



A water-based coating system for lower-grade leather and splits

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This environmentally sound coating system, known as Hydro PU Coating, is based on modern NMP- and NEP-free polyurethane (PU) polymers. It has been developed and fine-tuned over the past five years and is now in use at various manufacturing sites. The working principle of this system is a transfer-coating line as illustrated in *Panel 1*, which can even use existing machinery as designed for solvent-based systems.

The finishing coats are applied to a release paper which has the required texture, to create a reverse texture on the final leather surface. Hundreds of textures are at the manufacturer's fingertips, and there is no need for heavy investment in rollers and plates for embossing.

In practice, the release paper moves as a conveyor belt and passes through the coating station two or three times, depending on the effect needed. One option is to mechanically foam the middle coat to achieve better coverage. After each coat the paper passes through a dryer and normally a film thickness of between 50 and 150 µm is developed.

Once the film is created, an adhesion coat is finally applied on the film and leather is laminated onto the film via two rollers (in a calender process). There is no need for heat and pressure for this simple lamination process. Finally, the leather is peeled from the release paper, with the film forming the finish. After this separation, the paper is wound up on a roll and can be reused several times.

Applications of the technology

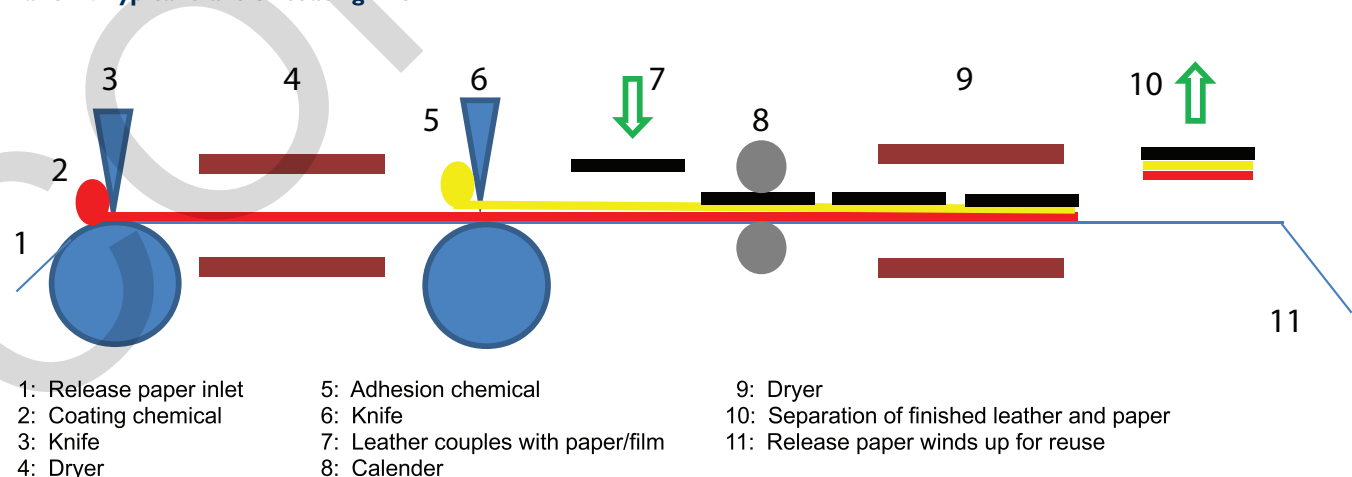
This technology is being successfully used on leather, splits and microfibre. High-performance polyurethanes are used to form a continuous (fully reacted) film, thus ensuring good physical performance together with upgrading by covering most small surface defects on the leather. The most suitable types of leather for this operation are those that need a heavier coating thickness to achieve high physical performance, such as in automotive or sports shoes.

The system is versatile and all kinds of effects are possible, such as pull-up, two-tone, patent, and nubuck, and the incorporation of properties such as anti-soiling, waterproofing and solar reflectance (COOL).

Machinery and equipment

The most common technique used for coating is similar to the draw-down technique with a bar or a knife (see *Panel 1*). The gap between a knife (bar) and the moving release paper controls the film thickness. Roller-coating also has been used as coating stations. No special equipment is required when compared to any existing solvent-based PU coating set-up. Drying cycles can have similar capacities, lengths and feed rates, but the temperatures may have to be adjusted. In the case of water-based systems, operational temperatures range between 90° and 120°C, and in practice there are indications that lower evaporation rates of water compared to solvent do not create a problem.

Panel 1: Typical transfer coating line



Note: Step 2, 3 and 4 can be repeated for multilayer coatings. With the exception of the leather industry, the draw-down technique is used in most coating industries. In this method, the liquid coating is poured onto a surface, then a bar is drawn across that surface to spread the coating. In transfer coating, the bar (or knife) is static and the surface (the release paper) moves under it.



Panel 2: Film formation and lamination of splits for steering-wheel leathers

1st coat:

Product	parts
Water based PU resin ⁽¹⁾	77.5
Pigment ⁽²⁾	8.0
Feel modifier ⁽³⁾	1.0
Flowing agent ⁽⁴⁾	0.5
Filler ⁽⁵⁾	10.0
Cross-linker ⁽⁶⁾	2.0
Viscosity agent ⁽⁷⁾	1.0
Total	100.0

Apply to paper (9 g/sf), dry 3 minutes at 90°C.

2nd coat (adhesion coat)

Product	parts
Water based PU resin	80.0
Pigment	10.0
Cross-linker	3.0
Penetrator ⁽⁸⁾	5.5
Viscosity agent	1.5
Total	100.0

Apply to paper (12 g/sf). Couple with split, laminate, dry for 5 minutes at 120°C.

Physical performance of finish

Test	Test condition	Test result
Wet rub fastness (Veslic)	1 kg load: change wet felt every 1000 cycles	Pass 12000 cycles
Ethanol rub fastness (Veslic)	1.5 kg load: change of felt every 50 cycles	Pass 2000 cycles
Tabor test	Wheel CS-10 and 1 kg load: resurfacing every 1000 cycles	Pass 7000 cycles
Hydrolysis	At 70°C and 95% RH for 7 days	No damage or change in color and appearance.

Advantages over conventional water-based finishing of leather

- Simple machinery set-up as the finish application can run in one continuous line.
- The surface texture is created by the release paper, and this eliminates the embossing operation.
- As the finish is applied dry to the leather, the finish does not penetrate into the surface, so grain swelling and firming are avoided.

- Fewer people are required than in conventional batch finishing process.
- The machinery costs less than for conventional finishing.
- Working capital is reduced as the process time is much faster - typically 15 minutes.
- Greater uniformity; supervision is mostly reduced to checking the thickness of the coats.
- No water is required and no wastewater is produced.
- Any waste is in solid form as coating film.

Advantages compared to a solvent-based transfer-coating process

- VOC emissions are potentially reduced from an average of 150 grammes per square-metre to less than 15 grammes per square-metre. This is well below many of the recommended limits.
- In the solvent-based transfer-coating systems, the solvent cannot diffuse completely from a drying film; therefore residues remain for a long time after production, so does the odour. This solvent contributes to the resilience of the final product, but in some examples, after the final loss of this solvent the film becomes brittle and may even crack.
- The working area is safer, and no extra installations or measures are needed to store and handle the chemicals, or address solvent vapours.
- A more natural appearance of the finished article can be achieved.

Challenges for the Hydro PU coating technology

Care must be taken to ensure a level and uniform coating film. One critical parameter is the adhesion, as the coat has to be adjusted to suit its absorption into the surface of the substrate. Also, there are restrictions as it is difficult to operate with very thin films, so it is not possible to make aniline-type or naked effects. And care is needed when placing the leather onto the film, otherwise there can be a high level of film waste. It is noted that the maximum width of release papers available at this time is approximately two metres, so this does not allow the coating of full hides.

Coating splits for steering-wheels

One of the important advantages of this system is the high physical performance of the products. Steering-wheel leather requires specific physical properties because of the challenging end use. Moreover, the size of the components is small, and a split could be considered suitable material for such a product.

Conventional split finishing is not an easy task because of the high level of finish penetration, hence high material usage. In general, one needs more than 30-33 grammes of products (with 30%-35% solids) to be applied for each square-foot of split to achieve good results. In Hydro PU Coating process this number can be reduced to as low as 24 grammes per square-foot.

In this process, after the transfer of the film to the splits and separation, the finishing is mainly complete. Typical formulations used to create the film and the physical test results from this procedure are given in *Panel 2*.

If for any reason the gloss does not match the target, a third spray coat (as a regular automotive top coat) can be applied on transfer-coated splits (3 grammes per square-foot wet), then dried at 100°C for two or three minutes.



Panel 3: Film formation and lamination of crust leather for shoe uppers

1st coat:

Product	Parts
Water based PU resin	50.0
Water based compact binder ⁽⁹⁾	30.0
Pigment	15.0
Feel modifier	2.0
Cross-linker	2.0
Viscosity agent	1.0
Total	100.0

Apply to paper (10 g/sf), dry 3 minutes at 90°C.

2nd coat (adhesion coat)

Product	Parts
Water based PU resin	60.0
Water based acrylic resin ⁽¹⁰⁾	35.0
Cross-linker	4.0
Viscosity agent	1.0
Total	100.0

Apply on paper (10 g/sf). Couple to leather and dry 5 minutes at 120°C.

Coating of low-quality leather for shoe

Transfer coating is well suited to cover small surface defects, and a typical formulation used to create the film for shoe uppers is given at *Panel 3*.

The recipe for this fully pigmented article is very simple. However, by choosing the appropriate handle modifier and resin in the first and second coats a considerable range of softness and handle can be achieved. For fashionable articles, more film layers may be needed to gain a specific effect.

Summary

Transfer-coating technology has been mainly used for coating split leather with solvent-based PU systems. However, modern water-based PU transfer coating offers new possibilities for upgrading low-grade leather, dramatically reducing hazardous solvents and decreasing VOCs. This technology can be used for providing a finishing coat for high-performance leathers and fashionable articles with various effects. It provides an interesting alternative for the upgrading of low-grade leather. ☉

Legend:

- (1) PeVit XPU series
- (2) Roda lite 07 pigments
- (3) PeVit XMF 5495
- (4) PeVit XMF 5493
- (5) PeVit XMF 5498
- (6) PeVit XCL series
- (7) PeVit XVS 5491
- (8) PeVit XPU 5451
- (9) PeVit XCB series
- (10) PeVit XAC series.

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