



Gruppo Dani Tannery, Italy PHOTO CREDIT: WTP

The changes in footwear manufacture have been matched by the changes that have occurred in the production of leather. Some of the developments are similar to both industries but others have been driven by far-reaching environmental legislation and stricter controls to safeguard the end consumer. These have been mainly directed at the production of leather and the benefits have been enjoyed by the footwear sector. The chemistry of leather production has had to be rethought, too: solvents have had to be avoided, new dye formulations were required and alternatives to long cherished methods had to be found.

The dominance of global brands and the demands they have made on their supply chain are all intertwined in the footwear story of the past 25 years. The ubiquitous white trainer must also take some of the credit: the quantities of white leather needed by some brands meant that tanners had to be capable of producing the finished material in different countries to the identical finished standard. Once delivered, even the tanner could not say whether the leather had been produced in South America or Asian.

Richard Daniels, World Leather's Technical Editor, considers the leather sector and how it has achieved greater uniformity and consistency.

Keeping up with the footwear manufacturer

When compared to what was available 25 years ago, today's leathers are superior in terms of consistency of appearance and performance, as well as the range of products on offer. This is because of steady advance in three major areas: control within leather making, rationalisation of manufacture, and technical leather development and improvements. It can be anticipated that the coming years will present further opportunities for change, with fresh thinking on the tannages and finishes used before the leather

1] Control within leather making

THE MICROPROCESSOR

25 years ago can be taken as the time that the most powerful tool that has ever been introduced to leather making became available. This was the microprocessor, and there are two areas of special significance.

MICROPROCESSORS IN PROCESS CONTROL

Computers were in use in the 1970s and 1980s, but as main frame computers these were expensive items. Accordingly



Wet blue hides in process in a modern tannery.

PHOTO CREDIT: WTP

their use was in areas that were of direct financial importance to the organisation – accountancy, and possibly sales forecasts as these were predictable in part from values of goods in the production chain.

But in the mid-1980s powerful desktop computers became available at a fraction of the cost of a mainframe. Although slow to operate by today's standards, these could be programmed using off-the-shelf spreadsheet programs that were easy to use. They were also robust, so it became possible to use these within the manufacturing environment. The outcome was an explosion of accurate and detailed information focused entirely upon manufacture.

Before then, instructions used at the point of manufacture for chemical processing and machine operations were mostly based on handwritten instructions. Master copies of these details at best were typewritten, but amendments – which were often frequent – were slow to update, and often actions within manufacture varied from the masters. The combination of microprocessor, basic spreadsheets and fast printers changed this situation. Every chemical process was set down in detail, with chemical additions calculated for each load, controls identified, machine operations defined, and amendments when required were clear and immediately available to operatives.

This ability to control events resulted

in greater consistency almost as soon as these systems were brought into operation. Variations and causes became easier to identify, so the process could be better managed and upgraded. It was only a small step to include costing in terms of materials used in process, labour and allocated overheads for each operation. Technical manufacture became more transparent and the outcome was more consistent leather.

MICROPROCESSORS IN MECHANICAL OPERATIONS

Micro-computer applications within machine systems started at the same time, with the first examples found in water supply systems. Instead of deliveries based on hand-controlled additions of water, a simple push button system provided water at high rate, at the required temperature and volume to any processing vessel. The accuracy of these deliveries was critical, especially in terms of temperature control, so these systems rapidly incorporated both the monitoring of water delivery, and adjustment, so that water was only acceptable within a defined range of variance. Once established, it became clear that other chemicals in solution could be added to processing, and so the possibilities of very accurate weighing, addition and mixing of chemicals in wet processing and the finishing department became possible.

Similarly, the concept of using

microprocessors to manage machine settings and to make continuous adjustments within an operation began to evolve. This was especially significant in the control of the splitting operation, being the most difficult and skilled operation in leather processing, but became available to all new machinery and equipment used within the tannery.

QUALITY CONTROL SYSTEMS

Comprehensive quality assurance systems were beginning to appear 25 years ago. Originally introduced as Quality Assurance systems for the procurement of leathers for military use in the 1960s, these were followed by British Standards in the early 1980s, then ISO Standards.

Organisations that sought accreditation to these awards subjected themselves to a detailed self assessment. This started at the point of materials purchased and followed manufacture to the point of dispatch. It required proof in the form of documentation that processes and operations were clearly specified, and that these events took place in the specified way. The systems defined and allocated responsibilities, demanded proof that actions set down were enacted, and tightened all disciplines within manufacture.

2] Rationalisation of manufacture

The mode of leather manufacture also began to change. It became very clear that greater product consistency was required, and that manufacturing plants needed to become more efficient across the board to satisfy their customers. This caused rationalisation, with a rapid shift away from a labour intensive industry, coupled with a movement from small batch production towards larger batches, with faster rationalised movement of goods.

LARGER BATCHES OF GOODS IN PROCESSING

The processing vessel used for chemical processing is central to leather manufacture. Many different types of vessels have been investigated, but the traditional wooden drum, with versions in stainless steel and polypropylene, have

remained central to manufacture. However, there have been considerable refinements to these vessels, and the services to these vessels, that have made leather manufacture more consistent.

Drums became larger and more sophisticated. In part this was because it was easier to manage fewer, larger vessels technically, but also because of an increased efficiency in handling bulk loads and services. This was not just because of the availability of good support equipment – forklift trucks, conveyors and manipulators – but because of improved work areas demanded by the handling equipment that enabled the fast movement of goods.

This increase in size impacted on drum design. The internal structures of these vessels changed to enable better mixing of chemicals, and faster and more complete removal of water after each processing stage. A better understanding developed for applying forces more sympathetically to leather within chemical process. The speed of rotation was reduced and ordinary shelves were replaced by mixtures of shelves and pegs, and a shift towards longer and deeper shelves. This rationalisation was another significant step towards uniformity.

MACHINE LINKAGES

As processes became better controlled, with larger batches of goods available for subsequent operations at predictable times, it became possible to link clusters of machinery together using basic conveyor systems. Examples were quickly established where pieces were delivered individually by track systems into fleshing machines, onto a conveyor for trimming, then to the lime splitting operation. This could be followed by the weighing of each individual piece to gain an accurate load weight, then delivery to the designated processing vessel.

Water removal after tanning changed from essentially mangling machines to through-feed samm/setting machines that stretched the leather flat then offered the leather to belt presses to gently press water from the hide structure. Through-feed operations are ideal for conveyor linkages, so rationalisation was possible between samm/setting after tannage, quality



Ensuring standards: checking tensile strength.

PHOTO CREDIT: WTP

assessment, area and thickness measurement +/- splitting operations.

In drying areas, linkages were made between samm/setting machines and vacuum driers, with transfer onto pole conveyor systems for gentle slow final drying stage under ambient conditions. Similarly linkages within finishing areas where feed-through machines in the form of spray machines and roller coaters followed by drying cells could be further rationalised. All of these combinations ensured better control: events changed from the batch processing with their inevitable delays, to a smoother and more consistent movement where the outcome became more assured.

THE SHIFT TO LARGER CAPACITY TANNERIES

This combination of improved management structures, control of processes, machine operations and movement of goods made other development both possible and desirable in many situations. It was clear that for a long term future considerable rationalisation was required, and this required new machinery and buildings to house this equipment. The larger the units, then the greater the potential of more professional management structures, the highest quality sales and marketing, and improved cost effectiveness in terms of direct and indirect labour charges. Technical matters such as

treatment of liquid and solid waste and energy could be tackled more effectively when a greenfield approach was possible; a new operation had advantages in avoiding the many health and safety issues stemming from older plant and machinery.

New tanneries came into existence. Many of these were in areas that were expanding industrially, driven by the shift towards globalisation and by entrepreneurship within those regions. These tanneries were larger and more efficient, and led to the demise of smaller less efficient companies.

The tanneries that survived were more professional. The larger tanneries were capable of change and recognised new opportunities. The smaller units provided special services or products, that is, they were more aligned to bespoke requirements.

MEETING THE SAME STANDARDS

These advances in better management systems, technical control, and plant and equipment enabled goals to be met professionally in terms of customer specifications and reliability of delivery. It also meant that production parameters could be replicated across several tanneries. In other words, it was possible to provide a customer with leathers from different manufacturing sources that would meet specification. Tanners could meet the needs of highly organised footwear manufacture and retail demands.

3] Technical leather development and improvements

Developments and improvements occurred across the whole spectrum of leather manufacture for a variety of reasons. Inevitably, advances in control and production systems led to greater leather consistency. As the cause of variations that previously existed was largely eliminated, faults that occurred in production could be more readily identified and rectified. This was not just a case of correcting a problem — it meant that the cause of the problem could be identified and eliminated. The role of the senior technician changed from a largely “fire fighting” role to the management and operation of well designed systems that avoided problems and variation. And, from the more secure and consistent base that was developed, the scope for product development and refinements became possible.

THE ENVIRONMENT

Increasing environmental awareness, largely driven by mandatory limits for discharge of liquid effluents and charges based on volume and composition was also a driver of innovation and improved efficiency. It was soon recognised if pollution was reduced at source by better chemical processing, there was both a saving in materials consumed and a reduction in waste that required treatment.

But a more efficient process not only demanded a scrutiny of chemical processing, but also a more uniform substrate from machine operations, better chemical processing equipment, and better process management.

In post tanning stages, many tanners changed to systems where the hair was removed intact instead of dissolved. Replacement products were found or developed for substances that were considered hazardous or difficult to treat. Best available technology was employed and tanning processes became more efficient. All caused a further rationalisation of processes and tightened control.

WATER RESISTANT LEATHERS

The development of water resistant leathers was driven by the military needs to maintain armed forces in effective combat condition in wet

conditions. Many attempts were made to produce footwear that not only kept feet dry, but also minimised any increase in weight from water absorbed to avoid fatigue, and retained a high level of water vapour permeability. The comfort demanded was similar to normal footwear comfort, and the properties needed to be longlasting and reliable.

These aspirations only became possible with the development of specialised fatliquoring products from the chemical sector. These enabled military demands to be met technically, but also met good quality aesthetic standards.

This was not a simple case of modification of an existing process by the addition of a product: many technical requirements were needed at earlier stages of manufacture, and for reliable performance there was little room for error. The need for attention to detail and control was emphasised and raised to higher levels.

Considerable advances had also occurred in the automotive sector that indirectly influenced footwear leather manufacture. In this situation, a traditional material, originally based on the needs for furniture leather, needed to match the performance of

synthetic materials. This caused a massive shift in the manufacture of automotive leathers to meet demands based on engineering specifications.

New test methods demanded by the automotive sector ensured that the product would survive harsh conditions that might be experienced throughout the lifetime of the vehicle. This demanded very significant developments in physical performance, including ageing tests, and closely defined shape retention of components.

Driven by the demand for chrome free leathers by some automotive manufacturers, new products and techniques were developed. Also, a need to limit volatiles in enclosed spaces led to developments in formaldehyde free leathers, better removal of inherent fats associated with raw hides, and upgraded fatliquors to minimise volatiles that might cause fogging effects.

All of these demands have added to pressures on the chemical and finishing sectors to develop higher performance products that address the long-term demands of components within an extremely high value product. Many of these refinements have now found applications within footwear leather manufacture.



PHOTO CREDIT: MICAM

SOFTER AND MORE REFINED LEATHERS

In line with a demand for more natural leathers, new chemical products, suited to the demand for leather with more natural characteristics, became available in the 1980s. Polymeric agents, that could provide both filling of the leather, and at the same time a softer handle, proved to be a major advance in retanning systems. These products also enabled the creation of leathers that could maintain a tight break across the structure and suited the development of a more uniform grain texture when subjected to milling actions.

Improved fatliquors were also developed. These were partially to meet the needs of vacuum drying operations and avoid the migration of fats within the leather structure, but also to ensure lightness in handle when high percentage fatliquor offers were needed to provide softness. More recently, greater selectivity has become possible with retanning with the event of micro-spheres. Designed to penetrate the leather structure, heat application can cause these spheres to expand in-situ to a controlled degree. These have the potential to provide filling, and to increase the thicknesses and softness of leathers.

COMPATIBLE DYESTUFFS AND COLOUR CONTROL

There has been significant advance in the management of dyestuffs within the tannery. This first started with the introduction of ranges of dyestuffs that were compatible with each other. They exhibited similar rates of penetration into leather, exhausted from solution at similar rates, and provided similar colour fastness. The outcome was that with a relatively few dyes, a very broad range of colours could be provided. The often very varied stocks in tanneries were rationalised, and colour became more predictable.

This advantage was further enhanced by the use of systems where colour became measurable with great accuracy, causing less reliance on visual colour matching. Leathers were produced at the dye stage where it was possible to predict the final colour with reasonable accuracy batch after batch.

LIGHTER FINISHES

Greater colour uniformity within crust leathers led to radical changes within finishing. Unless a very high level of finish was required to cover surface defects, the need for high level of finish and pigments that were often required to correct colour diminished. Finishing became a much lighter operation, and it was possible for leathers to retain a softer and more natural feel and handle.

At the same time the properties of the finishing film improved: in general there was a shift from acrylic-based resins to more expensive but better performing polyurethane resins, or co-products that provided more defined properties. There was also pressure to replace solvent-based finishes, so better performing water-based and reactive finishes came into wider use. It also became possible to apply lower quantities of finish to the leather due to improvements in roller coating developments.

THE UPGRADE OF INFERIOR MATERIALS

An advantage arising from these advances had led to a better use of raw materials once viewed as inferior. For

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example, the size of a calf skin is now far greater than years ago because both control and technology has improved. Calf-like characteristics that were limited to smaller skins can be developed in skins that are more mature.

Downgrading due to excessive growth in neck areas and drawn grain in belly parts – once a very common feature of upper leathers – has also diminished, and grain surfaces are flatter and better extended. These improvements are not just due to better chemical processing, but more to better equipment and improved control systems.

LOOKING IN THE CRYSTAL BALL

Plant, machinery and control systems are now very advanced and it may be that their development for practical purposes is mostly complete. There is also a massive choice of chemical products already in use that can create a vast range of effects, although the availability of some of these will change due to environmental pressures. Moreover, there are issues concerning sustainable manufacture, so new raw material sources will be explored and developed by chemical providers. Improvements will inevitably continue, but radical change is unlikely.

It may be that more natural products

become involved in leather manufacture. A trend that has already started is to find natural colouring materials as an alternative to synthetic dyestuffs. These include plant and root extracts, but also stains developed by bacteria. In this event, and probably in line with other natural fabrics, greater tolerance will be required in areas of light fastness and rub resistance. Developments will also occur throughout wet processing to produce cleaner pelts which should also provide a better base for dyeing and even less finishes.

Chromium based tannages have a long proven track record of both durability and safety in wear – now more than 100 years – nevertheless, these leathers are always under some form of scrutiny. It may be that leather manufacture consumes less than one percent of chromium extracted, that it is the seventh most common metal on the planet. But, due to often unbalanced confusion between chromium salts in the trivalent state as used in leather manufacture and the hexavalent state, a pressure for change exists.

Despite considerable research there is no practical alternative to chromium tanned leathers in regard to the ability to resist shrinkage under conditions of high temperature and moisture – conditions not actually required in footwear use. Important questions being raised are “do we need leathers that are far more durable and longlasting than other footwear components?” and “does the ability to be break down at the same time as the other components provide advantage?”

The focus is shifting towards tanning products and products that make quality leathers and comply with the objectives of sustainability. New systems are offering interesting opportunities, but to date none meet the perhaps over-engineered standards of chrome tanned leather.

It is certain that the success of leathers available in 25 years time will be driven by the needs of footwear manufacturers, but also by their willingness to change. A good question for footwear manufacturers is “do you really need this combination of high temperature /moisture resistance found in chromium based tannages within footwear manufacture?”



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