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COATING OF NONWOVEN MATERIALS FOR SPECIALITY APPLICATIONS

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Abstract: *The present study deals with the objective of coating of needle punched non-woven fabric with polyurethane (PU) formulation of different coating concentrations for artificial leather effect. The properties of the coated fabrics were evaluated through a number of tests such as breaking strength, abrasion resistance, thickness, GSM, bursting strength, and air permeability. The work reveals that the tensile strength, GSM, bursting strength parameters of the coated fabric got improved as the coating is primarily a function of coating concentration and curing temperature. The coated samples exhibited satisfactory performance properties.*

Keywords: *Artificial leather, Coating, Needle punched nonwoven, Polyurethane, Textiles*

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1. INTRODUCTION:

Speciality coated fabrics combine the beneficial properties of a textile and a polymer, the textile component providing the tensile strength, tearing strength, and elongation control and coating offering protection against the environment to which the fabric is subjected [1]. Coated textiles have established themselves as one of the important products in the global textile market. Micro level modification of the end product is actually governed by choosing proper coating technique. Coatings enhance and extend the range of functional performance properties of textile, and the use of these techniques is increasing rapidly as the applications for technical textiles. Cheaper or loose fabric structure may be coated to provide higher added value to end- users and to get profit margins for manufactures. The success in textile coating depends upon the application method used for coating [2, 3].

The coating is a process in which a polymeric layer is applied to one or both surfaces of the fabric. Depending upon the end use requirements, heavy-duty technical textile coatings may be applied at high weight, while other end- uses for high-technology apparel may require coating weights very low. The coating formulation, the coating thickness, weight, the number of layers, the form of the technical textile and nature of any pretreatment are of great importance [4]. Coatings of the textiles achieve high level of functional performance than that is possible from uncoated textiles. The coatings used in technical textiles are all the thermoplastic polymers, which are long chain linear molecules, some of which have the ability to crosslink as the coated fabrics dried and cured after coating [5]. The rapid development and major upsurge in the coated technology is manifold especially with the introduction of water based PU coatings. The PU based coated fabrics because of its meritorious properties has projected its use in the production of artificial leather effect [6, 7]. Various fabrics are used in production of coated fabrics like woven, nonwoven, and knitted.

In the present study needle punched fabric is preferred due to its properties like they maintain their form; they are porous in nature, durable, having good mechanical properties and elasticity [8, 9]. Besides these nonwovens are soft with good hand, can easily cut, sewn and glued together. They have uniform properties in all directions. As these properties are required in the production of artificial leather nonwoven fabrics are generally used [10, 11, 12].

The present paper deals with coating of nonwoven materials with PU formulation at different coating concentrations on continuous knife- roller coating machine. These developments of PU coated needle punched fabric are used as a one of the components in artificial leather products [13, 14]. The effect of coating concentration on physical properties are reviewed, compared, and discussed.

2. MATERIALS AND METHODS

2.1 Material:

In the present work, needle punched nonwoven fabric for coating is procured from Tata Mills Dadar, Mumbai. Polyurethane (water based) is procured from Clariant chemicals, Mumbai.

2.2 Methods:

The coating of nonwoven fabric is carried out using following formulations

Appretan PUL liq - 10-90 Parts

Silicon softener - 1-2 Parts

Fixer CCL - 1-2 Parts

Synthetic thickener - 1-2 Parts

Pigment - 1 Part

Coat- cure 170° c for 90 Sec

3. TEST PROCEDURES:

The following tests are performed in evaluating the coating properties Breaking Strength: ISO 9073- 4: 1997 (E), Air permeability: ASTM D 5035- 95, Thickness: ISO 9073- 2: 1995 (E), Bursting strength: ASTM D 6707- 02, Abrasion resistance: ASTM D 6770, GSM: ASTM D 3776

4. RESULTS AND DISCUSSION

Tests were conducted for testing the Tensile strength, Bursting strength, Air permeability, & GSM of the needle punched nonwoven fabric treated polyurethane with different concentration and with different thickness.

For 0.5 mm Thickness

Table 4.1 Effect of concentration of PU on GSM of fabric.

	Concentration (g/l)									
	0	10	20	30	40	50	60	70	80	90
GSM	332	511.8	517.2	535.2	534.4	541.2	546	549.8	550.2	558

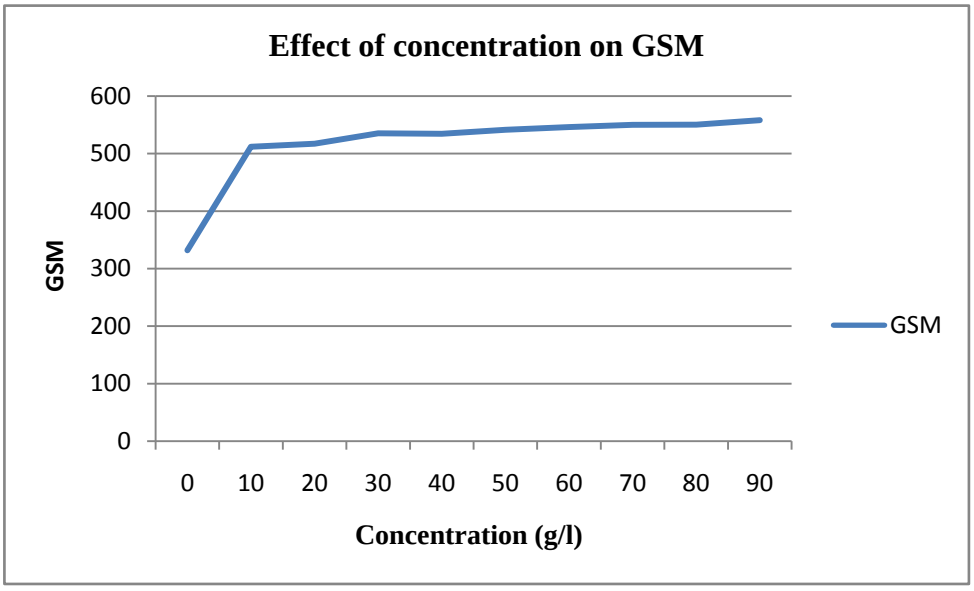

Fig 4.1:- Effect of concentration of PU on GSM of fabric.

From Table 4.1 and Figure 4.1 indicate that as the concentration of polyurethane increases from 10 g/l to 90 g/l, the values of GSM increases from 511.8 to 558. This is may be due to the increase in the coating layer on the fabric surface.

For 1.0 mm Thickness

Table 4.2 Effect of concentration of PU on GSM of fabric.

	Concentration (g/l)									
	0	10	20	30	40	50	60	70	80	90
GSM	332	540.8	550.6	560.8	553.8	557.6	561.6	561.6	563.6	573

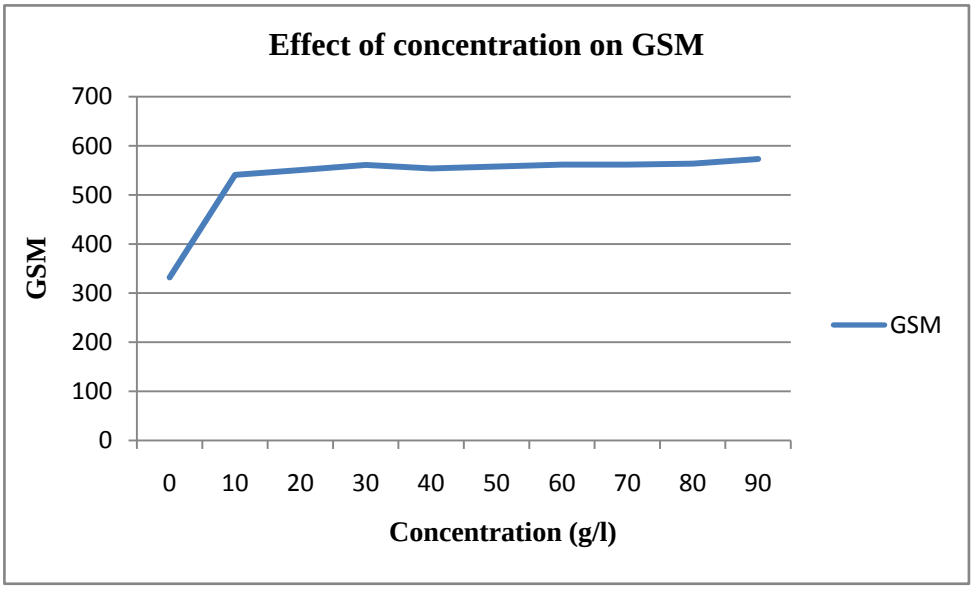

Fig 4.2:- Effect of concentration of PU on GSM of fabric

From Table 4.2 and Figure 4.2 indicate that as the concentration of polyurethane increases from 10 g/l to 90 g/l, the values of GSM increases from 540.8 to 573. This may be due to the increase in the coating layer on the fabric surface. Also it is observed that as the thickness of PU coat increases there is an increase in GSM of fabric too. This may be because of deposition of more quantity of PU coat on substrate.

For 0.5 mm Thickness

Table 4.3 Effect of concentration of PU on Air permeability of fabric.

	Concentration (g/l)									
	0	10	20	30	40	50	60	70	80	90
Air permeability	18.25	11.69	11.67	11.68	10.04	10.74	10.77	9.52	9.56	9.47

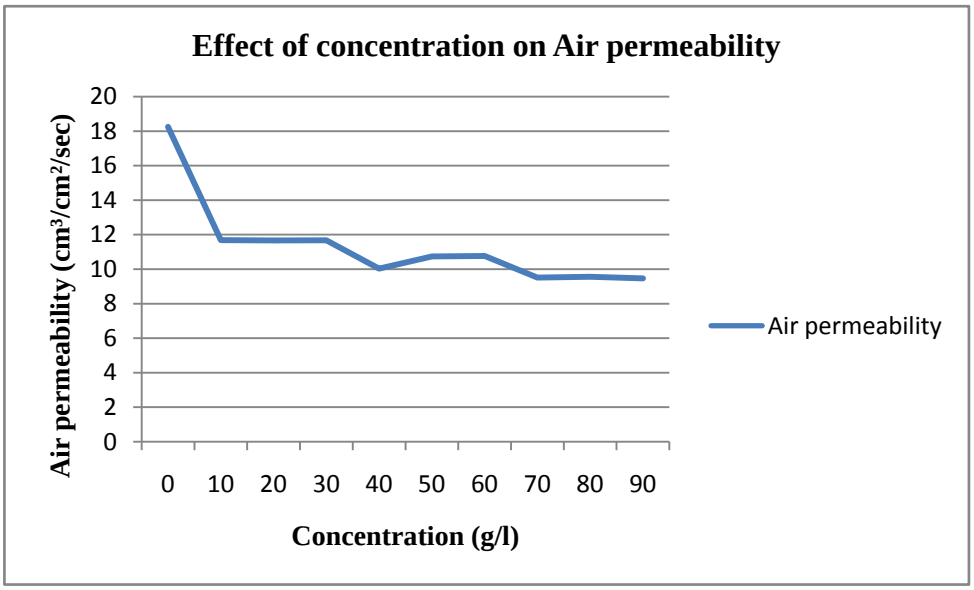

Fig 4.3:- Effect of concentration of PU on Air permeability of fabric.

From Table 4.3 and Figure 4.3 it can be said that as the concentration of PU increases from 10 g/l to 90g/l, the air permeability values decreases from 11.69 to 9.47 respectively. The minimum air permeability value was found to be 9.47 for 90 g/l PU concentrations at 0.5 mm of thickness. The decrease in air permeability values may be due to the presence PU which forms a coating layer on the fabric surface. Also the curing temperature at 170 ° C may attribute to higher cross linking efficiency of coated fabrics.

For 1.0 mm Thickness

Table 4.4 Effect of concentration of PU on Air permeability of fabric.

	Concentration (g/l)									
	0	10	20	30	40	50	60	70	80	90
Air permeability	18.25	6.25	6.25	6.11	5.41	4.64	4.51	2.37	1.21	1.17

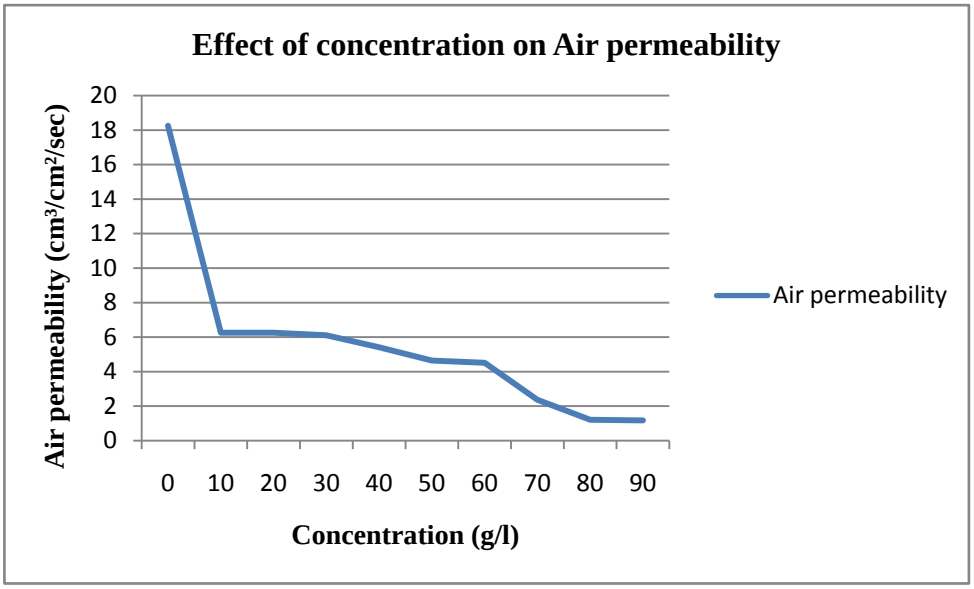

Fig 4.4:- Effect of concentration of PU on Air permeability of fabric.

From Table 4.4 and Figure 4.4 indicates that as the concentration of PU increases from 10 g/l to 90g/l, the air permeability values decreases from 6.25 to 1.17 respectively. The minimum air permeability value was found to be 1.17 for 90 g/l PU concentrations at 1 mm of thickness. The decrease in air permeability values may be due to the presence PU which forms a coating layer on the fabric surface. Also the curing temperature at 170 ° C may attribute to higher cross linking efficiency of coated fabrics.

For 0.5 mm Thickness

Table 4.5 Effect of concentration of PU on Bursting strength of fabric.

	Concentration (g/l)									
	0	10	20	30	40	50	60	70	80	90
Bursting strength	19.46	23.82	24.6	25.08	26.66	27.44	31.22	33.49	33.80	35.20

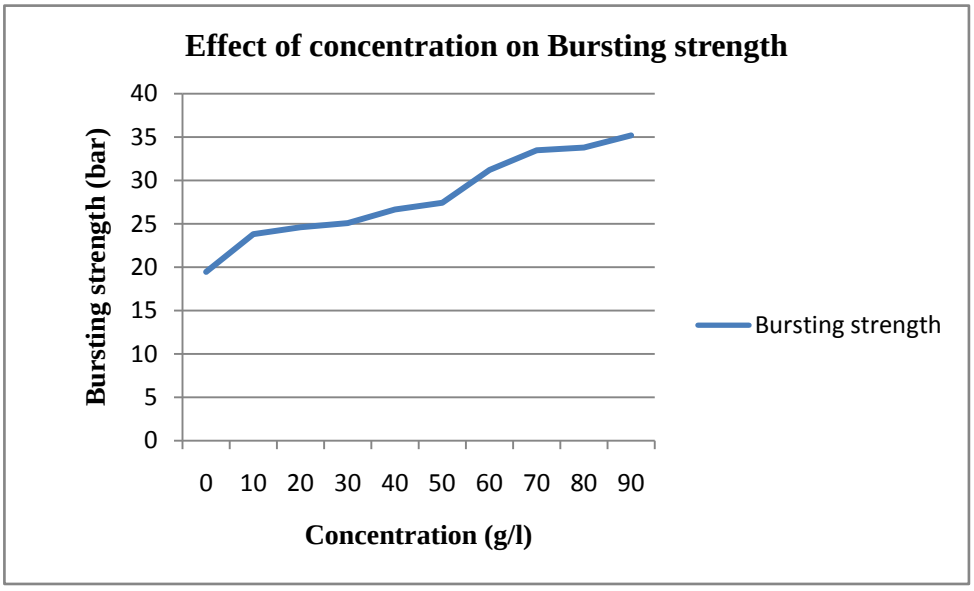

Fig 4.5:- Effect of concentration of PU on Bursting strength of fabric.

From Table 4.5 and Figure 4.5 indicate that as the concentration of PU increases from 10 g/l to 90g/l, the bursting strength value increases from 23.82 to 35.20 respectively. The maximum bursting strength value was found to be 35.20 for 90 g/l PU concentrations at 0.5 mm of thickness. The increase in bursting strength values may be due to the presence PU which forms a coating layer on the fabric surface. As the concentration of PU increases from 10 gpl – 90 gpl, the film forming tendency or cross linking efficiency of coated fabric increases which causes requires more energy to break the thicker film form, this can be supported by the thickness of fabric after coating.

For 1.0 mm Thickness

Table 4.6 Effect of concentration of PU on Bursting strength of fabric.

	Concentration (g/l)									
	0	10	20	30	40	50	60	70	80	90
Bursting strength	19.46	31.91	34.82	36.15	39.62	41.36	42.59	43.25	46.01	48.93

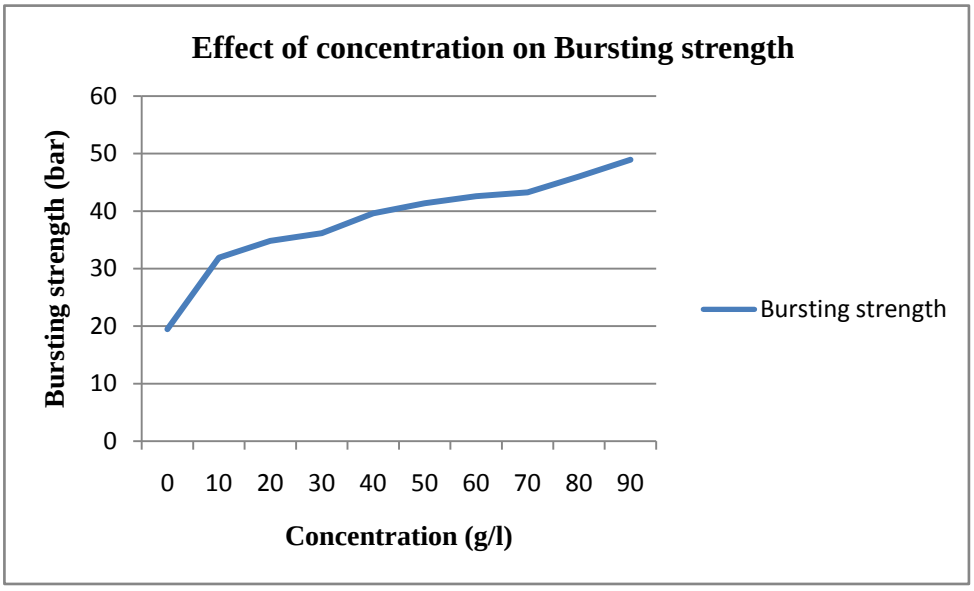

Fig 4.6:- Effect of concentration of PU on Bursting strength of fabric.

From Table 4.6 and Figure 4.6 indicate that as the concentration of PU increases from 10 g/l to 90g/l, the bursting strength value increases from 31.91 to 48.93 respectively. The maximum bursting strength value was found to be 48.93 for 90 g/l PU concentrations at 1 mm of thickness. The increase in bursting strength values may be due to the presence PU which forms a coating layer on the fabric surface. As the concentration of PU increases from 10 gpl – 90 gpl, the film forming tendency or cross linking efficiency of coated fabric increases which causes requires more energy to break the thicker film form, this can be supported by the thickness of fabric after coating.

For 0.5 mm Thickness

Table 4.7 Effect of concentration of PU on Tensile strength of fabric.

	Concentration (g/l)									
	0	10	20	30	40	50	60	70	80	90
Tensile strength	40.11	60.11	62.24	62.52	65.11	69.12	71.24	73.19	75.00	79.00

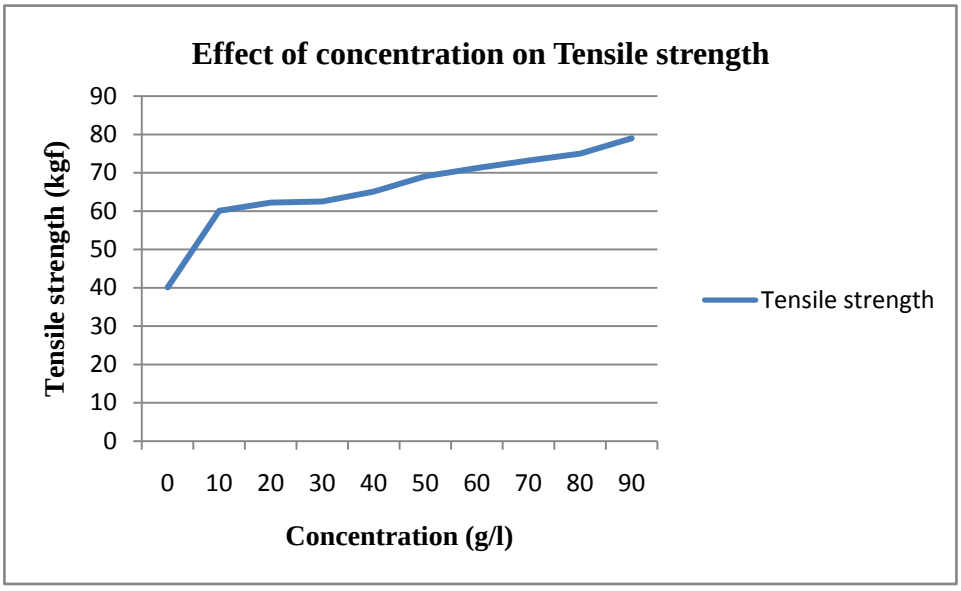

Fig 4.7:- Effect of concentration of PU on Tensile strength of fabric.

From Table 4.7 and Figure 4.7 indicate that as the concentration of PU increases from 10 g/l to 90g/l, the tensile strength values increased from 60.11 to 79.00 respectively. The maximum tensile strength value was found to be 79.00 for 90 g/l PU concentrations at 0.5 mm of thickness. The increase in tensile strength values may be due to the presence PU which forms a coating layer on the fabric surface. Also curing temperature may attribute to higher cross linking efficiency and more energy is required to break the film formed at higher concentration.

For 1.0 mm Thickness

Table 4.8 Effect of concentration of PU on Tensile strength of fabric.

	Concentration (g/l)									
	0	10	20	30	40	50	60	70	80	90
Tensile strength	40.11	113.25	118.28	122.24	127.21	130.31	132.24	137.14	142.20	159.11

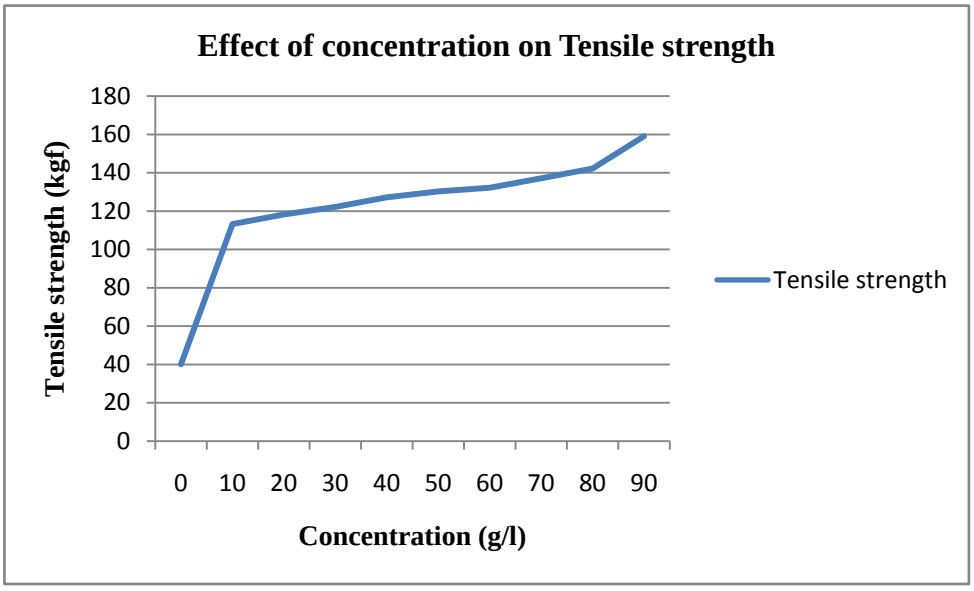

Fig 4.8:- Effect of concentration of PU on Tensile strength of fabric.

From Table 4.8 and Figure 4.8 indicate that as the concentration of PU increases from 10 g/l to 90g/l, the tensile strength values increased from 113.25 to 159.11 respectively. The maximum tensile strength value was found to be 159.11 for 90 g/l PU concentrations at 1 mm of thickness. The increase in tensile strength values may be due to the presence PU which forms a coating layer on the fabric surface. Also curing temperature may attribute to higher cross linking efficiency and more energy is required to break the film formed at higher concentration.

For 0.5 mm Thickness

Table 4.9 Effect of concentration of PU on Add on % of fabric.

	Concentration (g/l)									
	0	10	20	30	40	50	60	70	80	90
Add on %	0	1.13	2.22	3	4.24	5.14	6.51	7	8	9.38

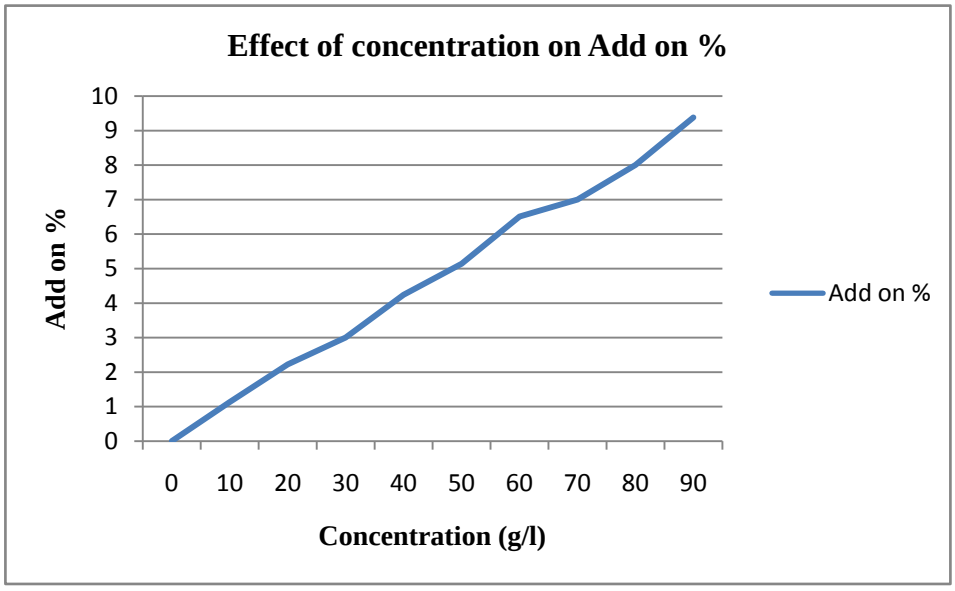

Fig 4.9:- Effect of concentration of PU on Add on % of fabric.

From Table 4.9 and Figure 4.9 indicate that as the concentration of polyurethane increases from 10 g/l to 90 g/l, the values of Add on increases from1.13 to 9.38. This is may be due to the increase in the coating layer on the fabric surface.

For 1.0 mm Thickness

Table 4.10 Effect of concentration of PU on Add on % of fabric.

	Concentration (g/l)									
	0	10	20	30	40	50	60	70	80	90
Add on %	0	1.45	2.8	3.75	4.85	6.66	7.78	8.62	10.5	12.6

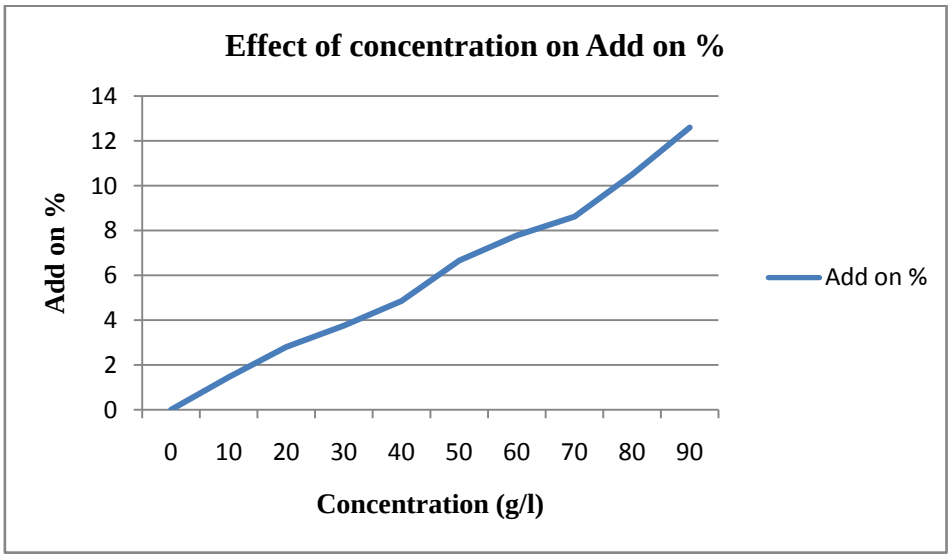

Fig 4.10:- Effect of concentration of PU on Add on % of fabric.

From Table 4.10 and Figure 4.10 indicate that as the concentration of polyurethane increases from 10 g/l to 90 g/l, the values of Add on increases from1.45 to 12.6. This is may be due to the increase in the coating layer on the fabric surface.

CONCLUSIONS

From the above results and discussion we can conclude that as the concentration of PU increases from 10 parts to 90 parts, there is an increase in values of GSM, tensile strength, thickness, bursting strength, and add on %. Also it is observed that there is desirable air permeability in both 0.5 and 1.0 mm thickness. The maximum tensile strength of 79.00 & 159.11 was observed in formulating recipes at 90 g/l polyurethane concentration in both 0.5 mm and1 mm thickness respectively.

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