

Hot-melt Adhesive for Automotive Interior

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1 Abstract

Various solvent-based adhesives (SBAs) are used for automotive interiors. High-performance reactive SBAs (RSBAs) are used particularly for doors because customers demand severe shape characteristics and heat-resistance. However, SBAs affect the environment and RSBAs complicate the process control. We have developed solventless and non-reactive hot-melt adhesives “ZH601-1” and “ZH551-4” to resolve these problems. These new products are applicable to doors. They contribute to eliminating solvents by replacing SBAs, and can be used in the precoat method because these products are non-reactive. Moreover, they can shorten lead time, since solventless and non-reactive hot-melt adhesives can reduce the solvent drying process and the reactive process compared with RSBAs.

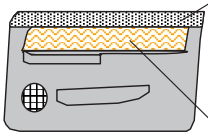
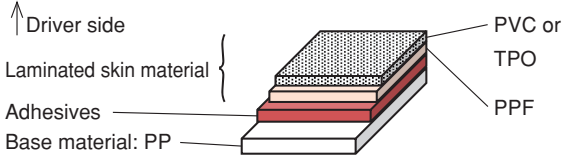
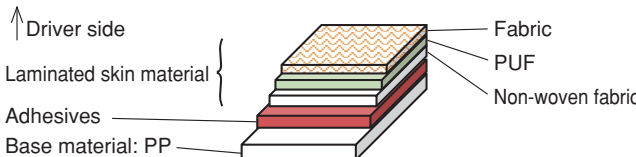
2 Characteristics of the New Product

- Hot-melt adhesives for automotive interiors (solvent-free and non-reactive) can be applied to doors.
- Lamination of pre-coated skin material can be stored due to PVC plasticizer resistance (ZH601-1 for vacuum forming).
- The new product can be applied to the press-contact adhesion method, because of its long open time (ZH551-4 for press-contact adhesion).

3 Background of the Development

Adhesives for automotive interiors, especially for doors, were improved in response to the market demand for a non-primer, one-liquid, and VOC13-removed substance with strong adhesive qualities. Currently, one-liquid, solvent-type reactive adhesives are mainly used.¹⁾ On the other hand, there is a demand for adhesives capable of removing VOC and reducing process costs. The vacuum-forming method uses one-liquid, solvent-type potential-curing adhesives corresponding to the pre-coating method (coating before storing). This method is capable of integrating the coating process by using a roll coater for continuous coating and is reported to be a way to reduce process costs.²⁾ For this method, we developed a solvent-free, non-reactive hot-melt adhesive (YH171-1P).³⁾ However, YH171-1P was easily affected by plasticizer migration during lamination after the PVC surface layer was pre-coated. In addition, the press-contact adhesion method could not be applied to conventional hot-melt adhesives that require adhesion via high-temperature melting, because the high temperature press deteriorated the quality of the fabric. For these reasons, we designed and developed Hi-Bon ZH601-1 and ZH551-4, which can be applied to each method.

Table 1 Configuration of adhesives for door

Schematic diagram of a door	Location	Adhesion method	Configuration	Solvent-type adhesives*
	Upper	Vacuum forming		<ul style="list-style-type: none"> • YA211-1 • 1212
	Ornament	Press-contact adhesion		<ul style="list-style-type: none"> • 1755 • 1255

PP: polypropylene, PVC: polyvinyl chloride, TPO: thermoplastic olefin resin, PPF: polypropylene foam, PUF: polyurethane foam.

*: Our grade of one-liquid type reactive adhesives

4 Technical Details

The general properties of Hi-Bon ZH601-1 and ZH551-4 are shown in **Table 2**. ZH601-1 for vacuum forming has adhesion qualities equivalent to that of YH171-1P, and improved PVC plasticizer resistance. Test results are shown in **Table 3**. In addition, ZH551-4 for press-contact adhesion achieves adhesion even for 60 seconds of open time (time from removal of the heat source until contact adhesion, hereinafter referred to as OT). For press-contact adhesion, to prevent deterioration of the fabric quality, a long OT is essential as the work time for the customer and heat radiation time. Our polymer alloy technology resolved the issue where a long OT generally caused a significant decrease in the heat resistance of hot-melt adhesives.⁴⁾ **Figure 1** shows the cooling solidification behavior of ZH551-4. A long OT and heat resistance were simultaneously achieved by maintaining storage modulus G' and by decreasing the rising speed.


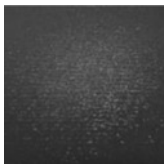

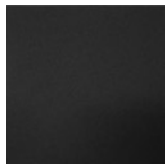
Table 2 General properties of new products

Item		Unit	YH171-1P		ZH601-1	ZH551-4
Method of applying adhesives		—	Vacuum forming		Vacuum forming	Press-contact adhesion
Properties	Appearance	—	Light yellow		Light yellowish white	Light yellowish white
	Viscosity (180°C)	mPa · s	10,000		20,000	33,000
	Softening point (ring and ball method)	°C	145		145	140
Adhesion conditions	Substrates (base material)	—	PP		PP	PP
	Substrates (skin material)	—	PPF/PVC	Non-woven fabric/ PUF/fabric	PPF/PVC	Non-woven fabric/ PUF/fabric
	Open time	s	5	60	5	60
	Surface temperature of hot-melt at contact adhesion	°C	120	30	120	30
Adhesive properties	Peel strength (23°C, 200 mm/min, 25 mm wide)	N	33.0 B	No adhesion	32.0 B	22.0 B
	Peel strength (80°C, 200 mm/min, 25 mm wide)		22.5 B	No adhesion	23.0 B	18.5 B
	creep (80°C, 100 g load, 24 h, 25 mm wide)	mm	0	No adhesion	0	3 A

Coating method: roll coater, coating amount: 100 g/m², adhesion strength: 0.05 MPa

Failure condition symbol: A (adhesive failure from base material side), B (material failure of skin material)

Table 3 Result of plasticizer resistance test

Item	YH171-1P		ZH601-1	
Appearance of PVC side				
	Before test	After test: Not acceptable because of contamination	Before test	After test: Acceptable (no contamination)

Pre-coated skin material (PVC, PPF, hot-melt adhesives) lamination, 9.8×10^{-4} MPa, 50°C, 168 h

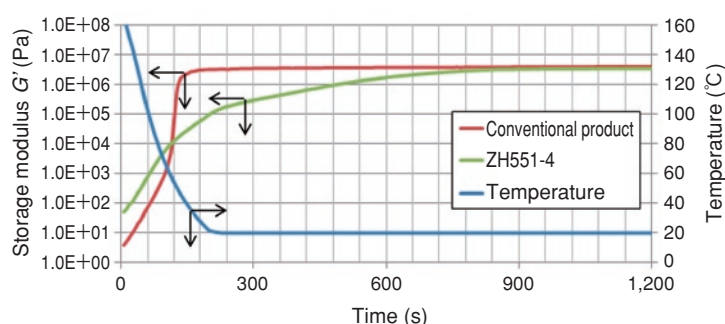


Figure 1 Cooling solidification behavior of “ZH551-4”

5 Future Business Development

- Promote adoption by automotive interior manufacturers

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