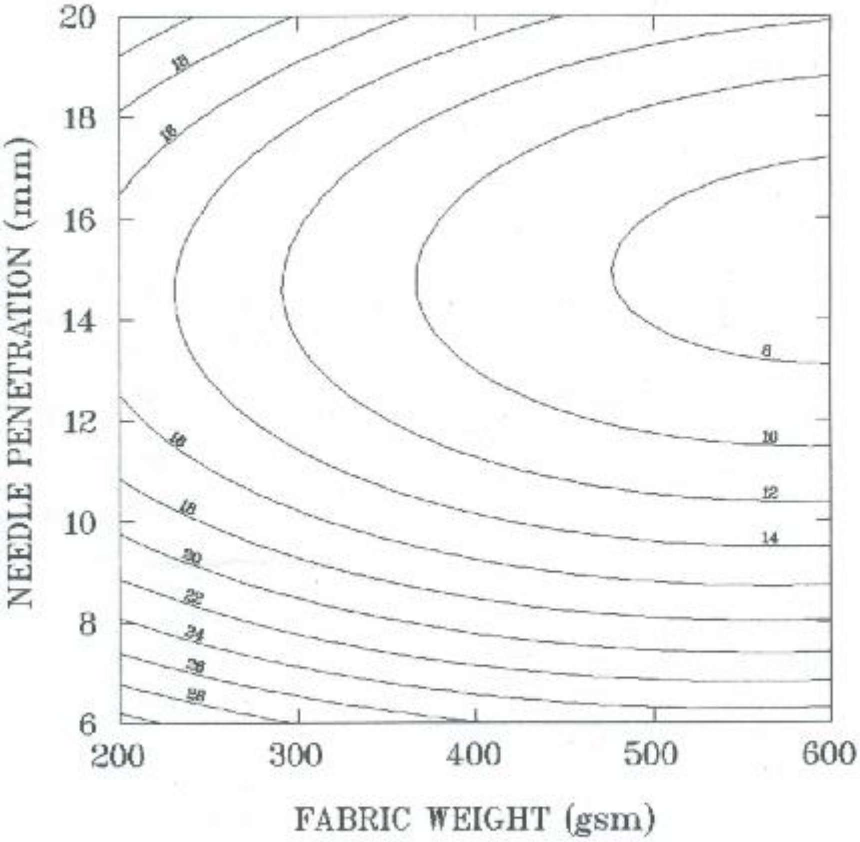

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Fig. 3: *Effect of FW and NP on SAP*

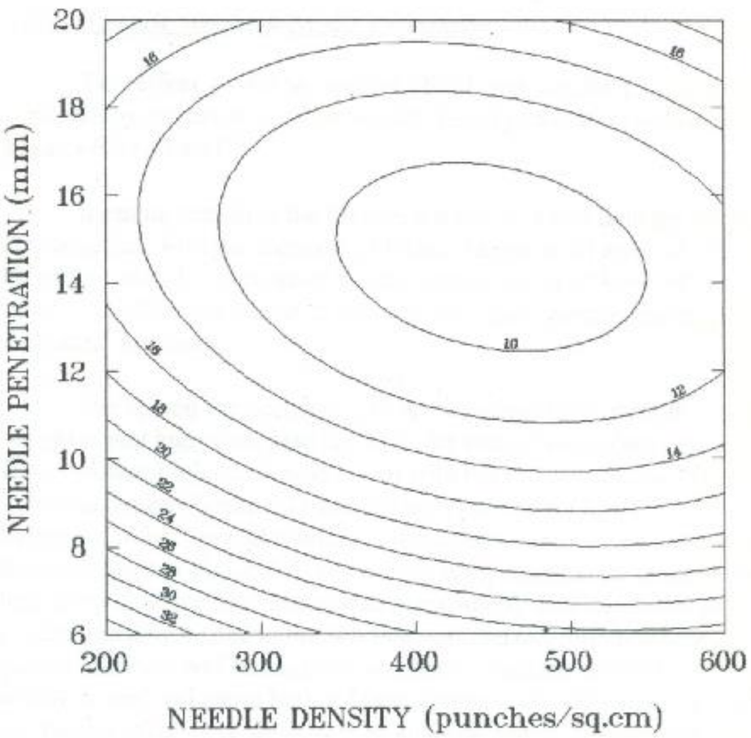

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Fig. 4: *Effect of ND and NP on SAP*

The coefficients of the equation 6.1 are used to develop canonic surface plots. Figures show the effect of FW & ND, FW & NP and ND & NP on air permeability values.

Similarly, the equation gives the obtained values of regression coefficients of sectional permeability (4).

$$P_S = 97.46 - 0.042\, m_a - 0.113\, N_d - 6.932\, N_p + 0.00005\, m_a^2 + 0.0001\, N_d^2 + 0.216\, N_p^2 - 0.00001\, m_a\, N_d + 0.002\, N_d\, N_p - 0.0007\, m_a\, N_p \quad (4)$$

3.1.1 Effect of Fabric Weight & Needle Density

Figures show the effect of fabric weight (FW) and needle density (ND) on the air permeability & sectional air permeability of the fabrics at constant level of needle penetration (11 mm).

It can be observed from the Figures that at any level of needle density when the fabric weight is increased the permeability decreases. From the figures, further observations can be made. With the increase of needle density at various level of fabric weights, the permeability first decreases and then rises. The effect is more pronounced at higher level of fabric weights. The decreasing trend of permeability is observed around 500 punches/sq.cm.

The decrease in air permeability with the increase in fabric weight can be ascribed to the higher total surface area with the higher gsm. Fabric thickness & fabric density also increases with the increase in fabric weight as can be seen from the Figures. The decreasing trend of air permeability with the fabric weight may be due to the more resistance offered by thicker & denser fabric. The initial decrease of permeability with the increase of needling density may be ascribed to the fact that increased needling density increases the compactness of the fabric, i.e., the density of the fabric is increased (as evident from the Figure), resulting in more resistance to air flow and hence reducing the air permeability. However, at higher level of needling density (in this case after 500 punches/sq.cm), the air permeability increases with the increase in needling density. This may be due to the fact that at higher level of needling density, any further increase in needling density ensuring the number of pegs to be greater which ultimately results in higher air permeability.

From the above study, it may be concluded that with the help of contour curves various definite permeability values can be obtained by different combinations of gsm & punches/sq.cm. Optimum values of permeability can be chosen either by selecting higher gsm and lower punches/ sq.cm or by selecting lower gsm with higher punches/sq.cm from various combinations. For example, 600 gsm with 300 punches/sq.cm can be chosen to get 14 sectional permeability values. However, similar values can be obtained from 320 gsm (approx.) with 500 punches/sq.cm. It is preferable to produce filter fabrics with 600 gsm with 300 punches/sq.cm to obtain 14 cc/cm/sec sectional permeability value, as because higher gsm (600) will produce durable fabric and by lowering punches/sq.cm (300), the productivity will be higher as well as less chance of damages of nonwoven structure as compared to the fabric with 320 gsm and 500 punches/sq.cm. Moreover, from the above curves, permeability values at same gsm with varying punches/sq.cm or vice-versa can be obtained. Therefore, 600 gsm with 400 punches/sq.cm can be chosen to obtain 11 cc/cm/sec sectional permeability values instead of 600 gsm with 600 punches/sq.cm for the same reason as explained earlier that more is the punches/sq.cm, more will be chances of breakage of fibers and hence the durability of nonwoven structure will be reduced.

3.1.2 Effect of Fabric Weight & Needle Penetration

The effect of fabric weight (FW) and needle penetration (NP) on the permeability values at constant needle density (400 punches/sq.cm) are shown in Figures.

It can be seen from the Figures that both permeability values are decreased with the increase of fabric weight at all levels of needle penetration. However, with the increase of needle penetration at all levels of fabric gsm the permeability values are found to be reduced up to certain extent (14-16 mm) and thereafter increases.

The reason for the decreasing trend of permeability with the increase in fabric weight is that the higher the gsm, the higher is the total fiber surface area restricting the air flow. Another probable reason is that with the increase of gsm, the thickness of the fabric increases and the thicker is the fabric, the lower is the air flow. Further, the increase in fabric weight resulted in dense fabric (as may be evident from the fabric density results and the denser is the fabric, the bigger is the air drag and hence lesser is the air flow. The decrease in permeability with the initial increase in needle penetration may be due to the fact that with the increase in needle penetration more number of fibers will be caught by the barbs resulting in better interlocking of fibers, which in mm will cause higher fabric compactness. The increased compactness of the fabrics offers more resistance to air flow and so the permeability of the fabric reduces. Though, at lower fabric weight the air permeability value does not change much after 12-14 mm penetration, however, after 16-18 mm penetration increasing trend has been observed. With the increase in needle penetration, the change of fiber arrangement along the direction of air flow resulting reduced air drag. This may be predominating over the effect of fabric density. At much higher needle penetration the number of fibers which break becomes high and so the size of the pegs becomes larger. This causes the air permeability values of the fabric to increase.

From the above study it may be concluded that for obtaining certain permeability values optimum level of fabric weight (gsm) and needle penetration can be chosen. For example, it will be useful in providing various ranges of fabric weight (400-600 gsm) and needle penetration (12-18 mm) to obtain sectional permeability value as 10 cc/cm/sec. 600 gsm with

12 mm penetration should be used to get the above mentioned permeability value in order to achieve better filter life and less chances of fiber breakages.

3.1.3 Effect of needle density & needle penetration

Figures depict the effect of needle density (ND) and the depth of needle penetration (NP) on the air permeability and sectional air permeability values at constant fabric weight (400 gsm).

When air permeability decreases, the increase in either needling density or needle penetration up to a certain limit may be seen, but at higher levels of needling density (450-500 punches/sq.cm) and needle penetration (14-16 mm) the air permeability of the fabric rises.

The decreasing trend of permeability at the initial stages of needle intensifies, probably due to the consolidation of web structures resulted in dense fabric, which may be evident. However, after a certain limit of needle intensities, any further increase of either needle density (i.e., after 450-500 punches/sq.cm) or needle penetration (after 14-16 mm) the permeability values are found to be increased mainly because of peg formation. The channels created in the fabric due to the passage of needle are considered to be one of the main reasons for the rise in air permeability. The fiber breakages may again be attributed to the above phenomenon.

From the above study, it may be concluded that the contour curves will be helpful in getting a series of combinations of penetration & needle density values for a definite permeability. Moreover, the values of penetration up to 14 mm & punches/sq.cm values up to 450 can be chosen so that fiber breakages do not take place.

3.2 Filtration properties

Filtration properties in terms of filtration efficiency and pressure drop were measured. Table 3 gives the values of filtration efficiency and pressure drop values after one minute of filtration time.

The filtration efficiency & pressure drop data and conditions of the variables given in Table 6.3 are processed in software 'SYSTAT' for regression analysis. The coefficients of the regression analysis obtained is given in equation 5.

$$n = 85.7 + 0.0225\, m_a + 0.0123\, N_d + 0.738\, N_p - 0.0000243\, m_a^2 - 0.000018\, N_d^2 - 0.035\, N_p^2 + 0.0000063\, m_a\, N_d + 0.000092\, N_d\, N_p + 0.0003\, m_a\, N_p \quad (5)$$

Tab. 3: *Filtration Efficiency, Pressure drop, Collection capacity, Dust weight*

Sample No.	Filtration Efficiency [%]	Pressure Drop [mm]	Collection Capacity [mg /sq.cm]	Dust weight (abs. Filter) [mg]
F1	96.98	13	48.75	10.97
F2	98.95	18	53.69	7.45
F3	97.12	14	49.65	9.46
F4	99.23	21	64.53	6.49
F5	97.32	15	49.70	9.20
F6	99.48	26	55.18	5.99
F7	97.46	16	50.44	8.92
F8	99.98	28	56.52	5.12
F9	97.99	17	52.07	8.39
F10	99.50	25	55.56	5.22
F11	98.71	18	52.57	7.86
F12	99.13	20	53.78	6.78
F13	97.86	16	51.13	8.59
F14	99.26	21	54.72	7.27
F15	99.28	21	57.24	9.94
F16	98.73	20	56.92	10.18
F17	99.08	21	52.38	9.04
F18	99.36	22	55.87	9.56
F19	99.42	23	55.82	10.26
F20	99.30	22	54.75	9.20

Source: Own

3.2.1 Effect of fabric weight and needle penetration

The results of filtration efficiency with the increase of gsm (FW) and needle penetration (NP) are shown at constant needle density (400 punches/ sq.cm).

Filtration efficiency is found to be increased with the increase of gsm at all levels of needle penetration. With the increase of needle penetration, the filtration efficiency first increases and thereafter decreases at all levels of gsm.

The reasons for increasing the filtration efficiency with the increase in fabric weight are already explained. The initial increase of filtration efficiency with the increase of penetration may be due to the fiber to fiber interlocking within the web structure and hence compactness of the fabric increases. However, after a certain limit, any further increase of penetration may create peg holes through which dust particles may escape, causing reduced filtration efficiency.

From the above study, the conclusions can be drawn that it may be useful in selecting various combinations of fabric weight and needle penetration values for obtaining maximum filtration efficiency. For example, 500-600 gsm with 10 mm penetration may be selected in obtaining more than 100 % filtration efficiency after t minute of filtration time.

3.2.2 Effect of needle density and needle penetration

The effect of needle density (ND) and needle penetration (NP) on the filtration efficiency is shown. It may also be seen that with the increase in either needling density or needle penetration, the filtration efficiency increases firstly up to a certain level and then falls.

The reasons for the above mentioned trends have been discussed earlier: that better fiber to fiber interlocking and mass consolidation is taking place with the increase in needle density, thus ultimately producing a dense fabric on which dust particles can be easily adhered due to surface filtration mechanism and therefore showing higher filtration efficiency. However, after a certain limit, in this case 400-450 punches, the reverse trend is observed i.e., with the further increase in needle intensity in the form of punches/sq.cm, no more consolidation is taking place, on the other hand peg-hole formation and fiber breakages may occur and thus lowering the filtration efficiency. With the initial increase in the depth of penetration, the density of the fabric increases and hence filtration efficiency also increases. On the other hand, after a certain depth of needle penetration, the filtration efficiency drops.

In practice, the fibers in the pegs lie in a parallel direction to the gas flow during filtration & thus do not form a good barrier to the passage of small dust particles. The increase in the depth of needle penetration will effectively increase the size of the pegs, which in mm would cause reduction in filtration efficiency. The results are in accordance with the findings of Igwe [2, 6, 21] and Igwe and Smith [10, 11, 20].

From the above study it may be concluded that both the needle density & needle penetration values can be selected according to optimum requirements of filtration efficiency. For example, 400-450 punches/sq.cm with 12 mm penetration can be useful in obtaining more than 99.4 % filtration efficiency after 1 minute of filtration time.

3.3 Pressure drop

Pressure drop (mm-WG) was measured after 1 minute of filtration time from the readings of manometer across the fabric. The manometer reading across the orifice was maintained constant at 2 cm-WG so as to maintain constant face velocity as 30 cm/sec.

3.3.1 Effect of fabric weight & needling density

It is observed that the increase in fabric weight shows higher pressure drop at all levels of needle densities. As observed, the pressure drop of the fabrics first increases with needling density & then it falls.

The above phenomenon can be explained as due to the fact that with the increase in fabric weight total fabric surface area increases. Another reason which may attribute to higher pressure drop are fabric thickness & density. The increase in fabric surface area will be able to restrict the air flow and thus causing more air drag. Again, increased fabric density rises air resistance which in turn enables retention of a higher quantity of dust particles but at the same time increases the pressure drop as observed. The rise in pressure can be attributed to the fact that the initial increased needling density leads to an increased entanglement of fibers within the fabric which increases the density & hence it offers more resistance to flow. The fall in pressure drop is ascribed to the decrease in density due to higher needling action. Hence, the resistance to flow decreases with the further increase in needle density.

It will be helpful in selecting the ranges of fabric weight and needle density values to obtain minimum values of pressure drop. Lower pressure drop level (10 mm-WG) may be obtained by using 200 gsm with 200 punches/sq.cm and 600 punches/sq.cm. 200 gsm with 200 punches/sq.cm should be selected for higher productivity and less chance of breakages. However, from the filtration efficiency studies, 500 gsm is preferable with 400 punches/sq.cm, it depicts that with 400 punches/sq.cm, maximum pressure drop values obtained as 27 mm-WG for 600 gsm fabric. One can conclude from the above studies that less pressure drop (22 mm-WG) can be obtained for 500 gsm with 300 punches/sq.cm or similar pressure drop level (22 mm-WG) can be obtained with 600 punches/ sq.cm for 500 gsm fabric weight. Hence, 500 gsm with 300 punches/sq.cm or 500 gsm with 400 punches/sq.cm can be selected to obtain higher filtration efficiency with acceptable pressure limit (22 -24 mm WG).

3.3.2 Effect of fabric weight and needle penetration

The plot of pressure drop with the variation of fabric weight (FW) and Needle Penetration (NP) at constant Needle Density (400 punhces/sq.cm) is shown.

The pressure drop results are found to be increased with the increase of gsm at all level of penetration. However, at higher penetration range (14-18 mm) more pronounced effect is observed. With the increase of penetration, at higher gsm level (500-600), the pressure drop is found to be increased. However, at lower level of gsm the pressure drop first increases and thereafter decreases with the increase of penetration.

With the higher gsm, dense fabric causes lower air flow which results in higher air drag. At higher gsm, the fabric thickness increases and hence, with the increase of penetration more barbs will actuate for fiber locking and therefore better consolidation of web structure takes place resulting in dense fabric. The denser is the fabric, the lower is the air flow causing more pressure difference. On the other hand, at lower gsm, the fabric thickness is reduced, thus fiber ruptures as well as creation of channels may take place with the increase of penetration.

Conclusion

The results of the study will be beneficial in optimizing pressure drop values for various combinations of gsm & needle penetration. Though lower pressure drop values are obtained for 200 gsm with 20 mm penetration, it is not advisable, however, because higher penetration values may cause more fiber breakages. As mentioned above, 500-600 gsm will be useful in obtaining higher filtration values. Therefore, from the above work it may be concluded that with the 500-600 gsm with 8-10 mm penetration would give acceptable pressure drop limit (20-24 mm-WG). The predicted equations for various responses agree well with the experimental data, as can be seen by the high coefficient of multiple correlations. Furter conclusions might be drawn later from the ongoing research.

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KVALITATIVNÍ ASPEKTY VPICHOVANÝCH NETKANÝCH POLYESTEROVÝCH FILTRŮ PRO KONTROLU PRACHU

Náš výzkum byl zaměřen na vpichované netkané filtrační textilie vyrobené z polyesterových vláken pro filtraci prachu. Na laboratorně sestrojeném filtračním zařízení byly změřeny filtrační vlastnosti. Byl zkoumán vliv gsm tkaniny, hustota jehly a penetrace jehly na vlastnosti filtrace. Tkaniny s vyšším gsm vykazují vyšší filtrační účinnost filtru, ale za cenu zvýšené tlakové ztráty. Se zvyšující se hustotou jehly a hodnotou penetrace jehly se filtrační vlastnosti nejprve do určité míry zlepšily, avšak poté následoval pokles.

QUALITÄTSASPEKTE VON NICHT GEWOBENE NADELGELOCHTEN POLYESTERFILTERTEXTILIEN ZUR STAUBKONTROLLE

Nadelgelochte nichtgewobene Filtertextilien, die aus Polyesterfasern gefertigt sind, wurden für die Eignung zur Staubfilterung getestet, wobei die Filtereigenschaften an einem speziellen Filtergerät gemessen wurden. Es wurden der Effekt von gms-Fasern, Nadeldichte und Nadeldurchdringung auf Filtercharakteristiken untersucht. Gewebe mit einem höheren gsm weisen eine höhere Filtrationseffizienz und Sammelkapazität aus, aber auf Kosten eines erhöhten Druckabfalls. Mit erhöhter Nadeldichte und erhöhtem Nadeldurchdringungswert verbesserten sich die Filtrationseigenschaften anfangs bis zu einem gewissen Ausmaß. Danach fand eine Reduktion statt.

JAKOŚCIOWE ASPEKTY IGŁOWANYCH NIETKANYCH FILTRÓW POLIESTROWYCH DO KONTROLI KURZU

Nasze badania dotyczyły igłowanych nietkanych tekstylii filtracyjnych wyprodukowanych z włókien poliestrowych i służących do filtrowania kurzu. Na skonstruowanym urządzeniu filtrującym dokonano pomiaru właściwości filtracyjnych. Badano wpływ ciężaru tkaniny (gsm), gęstość igły oraz penetrację igły na właściwości filtracyjne. Tkaniny o większej gramaturze (gsm) mają większy potencjał skuteczności filtracji i odseparowania, ale za cenę większej utraty naprężenia. Wraz z rosnącą gęstością igły i wartością penetracji igły właściwości filtracyjne najpierw do pewnego stopnia się poprawiły a następnie obniżyły.