

The chemistry of leather manufacture is well-documented, and can be readily measured and controlled. But the way that forces are both applied and accepted by hides and skins are largely unseen and cannot be measured. Moreover, the outcome of these events is significant both within chemical processing and machine operations, and affects the whole progression of manufacture. When changes occur they are frequently not obvious, but the outcome is often beyond the scope of chemical or machine amendment.

This is a complex subject, but this new work sets out a structure where the better-known aspects of leather chemistry and machine processing operate. With roots within the physics and craft of leather making, it is hoped that technicians will find this series of interest and value.

*Designed to explore leather making from a rather different perspective, welcome to:
"Back to Basics: A framework for leather manufacture."*

Back to Basics: A Framework for Leather Manufacture

Richard Daniels and Walter Landmann

Introduction to the series

There is a considerable understanding of the chemistry of leather manufacture, from theoretical studies to practical applications. This is well-documented, and extends from the structure of collagen to the cutting edge of manufacture. However, the application of forces to hides and skins within the leather making process, the way that these forces are received, and the outcome of these interactions are a different matter.

The need for mechanical action within chemical processing is well-understood, so the role of these interactions is recognised as significant. Nevertheless, even within very precise formulations, the running times and speed of rotation of processing vessels are the only ways of acknowledging these factors. Similarly, within process formulations, the attention given to the state of the hide or skin at the point of presentation to a machine is only cursory.

Limits governing the chemical process

There are practical limits that govern the chemical processing of leather. This

becomes clear when creating a new type of leather using a formulation that has been provided. In this event, the characteristics of the in-house plant and machinery set limits within the process parameters. If the process succeeds, the chemistry has worked around the opportunities and restrictions imposed by the equipment available to the tanner. The leather technologist has taken the chemistry of processing and skillfully shaped it within the resources available. This is the true art of leather making.

The role of mechanical operations

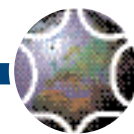
Consideration of the typical hide or skin throughout manufacture provides a clear insight into the role of mechanical operations in leather making. If the chemistry of leather manufacture is followed without the attendant mechanical operations, then the final product can be termed leather by the normal definitions of resistance to putrefaction and heat stability, however, not only will it be very irregular in substance, softness and handle, it will also be in a rounded animal shape, instead of

flat and uniform—it is technically leather, but practically useless!

The physical properties of hides and skins

As the raw hide progresses towards finished leather, the structure of the skin is modified, so the physical properties change. This can be observed stage-by-stage as the process advances.

Furthermore, throughout the whole chemical process, changes in conditions affect more than just the rate of the reaction. If, for example, there is an increase in temperature, there is an increase in softness, and changes in elasticity and plasticity. These factors affect the way that forces are received by hides and skins, and can be seen in the way that pieces flex, extend, and relax. In turn, this influences both the release of unwanted skin components and the rate of chemical penetration. Similarly in machine operations, the outcome is not just the result of machine settings. The physical properties of the piece also have to be taken into account. The outcome of an applied force is wholly dependent upon the way they are received by hides and skins.



A perspective limited by specialisation

The chemistry of leather making has received considerable attention, as have the role and features of machinery. However, the importance of forces applied to hides and skins within the chemical process and machine operations—and the way that they influence the outcome—has not been the subject of an encompassing overview.

These influences are viewed differently by the chemist, leather technologist, machine manufacturer, machine operative, maintenance engineer and the hands-on technician. All have considerable understanding within their areas of expertise, but their perspectives are quite different, and their overviews are seldom complete.

Change at a fundamental level

A comprehensive overview requires more than a consideration of the changing physical properties of pieces within chemical processing. The events that cause these changes at basic level—such as osmotic swelling, surface charge and temperature effects—require addressing. From this base the behaviour of pieces can be better understood as the chemical processes evolve.

Similarly, the behaviour of hides and skins in machine operations need careful study. Not only does this involve the way that a force is applied to a piece—that is the direction, load and dwell time of the force—but the way the force is received. This is not only dependent upon the fibre structure of the skin as modified by process. The temperature and moisture content of a given piece affect both the softness/hardness, and the balance between elasticity and plasticity. Clearly, if a single machine setting were used in an operation, changes in these important properties would significantly affect the outcome.

Presentation of the series

Although the series is in a concise Back to Basics format, the spread of subject matter demanding discussion is considerable. This has created a longer series than our previous publications; in order to make it more manageable for the reader, the material will be presented as a series of essays. Each is a comprehensive stand-alone study in its own right, but the series is structured so that each essay has a specific place within the framework. If placed in order the series will read as a book.

This latest in the Back to Basics series follows events through three areas of leather

making. The first essays address the way that the physical characteristics of hides and skins are developed, and their influence within the chemical process. The discussion then shifts to the way that wet-end machines apply force to pieces, how these are received, and the results of these interactions. The focus then shifts to taking leathers fully modified by wet-end procedures and machine operations through drying operations to the final leather state.

Supporting material

It becomes clear when following this series that many of the essays are a precis of subjects that deserve deeper consideration. Accordingly, it is our intent to publish new papers from experts to provide deeper insight into these areas.

Furthermore, it has been realised that some of these subjects have never been clearly developed in ways that are entirely useful to the tanner. An example can be found in the liming process.

Work began on “Back to Basics: A framework for leather manufacture” almost 18 months ago. However, it became apparent that although certain temperature-related effects within liming were known, the fundamental reasons were not clear. Since then three papers have been created that relate to the liming process. Respectively these have required practical trials and measurements, have drawn upon cutting edge research into the behaviour of the collagen backbone structure, and brought together important aspects presented by two different authors in the 1960s and 1980s.^[Legend]

In light of this improved understanding, the original essays covering the role of water within the skin and temperature-related effects have been rewritten. Longer-term it is intended to produce more papers on this important subject so that the different facets can be brought together in a clear and comprehensive manner.

The involvement of industry

This series has required a deeper subject understanding than provided by a single author with roots in leather manufacture. Engineering standpoints need consideration and, in particular, how these relate within machine operations—hence joint authorship. Furthermore, this series has required research into earlier publications and has taken into account the considered opinions of many people. This includes machine manufacturers, training organisations, practising leather

technicians and machine operatives. In other words, there has been a considerable involvement with industry.

Finally, it is hoped that the series is of use to the leather industry in general. The discussions are mainly technical, but there are very strong linkages with the craft aspects of leather manufacture. As such, these matters are neither taught in detail, nor the subject of presentations. The objective of this study is, therefore, to bring these matters together and provide a rationale.

To the new technician there is a considerable amount of information that would otherwise take a considerable time to acquire. To the experienced technician some issues raised may be useful. We remain hopeful.

Legend:

- *Observations: Temperature related relaxation within liming and other wet processes: R. Daniels, World Leather—August/September 2004, pp44–45.*
- *The glass transition temperature of leather and its implications to the leather industry: S. Jayapalina, British School of Leather Technology, University College Northampton, UK. World Leather—August/September 2004, pp47–49.*
- *The role of bound and free water in the liming process: Summary of investigations by Herfeld and associates, Lederinstitut Gerberschule Reutlingen, Germany and Bienkiewicz, Leather Research Institute, Lodz, Poland—World Leather, December/January 2004/5, pp23–25.*

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- *David Stratford*
- *Kevin McNamara*
- *Reginald Andrews*

The combined experience within leather manufacture of these three individuals is considerable—more than 100 years.

Work on the final third of the series has already started and once complete will be similarly subject to critical review. The complete series of essays is to be published in World Leather magazine. Furthermore, it is anticipated that the series will be available in book form when the final essay is complete. 