

# Physical Properties of Leather-Feeling Coatings for Automotive Interior

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## ABSTRACT

The performance of the car, as well as the emotional quality is an important factor as the product and the importance of automotive interior materials is getting increasing. With expandable microspheres at a constant temperature, leather -feeling surface can be implemented and it could express not 2-dimensional feeling but 3-dimensional feeling (bushed or suede-like feeling). For the automotive parts, leather-feeling coatings similar to feeling of leather could was developed and could correspond to emotional quality of consumer.

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## INTRODUCTION

Automobile is major transportation in our lives and main trends of development are focused on performance of engine, brake system and convenience of device. But, as growth of automobile market, aesthetic factors are emphasized and design, color and finishes become very important factors of purchasing demand. In particular, automobile interior is one important factor in determining the purchase of the vehicle.

Interior parts can be divided into a main part of the cockpit crash pads and small parts of the vehicle. Crash pads are primarily classified with Hard IP and Soft IP. Soft IP is generally divided by skin + PU foam or leather-wrapped IP. Hard IP is composed of PP injection and coating. Small parts are generally divided into hydrographic, insert / in-mold film, real wood / aluminum and injection parts + paint Table 1. There are several types of coating material and the coating being such as a matte, metallic, high-glossy, textured, high modulus coating.1)~3)

In particular, soft-feel paint and high modulus paint are composed of the raw material such as soft polyester resin and the surface adjuster. Soft-feel paint and high modulus paint can express the desired texture and can hide cheap feeling of plastic substrate. However, soft-feel and high elastic paint are two-dimensional coatings and could not meet the higher sensitivity of the consumer level. Especially, twodimensional high modulus coating which is higher than the current soft-feel paint does not appeal emotional quality to consumer.

In this study, coating materials with a new concept, leather-feeling coating is developed and it could express luxurious leather feeling same as leather surfaces and it is expected to be able to contribute to increase the purchasing values of the product.

Table 1. Interior trends according to segment of automobile

| Segment  | Surface Finish                | To-be                           |
|----------|-------------------------------|---------------------------------|
| Compact  | Decorative / Metallic         | HI glossy / Wrapping            |
| D, E seg | Hydrographic / Carbon Pattern | Real Aluminum                   |
| Luxury   | →                             | Suede / Real Stitch / Real Wood |

## EXPERIMENT

### Preparation of Coating

Manufacturing process of coating materials is shown in Fig 1. Coating materials are made with two steps. At first, raw materials such as polycarbonate polyol (molecular weight : 500~2000), polyester resin, acrylic urethane resin, some special resins and additives, pigments, solvents are mixed with roll-mill process. At that time, mixing should be maintained in 30 minutes for sufficient wetting of pigment with resin. For grinding of resin, size of granule is limited below 10 microns for good surface properties.

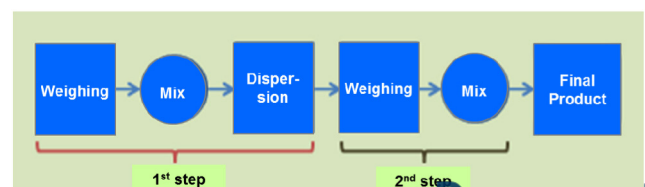


Figure 1. Process of coating manufacturing

In second process, raw materials such as silicone wetting agent, wax, microsphere, solvent and matting agent are input into coating resins. Microsphere is finally feeded into coating resins for homogeneous dispersion. Stirring must be maintained in 10 minutes for complete mixture of coatings.

For coating onto substrate, the ratio of main components and hardener, NCO/OH are 1.1~1.3. And viscosity was adjusted with solvent (ford cup #4 : 16~18 sec) for appropriate coating process.

### Paintings of Coating

For primer coating, CPO based primer is applied onto PP substrate and acrylic urethane based primer onto PC/ABS substrate. In coating thickness of primer, acrylic urethane based primer is applied in 10~15 microns, CPO based primer in 5~10 microns. For leather-feeling coating, coating thickness must be 50~70 microns (including expanded microsphere) for preventing release of microsphere and maintaining soft feeling. After application of coatings, sufficient curing is required for of leather-feeling coating. For sufficient curing, surface temperature of 90~95C in 3~7 minutes and 10 minutes of retention time should be attained. It can be made by control of drying oven condition (initial expansion of microsphere). After finishing of baking, temperature of 80 in 30 minutes should be required.

### Mechanical Properties of Coating

Adhesion of coating is performed by ISO2409 with 2mm cross hatch test. Anti-scratch test is performed by JIS K6718 with 5 mm-sapphire tip. The applied load of scratch tip is 500 g and scratch was evaluated from grade 1 to grade 5 with bare eyes. (Grade 5 : significantly observed, grade 1 : not observed). Abrasion resistance was performed in back and forth movement of abrasive bar with 1 kg, 1000 times. Sun-tan cream test was performed as follows. Sun-tan cream (NIVEA SPF47) was applied onto coated substrate and put sample into convection oven of 80C in 2 hours. After aging, scratch and adhesion were tested. Heat aging property was tested by convection oven of 110C in 300 hours. Humidity test was performed with 50C 95% in 7 days. Weathering was tested by SAE1885 testing method. Adhesion, color difference, gloss retention were measured in all of these aged coating specimens.

## RESULTS AND DISCUSSIONS

### Principles of Leather-Feeling Coating

Generally, surface of real leather shows fine fiber skin protrusions and urethane coatings as Fig 2. Person can feel the touch of real leather with these fine fiber skin protrusions and touch of urethane coatings. Leather-feeling coating is a coating with artificial microsphere protrusions which are substituted for fiber skin protrusion.

Microspheres, which show protrusions onto coated substrate, have characteristics to expand in special temperature and time condition. Like a balloon, shape of microsphere is bigger according to rise of baking temperature and according to retention of baking time. Such effects are due to hydrocarbon type gas or solvent which is inside of microsphere. Before baking, Hydrocarbon gas shows micron-sized microsphere. If microsphere gets heated, it grows rapidly and reaches

dozens of micron size. Degree of expansion is able to be controlled by molecular weight of hydrocarbon gas of microsphere. The bigger the molecular weight, the higher temperature microsphere expands.

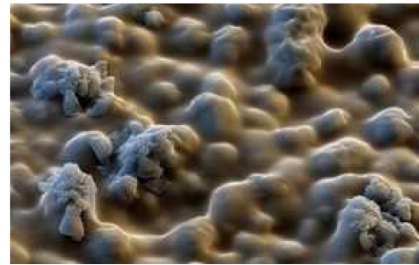


Figure 2. Protrusions in real leather with urethane coating

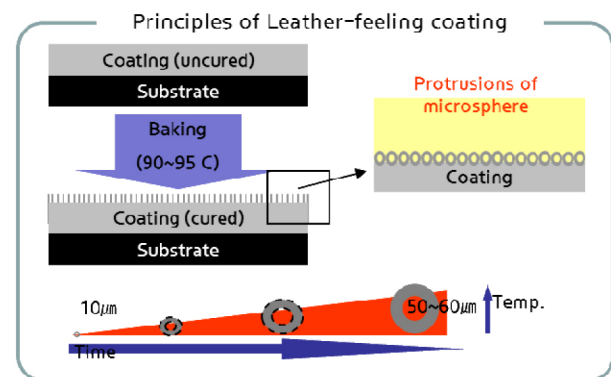


Figure 3. Principles of protrusion in leather feeling coating

### Optimizations of Baking and Morphology

As mentioned before, size of microsphere depends on specific baking temperature. Expansion of microsphere due to temperature is shown in Fig 4. As shown in Fig 4, optimum size of microsphere was in 90~95C.

1. 80C, 40 min: State before formation of protrusions. Only matting agent, wax and microspheres exist onto substrate.
2. 85C, 40 min: State of beginning of protrusion formation. Microsphere which is located in uncured coating begins to expand. Protrusions can be felt finely. But its size is still small.
3. 95C, 40 min: State of completion of protrusion formation. Surface gloss decrease and microsphere expand until some part of microsphere goes up to surface of coatings and protrusion is formed. Leather feeling of surface is completed.
4. 105C, 40 min: State of over expansion of microsphere. Microsphere is too expanded and its size becomes to be bigger than that of coating thickness. Excessive expansion of microsphere effects inhibition factors of physical properties of coating.
5. 115C, 40 min: State of maximum expansion of microsphere. It shows over expanded and too much distributions of microsphere. Over expanded microsphere can be easily damaged by external forces.