Primer-less Adhesive for Plastic back door Assembly

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1 Abstract

In recent years, automotive back doors made of plastic that are lightweight and have good designability have been making inroads. Primer-combined adhesive is superior in adhesion reliability, and has been applied to the assembly of the plastic back doors. However, it needs a primer application process, increasing the manufacturing costs of plastic back doors. In order to reduce the manufacturing cost, a primer-less adhesive is required, but achieving primer-less adhesion is difficult because plastic back doors consist mainly of Polypropylene (PP), which is a hard-to-bond material. We have adjusted the adhesive-substrates interaction and the physical properties of the adhesive, and then developed a new primer-less adhesive having good adhesion properties and adhesion reliability for PP-based plastics for back doors.

2 Characteristics of the Product

- Offers superior adhesion properties on hard-to-bond PP material, without using a primer.
- No drop in adhesion properties after long-term exposure to heat or hot water.

3 Background of the Development

Stricter regulations on CO_2 emissions due to the growth of the automobile market in recent years has led to increased demand for lighter vehicle bodies to lead to improved fuel economy. Against this background, Hitachi Chemical launched lightweight plastic back door modules[1]. Polypropylene (hereinafter, "PP") is the major component of plastic back door modules. PP has excellent mechanical properties but is generally a hard-to-bond material. For this reason, surface treatment and primer application were performed as pre-bonding treatments. **Figure 1** shows the adhesion process.

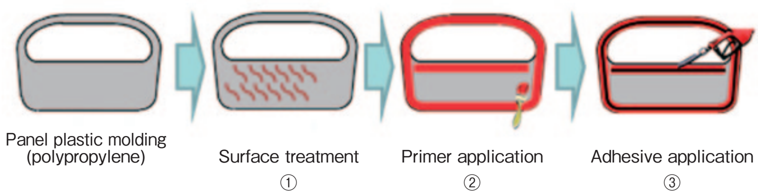

Figure 1 Adhesive process of Plastic back doors

It is known that eliminating the primer application process (**Figure 1** ②) leads to a significant cost reductions in the adhesion process. Therefore, we started to develop a primer-less adhesive but problems with adhesiveness and adhesion reliability still remained.

4 Technical Details

The newly developed product achieves primer-less adhesion through changes to the composition of conventional primer-combined adhesive. The details of the composition changes were determined from the results of surface analysis of the substrate and the results of various simulations. **Table 1** shows the values calculated by molecular simulations of the interaction energy between the two functional groups A and B in the adhesive and the substrate surface. **Figure 2** shows the stress simulation results of lap-shear model. Based on the results from **Table 1** and **Figure 2**, the interaction between the adhesive and substrate was increased and the stress concentration was reduced, making it possible to maintain the adhesive strength without using a primer.

Table 1 Interaction energy between functional group of adhesive and substrate

Functional groups in adhesive	Interaction energy (J/m^2)
A	0.0874
B	0.1098

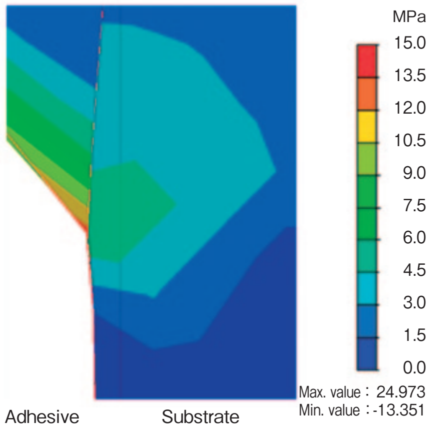

Figure 2 Stress simulation result of lap-shear model

Table 2 shows the general properties of the developed product. This newly developed product requires no primer to achieve adhesion properties and adhesion reliability comparable to those of the primer-combined adhesive on plastic back door modules with PP as the major component.

Table 2 General properties of the new primer-less adhesive

Class	Item			Primer-combined adhesive	Primer-less adhesive (developed product)
Process properties	Primer			Yes	No
	Viscosity [Pa s]			1600	1600
	Two-part mixing ratio (base:hardener) [vol/vol]			1：1	1：1
	Curing time [min]			7.5	7.5
Adhesive properties	Manual peeling test	Initial	R.T.	CF100	CF100
	Lap shear test	Initial [MPa]	R.T.	3.5	2.4
				CF100	CF100
		Thermal aging [MPa]	90℃,336 h	3.3	3.6
				CF100	CF100
		Warm water immersion [MPa]	40℃,336 h	3.8	2.9
				CF100	CF100
	Tensile test	Elongation [%]		350	380

* CF100: 100% cohesive failure

5 Future Business Development

・Improvement of properties to expand substrate/surface treatment conditions

【References】
1) Teruhiko Iwata et al., : Plastic Back Door Module for Automotive, Hitachi Chemical Technical Report, 44, 21-24 (2005)