



Leather properties required in the moulding process

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The current move towards the use of leather in computer goods, household appliances, water sports and interior décor may lead to adaptations in the leather properties being required as leather-moulding techniques are used in the manufacture of these products. If these methods are employed within mass production, the leather is subjected to different forces than those used in traditional methods of leather-making and this can reduce the quality of the leather.

To investigate the potential problems, the various techniques used for shaping and forming leathers within these new applications were studied. Ways were investigated to best to protect leather under these conditions, and the objective of this study is:

- To define the constraints that leather must sustain during both moulding techniques used in the manufacture of goods and in the finished articles.
- To recommend formula for the treatment of leather in relation to these processes.

Technique involved in moulding leather

The process of moulding consists of permanently deforming and shaping a piece of leather over or under an existing component. Polymers are often used to achieve the end result, and frequently high temperatures are used in the forming process. As a result, these polymers often cause damage to surfaces that they may contact.

In forming these composite products, the principal techniques used are injection moulding and sheet moulding.

Within this process—according to the type of moulding technique adopted and the polymer used—the leather can be exposed to temperatures ranging from 80°C to 220°C for a short period of time (i.e. a matter of seconds).

The polymers are also used in varying states of viscosity. This can range from 1 to 1,000 Pa.s, and according to the polymer and equipment used, they can often diffuse throughout the entire thickness of the leather. An example of moulding is given as *Panel 1*.

The reaction of leather to temperature

To study the behaviour and reaction of leather to temperature, a highly viscous thermo-plastic polyurethane polymer was heat-pressed against a leather sample. A wide range of finished leathers were used in these tests:

- Sheep nappa.
- Corrected grain cow hide.
- Box calf.
- Cow nappa.
- Full grain pigmented calfskin.

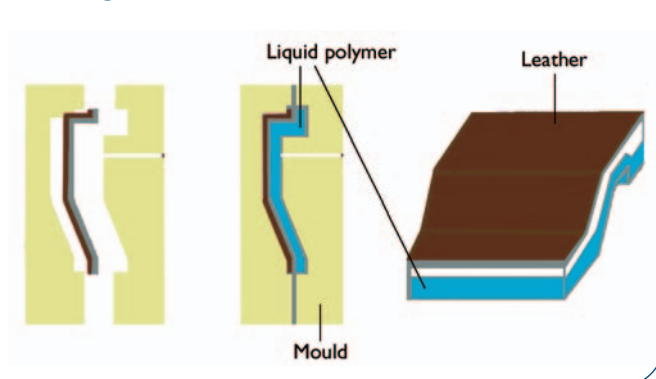
The following technique was used:

- A polyurethane sheet was held at 220°C on a lower plate.
- The leather was placed on the sheet.
- A cold sheet was laid on top of the leather.
- This was then covered with an upper plate. (The temperature of this plate was 80°C.)
- A pressure of 8 bars was applied for 5 seconds.
- The sample was cooled in a cold press under a pressure of 8 bars for 30 seconds and for a further 3 minutes out of the press.
- The sample was removed from the mould.

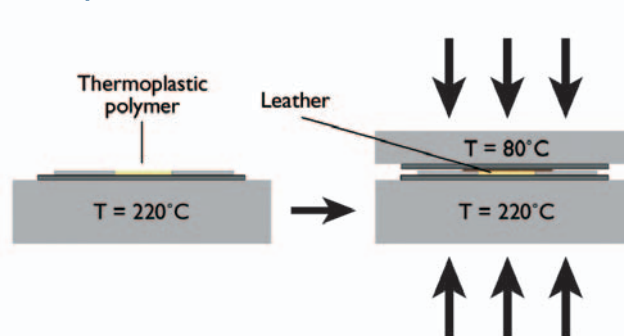
This technique is indicated in *Panel 2*.

When examined, no difference could be distinguished ➤

Panel 1: Example of forming a component by injection moulding



Panel 2: Test method for behaviour of leather to temperature



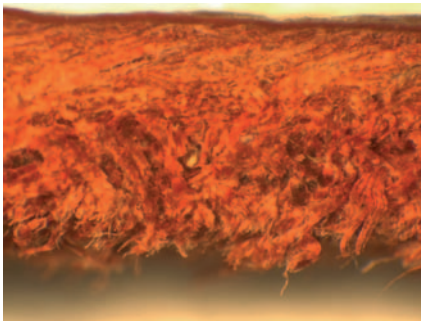


LEATHER PROPERTIES REQUIRED IN THE MOULDING PROCESS

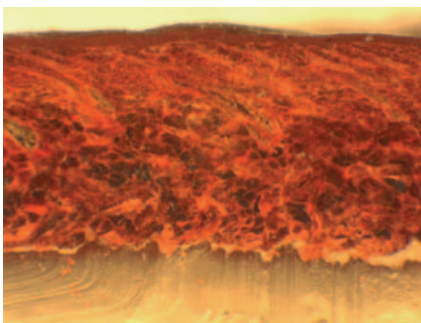
Panel 3: Effect of moulding on automotive leather

Leather type: automobile (enlarged x 46)

Reference



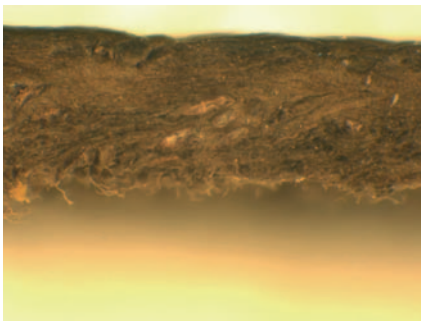
Moulded leather



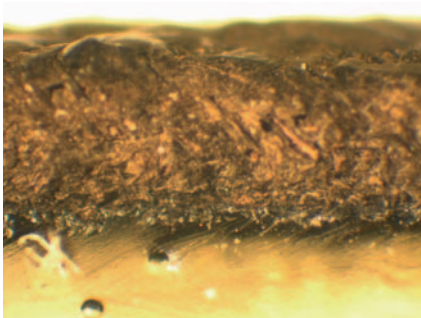
Effect of moulding on sheep nappa leather

Leather type: sheep nappa (enlarged x 60)

Reference



Moulded leather



between the various leather types tested using this type of moulding. All of the leathers had a pleasant aspect, and it was observed that the finish added protection in terms of the fat migration on the samples. Examples of three types of leathers are shown in *Panel 3*.

The porosity of leather

To test the porosity of the flesh side of the leather, an initial test was carried out. This used a very fluid polymer which was cold-

flowing (viscosity of 2 Pa.s at 50°C). This was moulded at 80°C with a thermo-hardening polymer.

The following technique was used:

- The leather was placed on a cold lower plate.
- The mixed and cooled resin was applied to the leather.
- The cold upper plate was placed on the leather.
- The mould was then closed. The temperature of this plate was raised to 80°C and maintained for 2 hours.
- The mould and sample were cooled.
- The sample was removed from the mould.

This technique is illustrated in *Panel 4*.

This process was limited because the polymer fully penetrated some of leathers tested. However, a simplified process was then identified that was more discriminating in terms of the level of porosity:

- Polymer (liquid PU) at a viscosity of +/- 5 Pa.s and 10 Pa.s was added at a low temperature, using a cold casting and a cold mould.
- Two polyurethane systems were used. The mixing, the casting (in an open mould) and the polymerisation were carried out at an ambient temperature.

In this situation the differences in the penetration of the polymer could be identified. This was determined by the nature of the leather and the viscosity of the product incorporated. The technique is illustrated as *Panel 5*.

The behaviour of leather under the conditions of moulding

In evaluating the reaction of leather to heat, it was considered that the main parameters to take into account in terms of leather properties are:

- Its sensitivity to heat—in terms of the risk of surface hardening.
- Its sensitivity to the pressure of moulding—in terms of the risk of deforming the grain.
- Its dimensional stability—linked to the diffusion of the polymer when in the molten state.

The investigations were centred on the behaviour of leathers according to:

THERMAL STABILITY

Two types of leather were used in the investigation: chrome-tanned and chrome-free.

CHARACTERISTICS OF FATLIQUORING AGENTS

Leathers used within automotive interiors require high physical/mechanical properties and show high resistance to migration. With this in mind the leathers used within the trials were fatliquored with a nourishing synthetic oil designed for automotive leather, a waterproofing fatliquor, and a sulfited fish fatliquor.

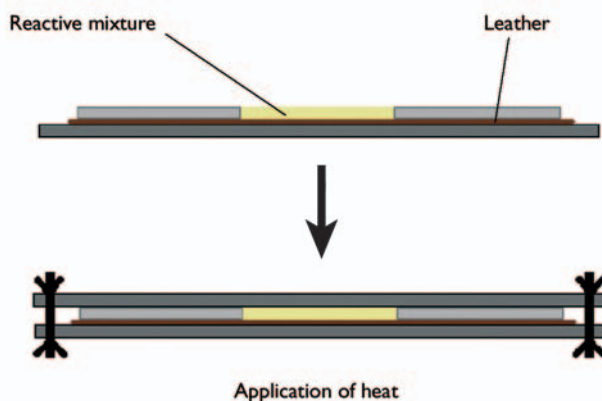
THE POROSITY OF LEATHERS

Various products were applied to limit the penetration of polymers into the leather structure, while maintaining adequate adhesion between the polymer and the leather.

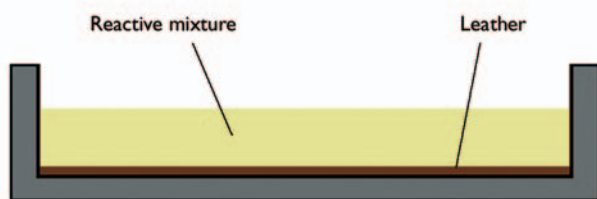
LEATHER PROPERTIES



Panel 4: Open mould casting at elevated temperature



Panel 5: Open mould casting under ambient conditions



The various leathers produced were moulded as described above, then evaluated using the following test methods:

- Traction to the standard ISO 3376.
- Suppleness to the standard PSA D45 1030 (automotive).
- Tear resistance to the standard ISO 3377-1.
- Migration behaviour (CTC method).
- Water droplet test (CTC method).

Findings from the investigation

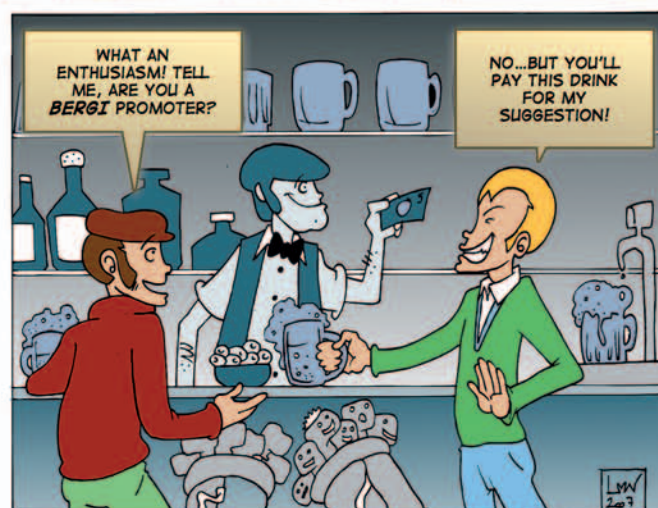
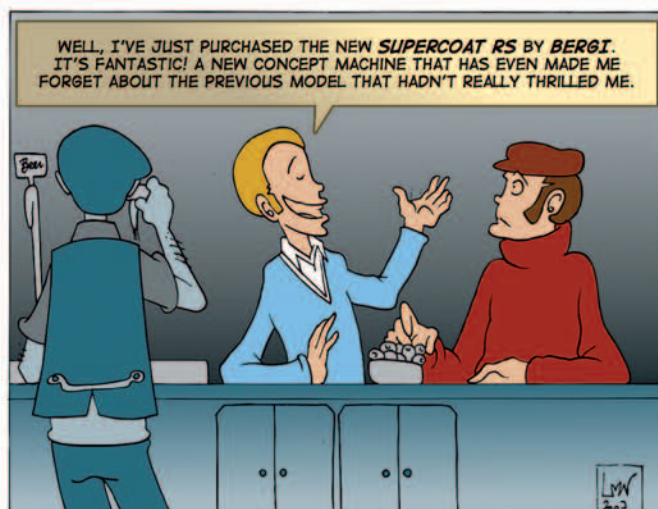
Within the moulding process, the major factors to take into account are:

- The type of tannage used. After ageing under dry heat conditions, the chrome-free leathers showed a lower level of surface shrinkage than the chrome-tanned samples.
- The porosity of the leather.
- The physical/mechanical properties of the polymer in contact with the flesh side of the leather.

Further work is concentrating on the effect of leather porosity, thickness, polymer properties, conditions of moulding, and the quality of the final product. This should determine a complete range of properties which leather must possess to be used effectively in the mass production of moulded decorative items, computer, electrical goods and household appliances. 🌐

Acknowledgements

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