



ALL CREDITS: UPACO

Adhesive films

Adhesives for sole attaching have been a key component in shoe manufacture ever since the 1940s when the cemented process first became viable using cellulose adhesives. Initially, it was restricted to ladies dress shoes with leather soles where bond stresses were relatively low. The 1950s saw the introduction of neoprene adhesives which were able to bond a much wider range of materials resulting in the process becoming a major construction worldwide that could be used to produce an ever greater variety of footwear.

The introduction of PU adhesives in the 1960s further extended the range of soling materials that could be used and, at the same time, improved bond strength and consistency. More recently, we have seen a move from solvent- to water-based adhesives to prevent environmental damage from

the release of VOCs (volatile organic compounds) and improve working conditions generally for factory employees. However, while the chemistry of footwear adhesives has made tremendous advances, the way in which they are applied in the factory in many cases remains much the same.

While many operations in the shoe making process have been streamlined and simplified, it still remains relatively complex and labour intensive. In the days of comparatively low wages this did not matter too much but, as these have risen dramatically for low cost Asian producers in particular, there is now a concerted effort to eliminate as much labour content as possible. This is difficult to achieve with 'wet' adhesives in the sole attaching process as the number of operations involved cannot be physically reduced and the only way labour content can be lessened is by the use of expensive robots.

One alternative that is being pursued is hot-melt adhesives which does reduce the number of operations as the adhesive is only applied to one surface (see article by INESCOP Spanish Footwear Technology Institute elsewhere in this issue of *World Footwear*). Although effective in a number of footwear applications, sole attaching still requires further research and development. There is also a further option, however, one that has proven technology but does not seem to attract as much attention as it might: adhesive films.

LISTENING TO CUSTOMERS

UPACO, a division of Worthen Industries, has been producing adhesives in the US for 150 years and covering a variety of industries, so it has an extensive knowledge and experience base. In the late 1990s, the company began to receive feedback

from customers in the footwear industry that they were becoming increasingly frustrated by the existing process of sole attachment using wet adhesive systems but, at the time, could find no safe and effective alternatives. The company took due note and looked for a possible solution.

John Slattery, senior technical manager at UPACO, says that, "We first began by imagining how to simply streamline the process by creating a film that would become a part of the sole. Originally this was for polyurethane poured or injected soles that allowed us to consider the end product as one unit rather than a variety of pieces that needed to be washed, primed, trimmed, heated and so on." After much development work and testing, a second film, EcoBond Film 2609 for co-moulding rubber outsoles to EVA midsoles was patented and brought to market.

UPACO says the film is totally emission-free, safe to store, non-flammable, does not create hazardous waste or empty container disposal problems, can be reground and is operator friendly. As regards performance, the company claims adhesion properties equal to or better than those normally seen with traditional wet adhesives, with the film having a consistently uniform profile and an indefinite shelf-life. It is supplied in either wide rolls or slit to narrow widths to assist sizing and minimise waste which can of course be reground as mentioned. However, initial customer reaction was far from positive, as EcoBond was more expensive to buy than traditional adhesives.

As Slattery says, "It was up to us to demonstrate that cost-savings would be significant when you took into consideration all the labour, waste, energy and material involved in the manufacturing process. We had to encourage customers to think about the entire cost of production. It required a great deal of modelling and energy audits on our part to gather the data." That he was correct can be demonstrated by the fact that although initially developed for in-mould application to PU soles, the EcoBond concept has since expanded to become applicable to a wide range of footwear materials and constructions.



Adhesion properties of EcoBond are claimed to be equal to or better than those seen with traditional wet adhesives.

CO-MOULDING

In the co-moulding process, the outsole rubber sheet and EcoBond film are die-cut to shape and the two are then moulded together with the film's protective release liner uppermost for five minutes at 160°C and at a mould pressure in excess of 100kgs to produce the outsole. The mould is opened, the release liner removed and any flash trimmed off. The outsole is then placed in a second mould with the film side uppermost, the EVA midsole blank is placed on top and the two are moulded together for ten minutes at the same settings as before. The finished sole unit is then allowed to cool before storage or use.

UPACO offers the following cost values per pair of soles produced in this way compared to using a wet adhesive system to demonstrate that it really does offer the savings it claims.

EcoBond	
Film	USD 0.20-0.25.
Labour	USD 0.05-0.10.
Total	USD 0.25-0.30.
Wet-adhesive	
Degreasing, cleaner, primer, adhesive	USD 0.20-0.25.
Labour depending on sole design	USD 0.20-0.40.
Total	USD 0.45-0.65

ECOBOND 2603(B)

This is a tri-layer thermoplastic film, one side of which has good adhesion to EVA, CPE, hypalon SBR and other rubbers when combined at or above 125°C. The other will bond well to PVC, PU, leathers and synthetics pre-cemented with PU adhesive and pre-primed/PU cemented EVA. There is a release liner on this side. The middle layer is a tie-layer which holds the outer two together. The film is again die-cut to shape and then placed on the sole thermoplastic side down and with the release liner on top. Heat of 125°C is applied either by a hot iron or press for a minimum of 10 seconds under as much pressure as possible to ensure complete contact and adequate time for the film to flow against and bond to the sole.

Alternatively, when a contoured or cupped rubber sole is involved, this can be partially vulcanised in the mould which is then opened and the film pressed and smoothed down to the sole. The mould is closed for at least three minutes after which it can be removed and allowed to cool down. Best results are seen when the bonded film is allowed to sit undisturbed for at least 24 hours but no more than a maximum of four weeks before use. For sole attaching, the release liner is peeled off and the film heat



Outsole moulded to midsole with actual outsole and film showing underneath.

reactivated at 48-57°C before locating and pressing it to the lasted upper.

Based on the success UPACO has enjoyed with its EcoBond films—they have been used for military boots for a number of years and that is as tough a quality test as you will find—adhesive films for soling purposes can clearly be made to work well and, apparently, be cost effective. However, they do suit large standardised production runs and certain types of construction more than others. For instance, they cannot be used in either direct moulded footwear or with leather soles and would not be flexible enough for small batch fashion producers. However, that still leaves a large number of applications where they can and, from an environmental point of view, they also have much to commend them.

ADHESIVES FILMS. FOR UPPERS

The actual assembly of the main upper sections for all conventionally produced footwear has always been made using sewn seams as this is both a strong and flexible method that is easily adapted to any style, construction or production volume. As things currently stand, this seems unlikely to change for the foreseeable future. Adhesives have nevertheless always been employed in various ways in the production of uppers,

mostly for laminating backers and linings where wet adhesives such as latex initially predominated followed by hot melt coatings and films once these became widely available.

There are also some decorative functions on the upper that, subject to the materials involved, can be performed using this type of adhesive system. This has been made possible by the development of more advanced polymers. UPACO has again been able to draw on its extensive industrial adhesive knowledge to develop a range of films which it markets under the Stitchless name, that are formulated to perform with different materials in a variety of ways to achieve the high bond strengths required. These films are made with different polymers and thicknesses for multiple substrates and applications such as heat pressing, RF welding and roller laminating. They are said to offer a soft hand, excellent bonding, UV stability and easy application. They can be used with TPU and on synthetic upper materials including fabrics and mesh.

Naturally, there are limitations to using adhesive films and material selection is important. For instance, weak upper materials are to be avoided as bonding can become a problem due to material tear. Genuine leather is also not recommended

without suitable priming to achieve a sufficient level of bonding, something that can be difficult to achieve with the required degree of accuracy. Big open meshes require too thick a film which can result in squeeze out and toe areas should be avoided as upper steaming and toe lasting may activate the film and impair bonding. UPACO offers a number of films to cover most situations.

F333 is a thermoplastic PU film designed to bond to a variety of fabrics, synthetic upper materials, vinyl, urethane and polyester surfaces. It can be heat activated at 100-150°C to form a strong bond which in many applications can replace stitching.

F375 is film designed for fabric, non-woven, nylon or nylon meshes, touch and close fasteners, TPU, PU synthetic upper materials and others with no need for stitching at the bond line. It activates at low temperatures and has good hot tack and melt flow characteristics with a softer hand but higher activation than F333.

F1003/F1005 is a thermoplastic PU film supplied with a blue polyethylene release liner. This film may be heat reactivated at approximately 70°C for a one-way application. It can also be used as a barrier film and has been proven to hold hydrostatic pressures of four lbs for more than three minutes without leaking.

F339 is a thermoplastic film designed to be heat activated at 125°-150°C to bond a variety of substrates including natural and synthetic fabrics, EVA and other polyolefin materials. It can reduce or eliminate the need for water- or solvent-based and hot-melt adhesives for combining linings to uppers and socklining covers.

F2609 is a thermoplastic film supplied on a release liner. It has good adhesion to EVA, CPE, SBR and other rubbers when reactivated at or above 150°C.

F8618 is a co-extruded film designed for decoration on footwear. The adhesive layer has good adhesion to various substrates and the top layer has good abrasion and other characteristics.

Adhesive films are indeed a radically



Adhesive films have an indefinite shelf life which greatly simplifies transport and storage.

different bonding solution compared to wet and even hot-melt adhesive systems. They certainly have advantages as regards storage and transportation, something that is always a problem with many adhesives—particularly hazardous solvent-based products—which is why they have traditionally always tended to be produced locally to the market they served. Stable, long-life and non-hazardous films do not, and this opens up the possibility for these high tech products to be used anywhere.

Adhesive films are also clean to use and operator friendly which is increasingly important in a world where factory working conditions are coming under ever greater scrutiny from consumers and the media. They also appear to offer a high level of performance as witnessed by their proven use in military boots which is what every shoemaker ultimately wants and therefore could have a potentially significant role in the way we will produce footwear in the future. 🇹🇼

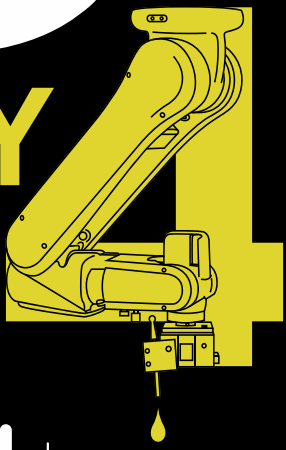




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