

Development of Moquette Fabric for Enhancing Quality of Assembled Car Seat

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ABSTRACT

A moquette fabric has been developed for car seats that reduces the incidence of grinning and wrinkles. This new fabric has had a huge effect on the quality of assembled seats. The pile yarn structure of the moquette fabric has been enhanced to prevent grinning by structuring the pile yarn so that highly crimped yarn is in the center. This reduces exposure of the foundation material when the fabric is folded. The fitting of the pile fabric to the seat has also been enhanced by increasing the stretchability of the foundation material by 50-100%. Furthermore, the bending resistance of the fabric has been decreased to under 50 mm by decreasing the amount used of highly permeable back coating material with an extra low Tg (Glass transition temperature). As a result, the seats assembled using this newly developed fabric are higher in quality, with no grinning or wrinkles.

1. Introduction

The demand for more luxurious automobile interiors has been increasing year by year. As seats are very important in terms of car interiors, demand is particularly strong for higher quality assembled seat appearance.

The various types of seat covering materials used include fabric, and synthetic and genuine leather. Of these, the most widely used material is fabric, so enhancing the appearance of seats covered in fabric is equivalent to enhancing the majority of seats used in Honda vehicles. Of fabric seat covering materials, moquette fabric has been extensively used as a high-quality material because it can be woven into a wide variety of patterns and also dyed in a wide array of colors. However, it is difficult to make further enhancements to assembled seat appearance made from conventional moquette fabric. Accordingly, there was a strong demand for an enhanced moquette fabric that could be used to make more luxurious seat covers and thus meet design requirements.

This paper describes the goals in developing a new moquette fabric for enhancing seat coverings, the features of the newly developed material, and the development technology and its effectiveness.

2. Construction of Moquette Covering Material

The general construction and the specifications of moquette are shown in Fig. 1 and Table 1, respectively. Moquette is a pile material made by center-cutting woven material of a double-faced construction⁽¹⁾. Various kinds of pile yarns such as regular yarn and textured yarns are used to make a variety of patterns. Both the warp and the weft of the ground yarn are made of twisted yarn consisting of polyethylene terephthalate (hereafter called PET) and rayon to provide strength and flame retardant properties. The resin back-coating material is acrylic resin applied in layers to prevent the pile yarn from dropping out.

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5 levels of Table 2. The development target was a level of at least 4 or higher at which grinning at sewn parts was not noticeable, as in the case of grinning that occurs at curved parts of the seat.

3.2. Setting a Development Target for Wrinkles

The stretchiness was obtained using B: Constant load method stipulated in 8.15.2 of JIS L1096, and the stiffness was obtained using the 45° cantilever method stipulated in 8.19.1⁽²⁾.

The target stretchiness and the stiffness of the developed material were the actual values for knit material which does not produce wrinkles. These were a stretchiness of 10% or higher and stiffness of 50 mm or less, and are shown in Figs. 6 and 7.

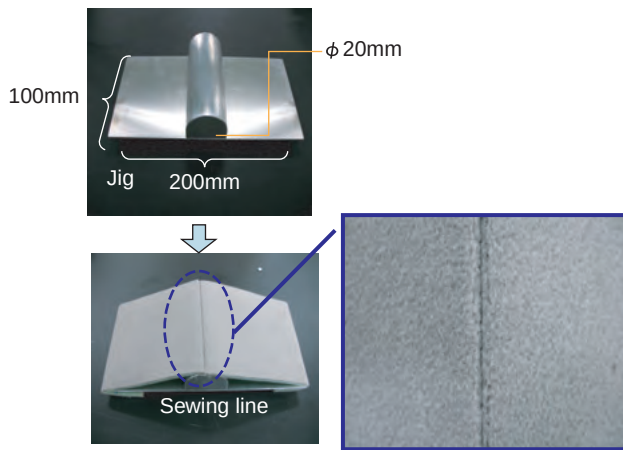


Fig. 5 Test of grinning caused by sewing line

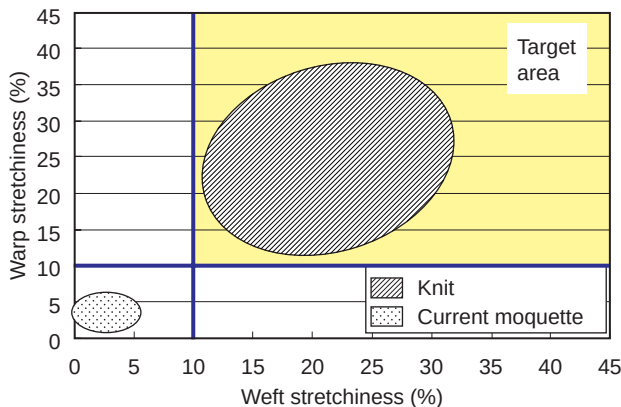


Fig. 6 Comparison of stretchiness in moquette and knit

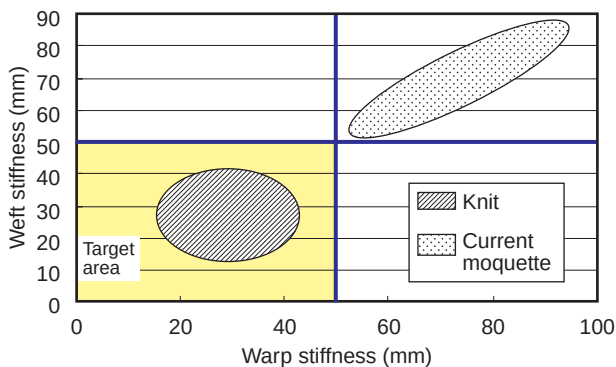


Fig. 7 Comparison of stiffness in moquette and knit

4. Technology Used in the Developed Covering Material and Its Effectiveness

4.1. Technology Used to Reduce Grinning, and Its Effectiveness

The pile construction was modified to achieve the target grinning level enhancement.

When moquette covering material of a general construction is used, gaps always occur at the bottom part of the pile, as shown in Fig. 8. When covering material is used on a flat surface, only the top part of the pile is visible, so the ground yarn cannot be seen.

However, when it is used on a curved surface, the difference in the top and bottom peripheral lengths of the covering material causes the top part of the pile to open up, enabling the ground yarn to be seen through the gaps. This phenomenon is known as grinning.

Although it is possible to reduce the gaps at the bottom part of the pile by increasing the density of the pile yarn, there is a limit to how much the density can be increased. In addition, the feeling of the moquette will be lost, so this is not an appropriate solution⁽³⁾. A method involving the use of crimped yarn for the entire pile also reduces visible gaps, but if the entire pile is made of this yarn, the intrinsic texture of the moquette will again be lost, and crimped yarn existing on the surface causes issues such as dust adherence.

A seat intended for use in an automobile always has sewn parts. The fabric used at sewn parts shows greater curvature than that on a curved surface, and at sewn parts, wrapping of the pile yarn occurs, as shown in Fig. 9. Given these factors, simply increasing the density, the traditional method studied up to now, is inadequate as a countermeasure.

To address these issues, it is necessary to cause only the bottom of the pile to swell. As a method of doing this, the pile yarn was woven into a dual-layer pile. Dual-layer pile yarn consists of several types of yarns, and the difference in shrinkage or crimping between the yarns is utilized. One layer of yarn is shrunk when center cutting during the moquette manufacturing process or the heating process to create a height difference⁽⁴⁾.



Fig. 8 Grinning in moquette

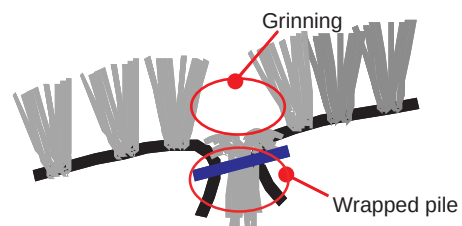


Fig. 9 Illustration of wrapped pile

Figure 10 shows a typical construction of dual-layer pile.

The pile yarn construction used in the developed covering material used a highly crimped yarn as the core yarn, and with a regular yarn as the sheath. To realize this construction, the twisted yarn construction was formed into the covered construction shown in Fig. 11. When the center cut is made, the highly crimped yarn shrinks while drawing in the regular yarn in the vicinity. The shrunken highly crimped yarn is placed at the bottom part of the pile. As a result, only the bottom part of the pile swells, thus reducing the gaps.

Figure 12 shows the cross-sectional structure of the covering material using this construction. By using highly crimped yarn, the bottom part of the pile swells, and adjacent parts of the pile fill up the gaps, thus preventing exposure of the ground yarn.

As shown in Fig. 13, this construction causes the bottom of piles adjacent to the sewn part to swell, preventing exposure of the ground yarn and wrapping of the pile, which occurred with the conventional construction.



Fig. 10 Typical construction of dual-layer pile

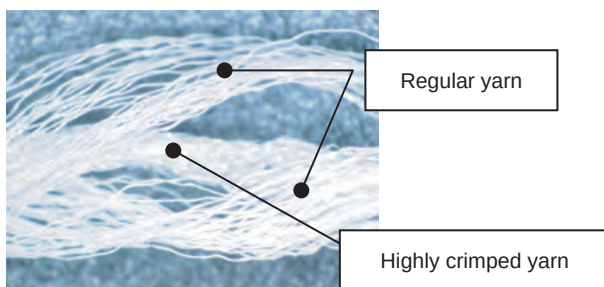


Fig. 11 Grandrelle yarn

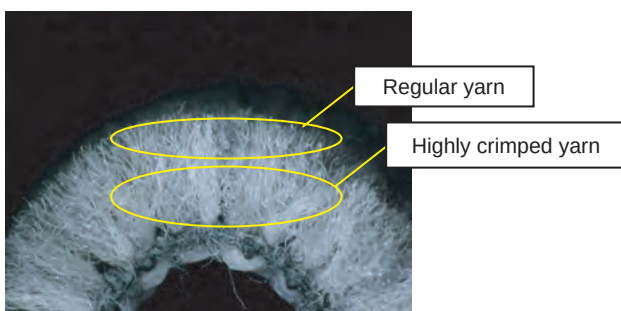


Fig. 12 Two-phase pile

Table 3 Grinning test results

Mixed yarn Covered yarn	Regular	Lightly crimped yarn	Highly crimped yarn
1dtex regular	Level 2	Level 3	Level 4
2dtex regular	Level 2	Level 3	Level 4
3dtex regular	Level 2	Level 3	Level 4

Yarns that were crimped to different extents were used as the core, and then combined with regular yarns of different sheath thickness to form the covering material. The grinning level evaluation results are shown in Table 3. It was found that only covering material that used highly crimped yarn as the core yarn achieved the level 4 target.

4.2. Wrinkle Reduction Technology and Its Effectiveness

To achieve the target stretchiness and stiffness of the covering material for minimizing wrinkles, the ground yarn construction and back coating were modified.

4.2.1. Ground yarn construction

Ground yarn for moquette covering material is often made of mixed PET and rayon yarn, with an eye to such characteristics as ability to resist flames.

However, the stretchability of both PET and rayon as yarn is low, and when it is used to make a seat, its shape conformity is low. Yarns that are well known as having high stretchability include polyurethane elastic yarn and PET elastomer⁽⁵⁾; however, all of these yarns need to be enhanced with respect to strength or other properties when used on their own.

To achieve the target stretchability of at least 10%, elastic yarns and other yarns with stretch effectiveness were studied.

Accordingly, moquette was fabricated using different yarn materials. As a result, as can be seen from Fig. 14, the target stretchiness was achieved by using urethane elastic yarn twisted with mixed PET and rayon yarn for the warp. Likewise, it can be seen in Fig. 15 that the target stretchiness was achieved by using crimped PET yarn for the weft.

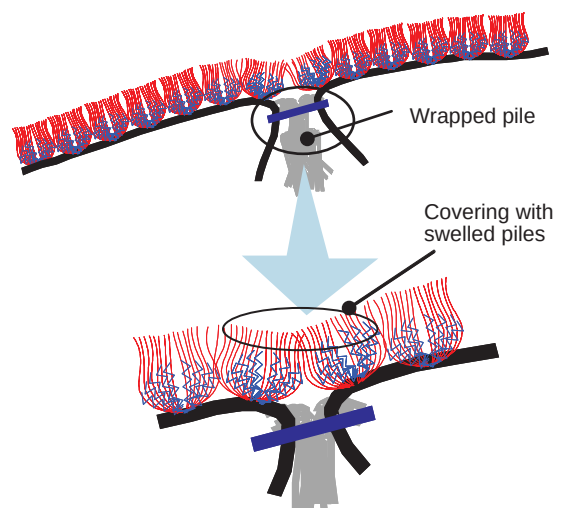


Fig. 13 Mechanism for covering grinning

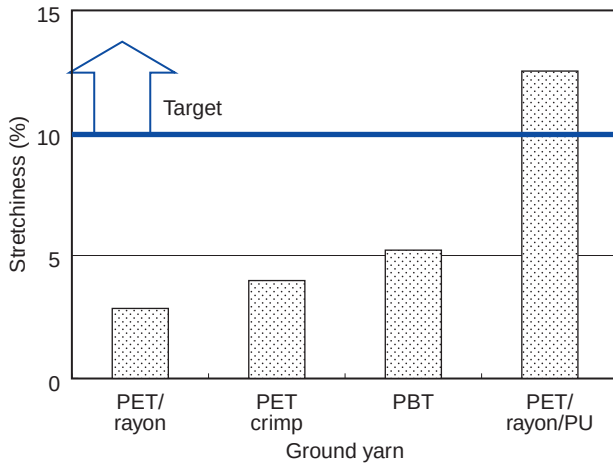


Fig. 14 Comparison of warp stretchiness in grand yarn

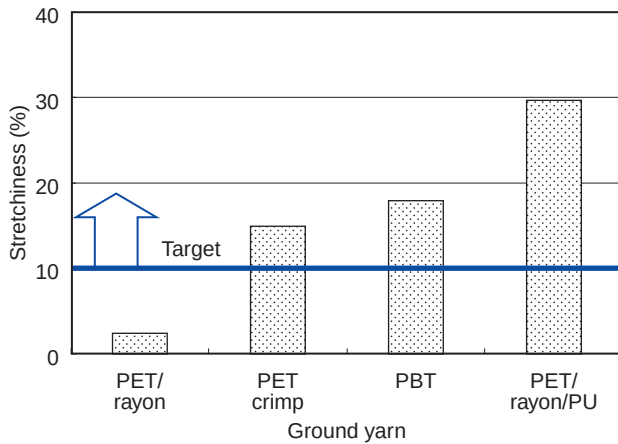


Fig. 15 Comparison of weft stretchiness in grand yarn

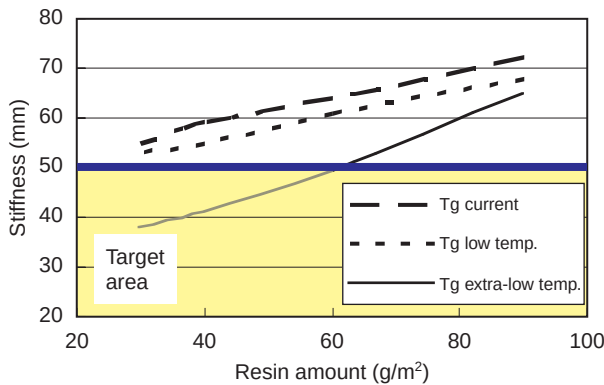


Fig. 16 Relationship between Tg and stiffness

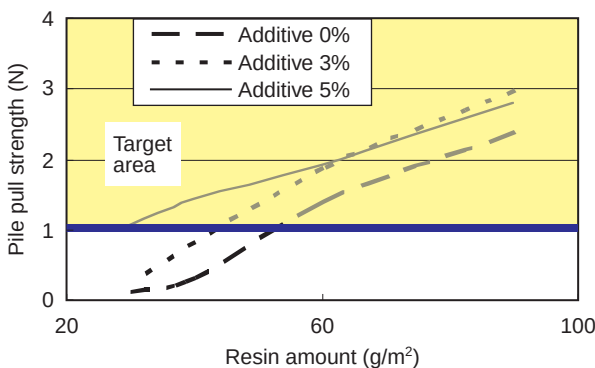


Fig. 17 Relationship between additive and pile pull strength

Table 4 Specifications for newly developed moquette

Category	Current moquette		Newly developed moquette	
	Material		Material	Note
Pile yarn	PET Regular		PET Regular	Textured yarn
			PET Highly crimped	
Ground yarn	Warp	PET/rayon	PET/Rayon/PU	Textured yarn
	Weft	PET/rayon	Crimped PET	
Backcoating	Acrylic resin		Acrylic resin	Max. 50g/m²
Stretchiness	1-5%		10-15%	
Stiffness	Min. 60mm		40mm	
Grimming	Level2		Level4	

4.2.2. Back coating

The back of the moquette is coated with back-coating material to prevent the pile yarn from falling out⁽⁶⁾. However, if the stiffness of the resin material used for the back coating is high, the stiffness of the covering material will increase, causing wrinkles. Accordingly, the coating amount and the stiffness of the resin material were modified to soften the back-coating material.

As shown in Fig. 16, generally there is correlation between the glass transition point of resin material (hereafter Tg) and stiffness: When Tg is lowered, the softness increases. The softness also increases when the amount of resin applied is reduced, but there is a corresponding tendency for the pile yarn pull strength, which is the purpose of the back-coating resin, to fall. Accordingly, a study was carried out with a view to reducing the application amount by raising the permeability of the back coating to widen the adhesion range of the yarn.

Figure 17 shows the correlation between the additive blend and the pile pull strength. From the results of the above studies, the glass transition point of back-coating material was set to extremely low temperature specifications. Addition of 3-5% of additive when blending the resin enabled the softness and pile pull strength to be balanced.

4.3. Application to Seat

The development specifications of this research are shown in Table 4.

The pile used highly crimped yarn and regular yarn to achieve a grinning level of 4. The specifications of the ground yarn were changed, enabling a stretchiness of at least 10% to be achieved. Also, the back-coating material was modified, realizing a stiffness of no more than 50 mm.

A seat was fabricated using these development specifications, and their effectiveness was confirmed. Compared to the conventional specifications, the development specifications produced no wrinkles or grinning at sewn parts, and the resulting seat had a good finish, as shown in Fig. 18.

5. Conclusion

A moquette covering material that was free from wrinkles or grinning and had a luxurious appearance was developed for use on seats.

- (1) A suitable construction to prevent grinning utilized the difference in height between pile yarns resulting from the combined use of yarns with different degrees of crimping. This construction achieved a level of at least that of knitted covering material.
- (2) A warp using PET, rayon and polyurethane elastic yarn, and a weft using PET crimped yarn were suitable to increase the stretchiness. The use of these materials enhanced the stretchiness by at least 10%.

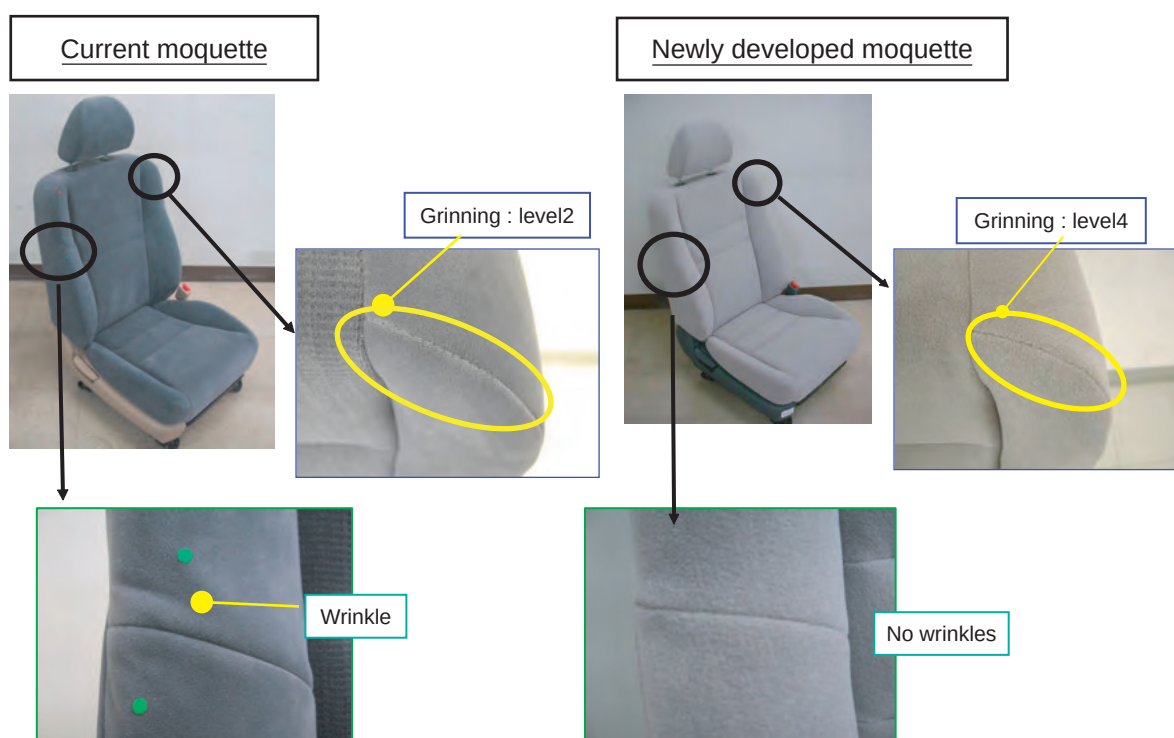


Fig. 18 Effect of newly developed moquette on seat assembly

- (3) Adjustment of the type and quantity of additives decreased the stiffness without reducing the pile pull strength or other physical properties, enabling even a low strength resin to be used.

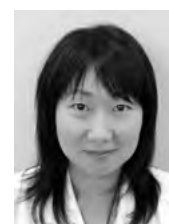
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