



DESMa Laser Processing Cell

CREDIT: DESMA

From roughing brush to laser

The first adhesives capable of successfully bonding a sole to the upper entirely on their own appeared in the 1940s and were based on nitrile or polychloroprene rubbers dissolved in solvents. The stuck-on construction, as it was named, really took off in the 1950s when it was found that polychloroprene adhesives could be heat reactivated some days after being applied and then bonded with short press times. This provided a high degree of flexibility as soles and sole units could be prepared in advance and stored ready for use.

One thing that became apparent from the very beginning was that good

bond strength also required careful preparation of both upper and sole. In the case of the latter, it was simple roughing with a rotating wire brush to remove loose fibres from the flesh side of leather soles and clean and increase the surface area on rubber ones. In the case of the upper, however, it involved removing the grain surface to expose the fibres of the corium to which the adhesive could anchor itself to and this was less straightforward.

The best bond is achieved when the grain is evenly removed over the entire lasted margin. Where it is not, there will be weak spots as the adhesive is unable to penetrate sufficiently to anchor properly; go too deep and

looser fibres that lie further down are exposed and offer a weaker anchorage for the adhesive. Different leathers also exhibit different fibre densities and strengths and, while this can be overcome through choice of upper leather, those variations will still occur to some degree depending from where on a hide the different upper components have been cut.

SIMPLE REVOLVING BRUSH

The favoured method was to use a revolving wire brush that was periodically sharpened using a carborundum stone with the brush rotation reversed. Hand roughing is still widely practised today but the machines

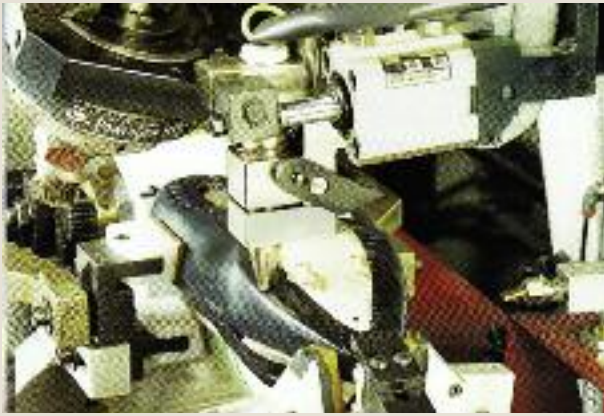


Fig 1 – “Self-learning” program on the CD1 uses an optic projector to trace and register the profile of the lasted bottom of the right foot of the medium size in the range.



Fig 2 – On the CD8 the right and left feet of every size must be traced in order to accurately delineate the roughing line on the side of the shoe.

CREDITS: MOLINA E BIANCHI

used now tend to have a narrow continuous abrasive band and are easier to control as they have less tendency to ‘grab’ the upper leather. Properly used by a skilled operator, they are able to provide excellent results. But there remains one big problem.

While at first glance this operation might appear to be simple and straightforward, it is not. The care and intense concentration required on the part of the operator in order to achieve a perfect result every time on different leathers and last shapes is extremely demanding. While not in the same skill category as forepart lasting, for example, a slip during roughing can nevertheless ruin an otherwise perfect shoe.

Roughing must follow the feather edge of the lasted upper accurately. Too far in and the sole will gape, moisture and dirt will penetrate and the bond weakened. Roughing over the edge will not only need extensive repairing later on—if indeed it can be repaired—but may also lead to the upper splitting in wear, especially if it is in the forepart of the shoe. Needless to say, the flatter and tighter the lasting, the easier roughing becomes. But, even so, achieving the right result calls for a careful touch, and the more so the lighter the upper material becomes.

Because of all this, upper roughing has never been a particularly popular job in shoe factories and finding people with the right level of ability who are prepared stand all day doing it has never been easy. As a result, maintaining consistent quality has always been a problem. Indeed,

maintaining the required level of concentration throughout an eight-hour shift is extremely hard for anyone. Interchanging two or more operators in the course of a shift is one answer, but they would have to be capable of multi-tasking and operator balance on the production line could also be affected.

USM POINTS THE WAY

The answer had to be a machine that could be programmed to rough the upper without any manual contact during the process; in other words, an automatic rougher. But how do you replicate all the various directional movements and adjustments needed to follow a three-dimensional shoe bottom? Not easy. An early example was patented by USM in America in 1982. This employed templates that guided two contra-rotating wire brushes, one for each side of the lasted margin on one shoe. It would do the right foot first and the template would then flip over for the left.

It worked well as far as following the feather edge was concerned in that the template could be shaped so as to rough to the edge or fractionally over for moulded footwear that tended to use thicker upper leathers. It was, however, difficult to find the right amount of pressure to consistently achieve the optimum depth of rough as the leather varied and the brushes were repeatedly sharpened. It was also necessary to have a template for each size of every last shape and, while this was acceptable for volume producers of moulded footwear, it was less so for producers of fashion and dress shoes.

Although many of the latter who tried it returned to traditional hand roughing, it did point the way to the future.

AUTOMATIC MACHINES

Today's automatic roughing machines are a far cry from that early machine. Although they mostly still use roughing brushes, the development of CAD/CAM and digital cameras has made possible refinements that the engineers at USM could not have dreamt possible. The modern automatic rougher has effectively de-skilled this key operation in the same way that the CAD revolution has with so many other aspects of today's footwear industry.

The program needed to control the various aspects of the roughing process is inevitably complex. Creating it, however, has become progressively easier and machines are now both simple and quick to program for different last shapes and designs. The CD1 and CD8 models from Molina e Bianchi S.p.A. of Italy are good examples. They are extremely versatile with the CD1 able to accommodate shoes or boots from size 18 to 52 and up to 110mm heel height and the CD8 to rough up the side of the shoe for side wall sole units. Both use an advanced ‘self-learning’ process to create programs for each last shape and design that then automatically control every function of the machine.

The self-learning system of the CD1 (Figure 1) uses an optic projector that progressively places itself automatically onto 64 points around the bottom of a right foot medium size lasted upper. The operator manually

locates the light from the projector on the profile that the roughing brush has to trace and confirms the point. Profiles for left and right feet of the total size range are then generated automatically. This takes only five to six minutes and also programs in the pressure of the brush, its angle and forward and rotational speeds at each point. Programming the frequency and degree of re-sharpening of the brush can also be done at the same time.

On the CD8 (Figure 2) the self-learning system goes a step further by adding a camera that can program roughing for side wall sole units by automatically reading and storing a profile drawn on the upper. If it is unable to read the traced line clearly because of other marks on the upper, the operator checks whether the camera is indicating an emergency sign and, if so, locates the cursor on the screen in the correct position. Unlike the CD1, both right and left feet of the medium size must be programmed separately and for every size in the range.

AUTOMATIC ROUGHING AND CEMENTING

But why stop at just roughing, why not also add cementing and perform both operations on a single machine? While this approach does not suit every factory, there are many where it does and there are several machines currently available.

The RZ series from Leibrock Maschinenfabrik GmbH of Germany demonstrates just what is possible with this type of machine. Programming is again straightforward and can be through a teach-in system or downloading the roughing and cementing contours from a disc. Grading for size is automatic

and programs for different last shapes can be selected by simply pushing a button. Good quality roughing is provided even on different material combinations as the rotation, downward pressure and forward speed of the brush as it follows the prescribed contour can all be individually adjusted as required. The inevitable change of brush diameter after automatic sharpening is balanced automatically.

The program also controls the cementing phase in a similar way so that a precise contour is followed and the amount of adhesive and application speed carefully regulated for the optimum result in terms of both accuracy and achieving maximum bond strength to the sole. Both solvent and water-based adhesives can be used and any harmful vapours are drawn off within the machine itself. The reason why this type of machine is a practical proposition lies in the fact that the two operations have so much in common.

The question is whether to go for a twin or single station machine. Leibrock offers both options depending on factory requirements. The RZ 20 is equipped with two shoe boxes for locking the shoe, allowing the two operations to be performed simultaneously. While the shoe in one shoe box is roughed, the shoe in the other box is cemented at the same time and vice versa. The RZ 10, on the other hand, is equipped with only one shoe box, where the operations of roughing and cementing are performed one after the other and with the shoe again locked in the box just the one time.

Machines of this type have not just replaced the demanding skills of the hand rougher but have greatly improved the quality and accuracy of the cementing operation. In addition, they are faster, do not require skilled operators and, indeed, if coupled with robots, relatively little human participation. The choice of automatic roughing or roughing and cementing machines now on the market covers just about every eventuality and it is hard to see how they could possibly be developed very much further. However, there is now an entirely different approach in the case of roughing: do away with the roughing brush altogether.

LASER ROUGHING

This is not a totally new idea and Italian company Brustia demonstrated a prototype machine at SIMAC in 2006. It created quite a stir at the time due to its speed and ability to rough to any depth without creating dust only where wanted on the upper. The latter aspect was attractive to sandal manufacturers but, at the time of writing, the machine is not available. The concept of laser roughing nevertheless has much to be said for it.

First and foremost, once the shoe bottom contour program has been set, a consistently flawless end result can be reproduced indefinitely regardless of design. A laser is practically frictionless so no re-alignment is needed during production. As no pressure is put on the upper, seams and changes in material have no effect on the roughing action and, in addition, any contour can be followed.

Another advantage is the individual processing of different materials in one upper. While a toecap made of tough leather must be processed intensively, areas of most types of synthetic material must be treated more carefully or not at all. Add to this a degree of precision down to within 0.1mm due to an extremely small beam width enables a laser to be precisely directed along the upper.



Leibrock RZ 20 automatic roughing and cementing machine.

CREDIT: LEIBROCK



DESMA laser cell in operation.

CREDIT: DESMA

LASER CELL

Speed is essential in industrial production today and a laser is able to process a large area in a short space of time; properly applied, this is where they can really score for roughing shoe uppers. Brustia's prototype was essentially an automatic roughing machine with the brush replaced by a laser, so the shoe was fixed while the laser moved. Its potential was therefore limited.

Klöckner DESMA GmbH of Germany did the reverse and, at its House Fair in 2008, demonstrated a prototype laser system where the laser remained fixed while the shoe moved through all dimensions. The Laser Cell as it is called has since been extensively tested on all types of footwear and upper materials and the first commercial units have now been delivered and are up and running.

Every part of the upper can in fact be reached so that, as well as preparing the shoe bottom for sole attaching, the upper itself can be decorated with writing, logos or other design elements. Thus special sample series for industrial customers, special editions and even personalised shoes all become possible in just one operation.

As remarked earlier, the laser does not 'rough' in the accepted sense, so seams pose no problem. As it also

operates at low energy, the actual stitching holding the seam together is not damaged, a factor unavoidable with roughing brushes however light the pressure involved. Maintenance is limited to cleaning the optical equipment and except for some ventilation only a small amount of air filtration is required, so roughing with a laser rougher is also energy saving.

User-friendliness is a key consideration nowadays and while one might expect laser technology to require specially trained operators, it is in many ways easier to program than a conventional automatic roughing machine. An integrated laser pointer is used to quickly sketch out the required contours for the shoe bottom and any additional upper treatments directly onto the upper. This allows the operator to clearly see not only contour points but also the entire contour itself and so avoids the need to make adjustments later on.

It is sometimes hard to remember that the stuck-on or cemented process has been with us for over 60 years. But

then again, while the basic principle remains the same, the adhesives and machinery available today bear little in common with those early days. While basic revolving wire brush or scouring band machines are still available in their original form, that simple technology has been progressively developed into the sophisticated automatic machines now used by many manufacturers.

Whichever way you look at it, however, they still rely on what is essentially 20th century technology in the form of a roughing brush or tool. Laser roughing, on the other hand, is a total break with the past and a truly 21st century technology that opens up all manner of new possibilities. And, unlike the simple machine of 60 years ago, it can achieve all this without the need for a high degree of human skill, concentration and stamina. 



Laser roughed shoe bottom.

CREDIT: ADIDAS