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A STUDY ON THE EFFECT OF NON WOVEN FABRIC PROPERTIES ON THERMAL APPLICATIONS

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ABSTRACT

The needle punched nonwoven can be used as automotive interiors. The needle punched product can full-fill this purpose. This will be eco-friendly and also serves as an alternative material. The needled punched web is prepared with the three different compositions in order to find the best suitability of the purpose. The raw materials used are the cotton, kapok and recycled polyesters. Using all the three raw materials, it was made of three sheets of needle punched web with varying proportions. Later, these webs were tested for the thermal conductivity which can be served for automotive things, false ceiling, and roofing and also as a composite for the wall. The machine used to test the thermal conductivity is the Flat Plate Fabric Heat Retaining Instrument. The results were observed and studied.

KEYWORDS: *Needle Punched Web, Cotton, Kapok, Recycled Polyesters, Thermal Conductivity*

INTRODUCTION

Around the world, the needle punching industry recommends probably the suitable way to carry on with this procedure. The needle punching industry around the globe is an energizing and different exchange including either natural or blend of both and manufactured materials. Customary weaving is incredible, yet of late appears to be centred on the excellent surfaces made with punch needle (likewise called needle punching) [1]. The art looks frightfully like weaving when, simply observe the, as need weaving floss or yarn, a loop, texture and begin. In any case, that additional instrument the punch needle itself has a major effect. Needle-punched nonwoven textures are produced using different fibre webs (generally carded webs) in which filaments are fortified together precisely through fibre entanglement and frictions after fine needle points over and over infiltrated through the fibrous web. Needle-punched textures have trademark periodicities in their auxiliary design that outcome from the connection of fibres with the needle bars. Fibre fragments are re-orientated and relocated from the outside of the web towards the inside of the texture, forming pillars of fibre orientated around opposite to the plane.

The fibre measurements and types utilized in needle-punched texture channels are adaptable, depending upon their application prerequisites, not constrained by the needle-punching process, and however may be limited by the checking procedure[2]. Fibres of certain ranges of lengths and fibre diameters could not be carded well in some carding systems. Fibres utilized in needle-punched channels may likewise be required to have warm protection from high temperature, fire retardancy, and synthetic opposition. Thickness of needled channel could be controlled through needle-punching parameters, for example,

needling thickness and punching parameters; many needle-punched nonwoven filters are made of different layer structures including different needled nonwoven and support layers (scrim, woven texture, lightweight spun bond nonwovens, and so on.) to accomplish required filtration effectiveness, conservativeness, measurement strength, and mechanical robustness. [3]

The presentation of needle-punched felt channels, including filtration effectiveness, pressure drop, operational life, cleaning execution, dust cake arrangement, and mechanical and synthetic opposition, are impacted by its fibre sizes, texture porosity, thickness, and texture piousness, be that as it may; they can be refined and improved with surface treatment and defensive completions for differing applications. The surface completions incorporate felting, calendaring, and coat burning, and the defensive completing incorporates antistatic, anti-adhesive, and anti-abrasive completions, fire obstruction, compound opposition, and water-repellent covering and implement. At the point when the textures are done with covering, calendaring, glaze singeing, general improvement of their filtration attributes are basically controlled by the calendaring, singeing, and coating parameters.

MATERIALS AND METHODS

Materials

The raw materials used are the cotton, the kapok and the recycled polyesters (Pet). Three sheets of needle punched web were formed. The miniature carding machine was used to card the webs. The needle punching machine was used to punch the webs. The Flat Plate Fabric Heat Retaining Instrument machine was used to test the thermal conductivity of the webs. They are as follows.

Table 1: Proportions

Sample	Cotton (G)	Kapok (G)	Recycled Pet (G)
1	35	30	35
2	25	25	50
3	15	15	70

Methods

Raw Materials

The raw materials were sourced and collected. They were opened manually. Then they were carded.

Carding

Carding, in material creation, a procedure of disentangles, utilizing a progression of separating and re-dividing steps, that makes a significant number of the filaments lie corresponding to each other while likewise eliminating the majority of the rest of the contamination. Carding might be finished felting, or other texture or fabric making exercises.

As three raw materials are used, the carding was first done individually. First, the cotton was carded of all the three propositions. Then, the Pet was carded fo**r** all the three propositions. As kapok is very difficult to be carded, we used a sandwich method. That means that the carded cotton was spilt and the carded Pet was placed in-between the carded cotton. The carded Pet was also split into two so that the kapok was filled equally all over the carded webs and the spilt carded cotton and Pet were placed over the kapok, which looks like a sandwich. The same procedure was carried out for all the three compositions. The three webs were collected and needle punched.

Figure 1

Needle Punched Web

The needle punching is the strategy for consolidation of web by the repeated insertion of needle into web. The strands or fibres are reoriented into the vertical plane such that tufts or sewing channels are framed. Fibre networks are characterized by

- Improved needle plan
- Increase needle thickness per working width
- Increase stoke frequencies
- Working widths

PRINCIPLES

Needle punching is a nonwoven procedure by which the strands are precisely entangled to create a nonwoven texture by repeated penetration of pointed needled through a performed dry stringy web. The needle board is mounted on a bar which is suspended with up and down responding movement. Thus fibres are interlocked, along these lines giving the mechanical quality. Non-stop fibres or short staple filaments are at first masterminded as a stringy web in different orientation (random, crossed, equal or composites). This structures a three-dimensional blended structure which satisfies the fundamental necessities of geo-textiles.

Present day needle looms work with proceeding with felt transport. For ideal needling effectiveness, the accompanying procedure arrangements are important.

- Batt Feeding
- Needle Feeding
- Felt Delivery

Figure 2

Batt Feeding

The uncontrolled draft during the feed into the needle loom is causing intra fibre movement, which prompts length dimensional changes during the needling, bringing about uneven surface mass / felt thickness. A best batt feed is particularly significant during the first needling pass, likewise referred to as pre-needling.

Needle Feeding

Measurements of the spikes and their relative plan change are contingent upon the application and machine activity. The nonwoven industry utilizes two sorts of needle, known as single decrease needle and double decrease needle. Single decrease needle is a lot stiffer than the double decrease needle. The single decrease needle is normally made uniquely for stiffer needles. The single decrease needle is utilized for hardened strands. Appearance and level of pressure of a needle felt are for the most part impacted by,

- Needle plan in the needle board
- Course of needle (from top, from base and from the two sides)
- Needle parameters (check, type of thorn, number of points)
- Needling parameters (penetration and thickness, draft)

Felt Delivery

At low frequencies, the conveyance of the needle felt happened irregularly. The contact weight of the conveyance rolls and the contact zone can be changed in accordance with the item. The needle felt is being guided emphatically and without distortions.

Web Parameters

The mechanical properties of needle punched nonwovens are needy after laying methods utilized for the creation of web structures or the underlying web structure. A needle punching machine can process a wide scope of stringy networks from various frameworks, which impacts the fibre structure inside the web.

Here, it was used with 50 punches per minute. Feed rate was 20 mm per stroke. The total needles were 1329. The penetration was for 2 mm. For one inch, there were 9 needles present. One sheet ran for about 3 minutes. So for 3 sheets, it took about 10 minutes.

Thermal Conductivity

The webs were tested for the thermal conductivity using Flat- Plate Fabric Heat Retaining Instrument.[4]

The analyzer is dependent upon the temperature of 35℃. With this instrument, insulating capacity of the examples of woven fabrics, knitted fabrics, pilled textures and other protecting materials can be tested. It is constrained by microcomputer and shown by LCD.

Standards: GB / T11048, ASTMD1518, JISL1096 etc.

Technical Parameters

- Temperature range: 0 ～ 50℃
- Time-setting range: 0 ～ 99min
- Range of circulating heating period: 1 ～ 9 times
- Testing times: 1 ～ 9 times
- Dimension of test plate: 250mm × 250mm
- Power supply: AC 220V ± 10 % 50Hz
- Power: 280W
- Dimension of controlling box: 300mm × 345mm × 150mm
- Dimension of test box: 510mm × 510mm × 640mm
- Net Weight: 30 kg.

Pre: YG541L Digital Crease-recovery Tester

Next: YG606LF Thermal Transmittance of Textile Materials Tester.

RESULTS AND DISCUSSIONS

We have got the test results as follows. As we tested the three samples the result were different among all.

Table 2

Sample No	Proportions	GSM (G / M²)	Thickness (Mm)
1	Pet–35 Cotton–35 Kapok–30	1074	8.83
2	Pet–50 Cotton–25 Kapok–25	523	8.38
3	Pet–70 Cotton–15 Kapok–15	703	8.75

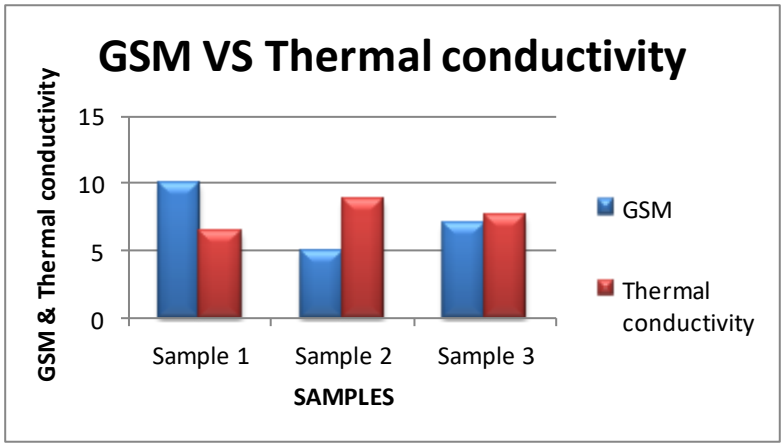

Figure 3

Discussions

According to the result, it is proved that the thermal conductance is influenced by the GSM. When the needle punched material has the highest GSM the thermal conductance is low and when the GSM is low the thermal conductance is higher. So the thermal conductivity changes according to the GSM. From here, it is understood that thermal conductivity and GSM are inversely proportion

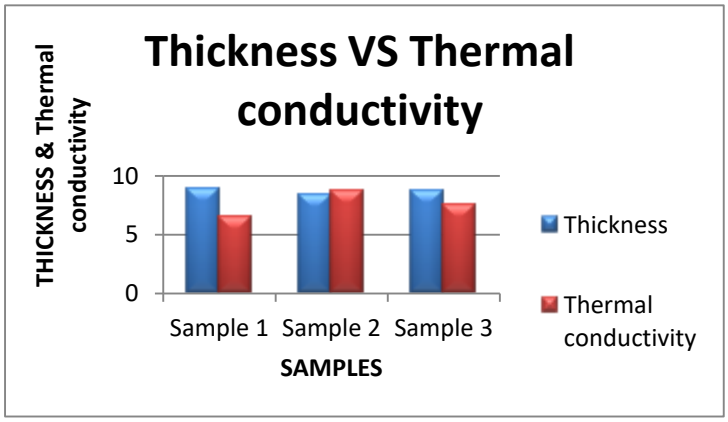

Figure 4

Discussions

According As to per the result, it is proved that the thickness is one of the factor factors to that can influence the thermal conductivity. When the needle punched material have the greater thickness, the thermal conductance is low and when the thickness is lower, the thermal conductance is greater. So, the thickness plays a vital role in changing the thermal conductivity. From here, it is understood that thermal conductivity and thickness are inversely proportion as such as GSM.

Table 3

Sample No	Thermal Resistance in (%)	Heat Transfer Coefficient in (W. m^{-2}. K^{-1})	CLO
1	74.57	3.09	2.12
2	66.95	4.54	1.50
3	71.50	3.60	1.80

Table 4

Sample No	Thermal Resistance in (W. K^{-1}. m^{-2})	Thermal Conductivity in (m. K. W^{-1})
1	1.36	6.49
2	0.96	8.72
3	1.16	7.54

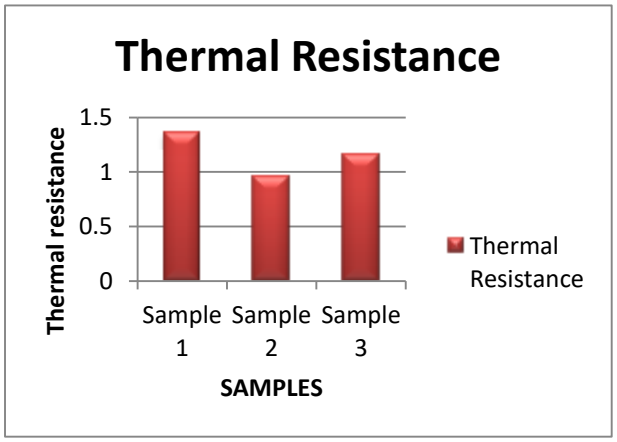

Figure 5

Discussions

The above chart here shows that when the recycled pet is added in small amount, the thermal resistance is higher but when the recycled pet is added in half the amount, then the thermal resistance is lower. When the recycled pet is added in greater amount, then the thermal resistance will be lower than the first sample. So, the recycled pet's proportion plays a vital role in deciding the thermal resistance.

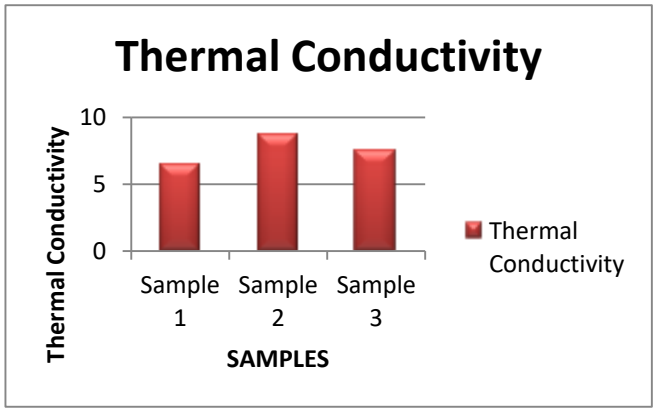

Figure 6

Discussions

The above chart shows that when the recycled pet is added in small amount, the thermal conductivity is lower, but when the recycled pet is added in half the amount, then the thermal conductivity is higher. When the recycled pet is added in greater amount then the thermal conductivity will be higher than the first sample. So the thermal conductivity is always the reciprocal of the thermal resistance. [5]

CONCLUSIONS

It has been found that from the tested results, GSM, Thickness and the thermal resistance plays a vital role in thermal absorption in one or the other way. The thickness influences the thermal conductivity in greater rate. The thickness and the thermal conductivity are inversely proportional.

- From sample 1, the thickness is about 8.83 mm with resistance of 1.36 W. K^{-1}. M^{-2} and conductivity of 6.49 W. K^{-1}. m^{-2}.
- From sample 2, the thickness is about 8.38 mm with resistance of 0.96 W. K^{-1}. M^{-2} and conductivity of 8.72 W. K^{-1}. m^{-2}.
- From sample 3, the thickness is about 8.75 mm with resistance of 1.16 W. K^{-1}. M^{-2} and conductivity of 7.54 72 W. K^{-1}. m^{-2}.

From the above results, we can conclude that the sample 1 with equal proportions of Cotton 35 %, Kapok 30 %, and recycled PET of 35 % is the best suitable for the insulation purposes in buildings and automotive textiles.

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