Application of Banana Nonwoven Fabric for Car Mats
Mansi Soni\textsuperscript{1} Sandip Patel\textsuperscript{2}
\textsuperscript{1,2}Assistant Professor
\textsuperscript{1,2}L.D College of Engineering, Ahmedabad, 380015, India

Abstract— The present paper reports a detailed study on properties Car Mats made by Banana Nonwoven Fabric. Banana fibre has properties like stiff, high breathable, quick dry, resistant to the action of an alkali, phenol, formic acid. Banana is one of natural fibre and biodegradable fibre. So banana fibre can use for making car floor covering (throw in the carpet) with the help of banana nonwoven fabric. Car mats have been prepared by using banana Nonwoven Fabric and coated with SBR, PU and acrylic solutions. In this, an attempt was made to study the abortion resistance, air permeability and tensile strength of car mat which is made of Banana Nonwoven Fabric.

Key words: Banana Nonwoven Fabric, Car Mats

I. INTRODUCTION

We are used much natural fibres since centuries. Natural fibres are the obtainable resource. It has some environmental benefits include low embodies energy, reduced depletion of fossil-based resources. Natural fibre such as hemp, flax, jute, and Kenaf has good strength and stiffness, whilst being significant than glass [5]. There are much natural fibres used in the automobile industry as above listed. Many automobile manufacturers have used natural fibre in place of synthetic fibre. Different car manufacturer like four motor GmbH, Audi, Volvo, Toyota. Lotus Eco Elise, and Mazda has used natural fibre in different parts of the car. [4] Banana is one of the natural fibres which can take place in automotive components of car. Banana stem has used the source of fibre since the 13th century [1]. Banana plant is agricultural fruit crop. In banana plantation after the fruit is harvested, the trunk will be wasted. Billions of tonnes of stem and leaves are thrown away annually. Such waste is provided with an obtainable source of fibre, which leads to a reduction of other natural fibre and synthetic fibre. Synthetic fibre requires extra energy and chemical for production. Banana stem has 14-18 sheaths, outermost sheath contains 4-8 sheath yield course fibre and the innermost contain 6-8 soft lustrous fibre [1]. Banana fibre has the property like highly breathable, microbial resistivity [3] and smaller elongation with quick dry.

II. LITERATURE REVIEW

Banana fibre is used for different application starting from handicraft to technical textile. Some product from banana fibre like currency notes, the thicker file made from banana fibre, composites, door panels, blended fabric, non-woven fabric, blended yarn with jute and cotton etc.[2]. There are new materials, usage techniques, and applications are developing due to cost and performance. It is for more than just reducing cost and weight.

<table>
<thead>
<tr>
<th>Physical property of banana fibre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cellulose</td>
</tr>
<tr>
<td>Lignin Content (%)</td>
</tr>
<tr>
<td>Liner density of fibre (tex)</td>
</tr>
</tbody>
</table>

Table 1: Property of Banana Fibre

| Tenacity (g/tex) | 24.2 to 62 |
| Elongation (%)   | 1.0-3.5     |
| Length           | 25mm to 890mm |
| Density(gm/cc)   | 1.35        |
| Width or diameter(µm) | 80-250 |

Forty automotive parts utilised for engineered nonwovens. It is used in rigid composites for body parts such as fenders, hoods, and trunk lids – and in carbon composites for structural reinforcement composites and dash panels [5]. Non-woven is used in different area such as carpet (43%), headliner (6%), hood liner (10%), trunk (13%), insulation (17%), door panels (1%), seating (6%), package trays (3%), and other miscellaneous areas (1%) [5]. Nonwovens can be used as face materials the surface area. We can see in construction areas, those that are components such as backing substrates, carpet reinforcement. Each car contains about 3.5 to 4.5 m2 of carpet, made by tufting or needle-punching. Carpet is an important part of the automotive interior. Mainly different carpets are Needle-felt carpets, tufted cut-pile. Major carpets are used tufted cut-pile carpets in their cars. Carpets generally have a rubberized backing. Carpets are manufactured either by tufting or needle felting. A large quantity automotive fabric is used nonwoven fabric mainly in carpets.

III. EXPERIMENTAL SETUP

A. Material Preparation

1) Method Of Manufacturing Banana Non-Woven

Banana fibre of grand Naine variety is used for making banana nonwoven. The tensile characteristic of the banana fibres used in the preparation are having a fineness – 9.2 tex, Tenacity – 35.5 g/tex and elongation at break – 2.3%. Extracted Banana fibre length is kept same for needle punching. Banana fibre is going to process for needle punch non-woven fabric on jute needle punch machine. The delivery machine is 2.5 m/min.

![Fig. 1: Process flow of Banana needle-punch nonwoven fabric](image)

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2) General Car Mat Construction Method

a) Carpet construction
   - The first layer is decorative layer which is tufted
   - Second layer Backing material
   - The third layer is thermoplastic or thermosetting for fibre [6]

There are different types of fibre used for carpet material. It includes synthetic fibre and other textile material. Different synthetic fibre is nylon, polypropylene, polyester, Rubber, EVA, acrylic, PVC etc. All fibres described are nonbiodegradable fibre.

B. Sample Preparation

We are going to produce biodegradable car mat with banana needle punch nonwoven. In this car mat construction method, Banana, needle-punch nonwoven is coated with resin front and back side for a car mat.

3) Acrylic Coating

Prepare thickener paste for the better viscosity of coating paste. First, take 16g of TKP (Tamarind Kernel Powder/powder. Then, boil water at 100°C for paste formation. This will go for stirring for uniform paste formation. We prepare TKP thickener Paste in the ratio of 1:100ml water. Coating paste has made from Acrylic of 60g and Water 82.5g. Drying temperature after coating is kept 140°C and time duration 10min.

4) PU Coating

Prepare coating paste as follow: Prepare coating paste with resin PU (Pidithane) and thickener TKP. First prepare thicker paste with 1000ml water and 90gm TKP powder. First, boil water at 100°C and add TKP powder with stirring process. Take 800gm paste and 200gm PU for coating mixture with pigment. Coating is applied with knife air coating pilot scale machine. For drying temperature is kept 160°C for 15min. In final car mat is prepared with front coating material as PU and back coating with help of SBR backing. Car mat material edges are bonded with synthetic fabric which gives better aesthetic appearance. It has been made anti-skid with stitching different effect on fabric; it helpful in binding fibre properly as well as gives anti-skid effect.

IV. RESULT AND DISCUSSION

A. Add On

In banana needle punch non-woven fabric has been coated with fabric. There is different coating material is used for coating. Add on the property of SBR and acrylic is low compared to PU as shown in figure 3. Due to better add on % of PU we are going to use PU for the front side of car mat. Coating material add on car mat add on affect the property like durability and thickness.

\[ \text{Add on }\% = \frac{x-y}{y} \times 100 \]

Where X = GSM of coated non-woven Y= GSM of raw non-woven

![Fig. 2: Sample preparation flow](image)

![Fig. 3: Add on the property of SBR, acrylic and PU](image)

<table>
<thead>
<tr>
<th>Coating material</th>
<th>Banana non-woven GSM before coating(Y)</th>
<th>Banana non-woven GSM after coating (X)</th>
<th>Add - on %</th>
</tr>
</thead>
<tbody>
<tr>
<td>SBR</td>
<td>856</td>
<td>942</td>
<td>10</td>
</tr>
<tr>
<td>Acrylic</td>
<td>856</td>
<td>980</td>
<td>14.5</td>
</tr>
<tr>
<td>PU</td>
<td>856</td>
<td>1110</td>
<td>29.67</td>
</tr>
</tbody>
</table>

Table 2: ADD ON %

B. Abrasion Resistance

Abrasion resistance of PU coating is 9000 cycles with the weight reduction of 8% with Taber abrasion tester. Abrasion resistance of SBR coating is 6000 cycles with the weight
reduction of 8% without any hole. Abrasion resistance after 9000 cycle is shown visually in fig.5.

![Coated Mat before Abrasion Test](image)

**Fig. 4: Coated Mat before Abrasion Test**

![Coated mat after abrasion test](image)

**Fig. 5: Coated mat after abrasion test**

### C. Air Permeability

ASTM D 737 method was used for measurement of air permeability of fabrics. Samples were conditioned at 270C and 65% RH. The test was performed at the constant pressure drop of cmf. Air permeability of banana nonwoven before coating is 188.7 cmf and after coating 80.9 cmf. After the coating, the air permeability of banana nonwoven is reduced about 50%. Show in table 3.

### D. Tensile Strength

ASTM D751-06 method was used for measurement of tensile strength of fabrics. Testing machine consisting of straining mechanism, holding clamps and load recording mechanism. Specimens 4 inches (10 cm) wide and not less than 6 inches (15 cm) long are taken for the test. Two sets of five specimens each are required, one set for the machine direction tensile strength having the long dimension parallel to the machine direction, and the other set for cross-machine direction tensile strength having the long dimension parallel to the cross machine. The tensile strength of banana nonwoven lengthwise and width wise show in table 3. The tensile strength in lengthwise increased 90% and width wise increased 166% after the coating banana nonwoven.

<table>
<thead>
<tr>
<th>Banana nonwoven fabric</th>
<th>Before coating</th>
<th>After coating</th>
</tr>
</thead>
<tbody>
<tr>
<td>GSM</td>
<td>850</td>
<td>1110</td>
</tr>
<tr>
<td>Air permeability* (cmf)</td>
<td>188.7</td>
<td>80.9</td>
</tr>
<tr>
<td>Thickness(mm)*</td>
<td>5.3</td>
<td>6.11</td>
</tr>
<tr>
<td>Tensile strength lengthwise(kgf/50mm)</td>
<td>49.92</td>
<td>87.96</td>
</tr>
<tr>
<td>Tensile strength width wise (kgf/50mm)</td>
<td>15.74</td>
<td>40.89</td>
</tr>
</tbody>
</table>

**Table 3: Test Result**

### V. CONCLUSION

1. Add on % increased then durability of banana nonwoven increased and thickness of fabric increased.
2. After the coating, the air permeability of banana nonwoven reduced about 50%.
3. The tensile strength in length wise increased 90% and width wise increased 166% after the coating banana nonwoven.
4. Abrasion resistance of banana nonwoven coated is 9000 cycle with a weight reduction of 8% with Taber abrasion tester.
5. Banana nonwoven fabric is used for making car mat. For better durability banana nonwoven is coated with resin.

### REFERENCES


