



# MODERN COW LEATHER PROCESSING – Version 1

Editor – Dr. Luis Zugno | Production sponsor – Halo Touch

**Collaborators:**

Vicky Addy, Rodolfo Ampuero, Ralph Arbeid, Giovanni Carpanese, Dr. Jurgen Christner (technical revision), Diego Cisco, Wilhelm Clas, Giovanni Cortez, Dr. Michael Costello, Volnei Durli, Riccardo Fabiani, Inge Flowers, Karl Flowers, Jean-Pierre Gualino, Rodrigo Henriquez, Vanderlei Horn, Rodger Maier, Gianni Maitan, Beverly McAuley, Dr. Mariano Mecenero, Dr. Campbell Page, David Peters, Eric Poles, Ernesto Pisoni, Simone Pucci, Jörg Rausch, Andreas Rhein, Federico Roth, Dr. James SanAntonio, Ian Scher, Dr. Wolfram Scholz, Kim Sena, Dr. Kerry Senior, Mehmet Sepici, Sirven Simon, Thomas Strebost, Simon Yarwood, ASSOMAC, ATC, Autenticae, BLC, Buckman, COINDU Automotive Interiors China, Conceria Dani, Durli Couros, GEMATA, GSC, Heller Leder, HUNI, ITALPROGETTI, JBS, Lanxess, Lectra, LHCA, Moore & Giles, PrimeAsia, Sepiciler Deri, SILVATEAM, STAHL, TANAC, TFL, Tyson, UK Leather, Young Il Leather Co., World Leather, W2O Environment



# INTRODUCTION

Since **pre-historic times** animal skins have been used for **protection against the elements**. The primitive preservation process was through smoking and drying. Later, vegetable extracts were used to **create the first leathers**.

**Leather making became one of the oldest known industries.** The earliest tanning recipe was created **around 700 BC**. Chemistry and tanning **processes have continued to evolve down through the generations**.





# TODAY SUSTAINABLE LEATHER IS PRODUCED

## for performance, fashion and luxury

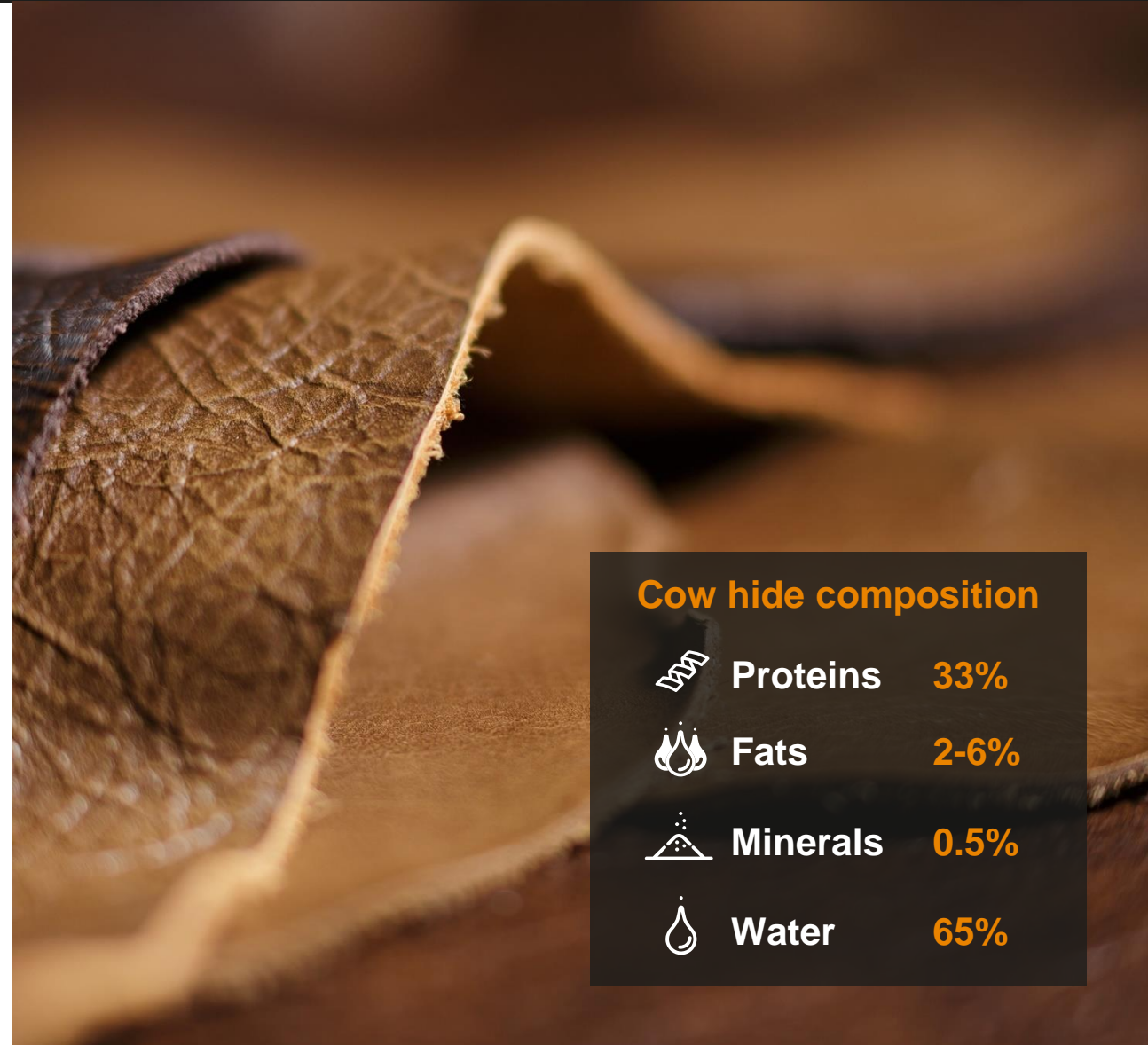
**Hides are a no-waste by-product of the food industry.** The leather industry uses the hides and skins produced by the meat industry, and only exists because of the meat industry.

**No meat = no leather**

**Hides are very complex organs composed mostly of proteins, fats, water and minerals.**

**The main proteins in a hide are:**

- **Collagen** – to be turned into leather
- **Keratins** – hair and epidermis, that are removed
- **Globular proteins** – removed



### Cow hide composition

	<b>Proteins</b>	<b>33%</b>
	<b>Fats</b>	<b>2-6%</b>
	<b>Minerals</b>	<b>0.5%</b>
	<b>Water</b>	<b>65%</b>

# DIFFERENCES BETWEEN hide, skin and leather

**HIDE + TANNING = LEATHER**  
**SKIN + TANNING = LEATHER**

**TANNING** is the chemical process that stabilizes the hide thermically, mechanically, chemically and microbiologically. Only a few chemicals have tanning properties. They are safe and non-toxic when used correctly.

**HIDES** are defined as skins of large animals. Eg, cows have hides, goats and sheep have skins

---

**SUN TANNING IS A DIFFERENT STORY**





# FROM HIDE TO LEATHER



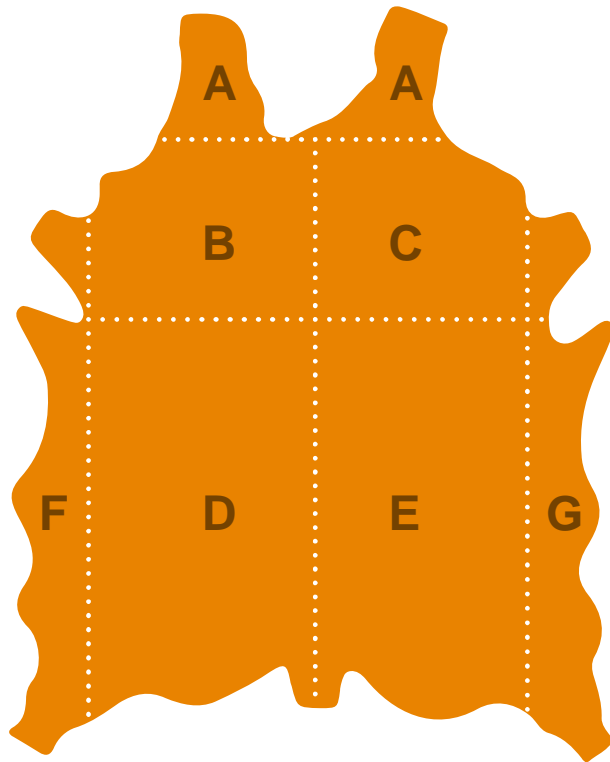
**Here is a cross section of salted hide** (bottom) that shows the **fat on the lower layer**, the **hide matrix in the middle** and the **hair on top layer** (this is the grain side).

After processing to remove the hair and the lower layer we have a thick piece of hide. The color is light gray and has a rubbery feel.

**The hide can be tanned with chromium, synthetic tanning agents or vegetable extracts.** In our illustration we see the full thickness of the hide compared to the size of a one cent coin.



# PARTS OF A HIDE AND TYPICAL DEFECTS



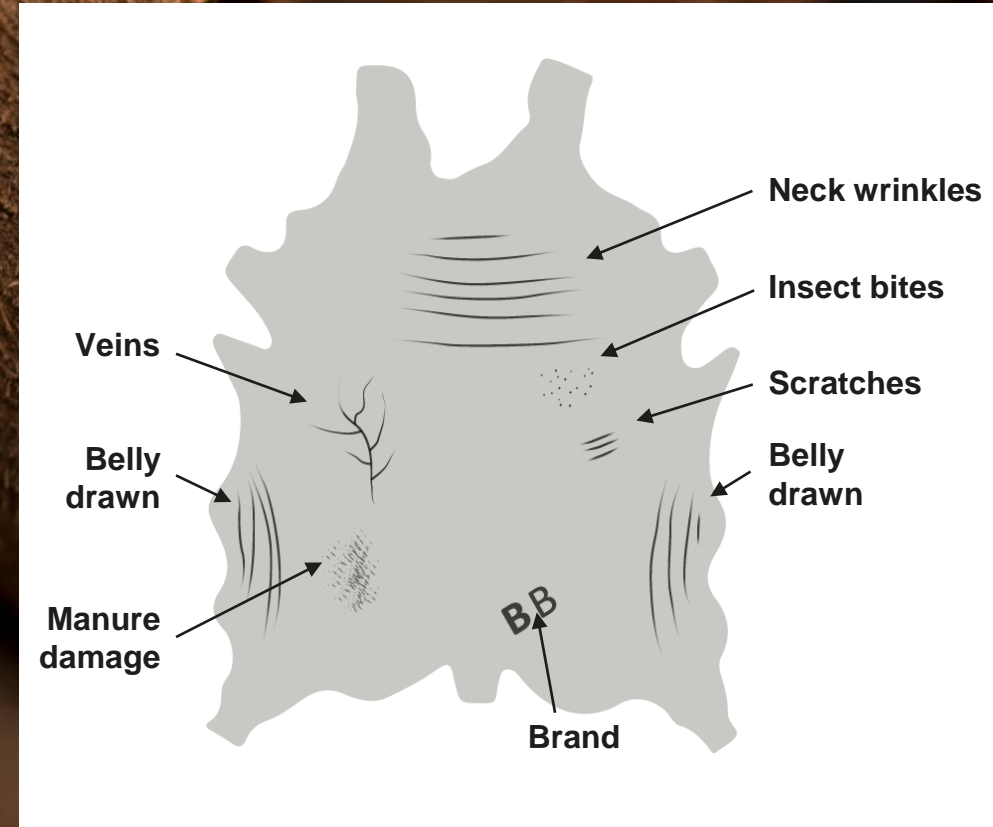
**Belly:** F and G

**Bend:** D and E

**Croupon:** D+E

**Side:** A,B,D and A,C,E

**Shoulder:** B+C





# TYPICAL NATURAL DEFECTS FOUND ON LEATHER

## BRANDS



## SCRATCHES



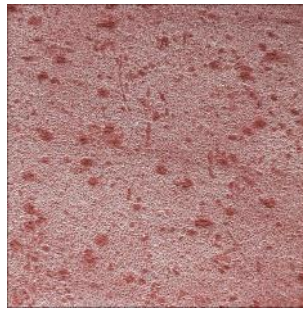
## VEINS



## WRINKLES



## PARASITES AND INSECT BITES





# A LOOK AT LEATHER'S STRUCTURE

## LEATHER GRAIN

Area from the surface to the bottom of the hair follicle. Fibers are fine and elastic on the top and get bigger and thicker going down. To get the required thickness, grain leathers usually contain part of the split

## LEATHER SPLIT

Area from the bottom of the hair follicle to the flesh side. Fibers are closely interwoven. Closer to the bottom, fibers get finer and sit parallel to the flesh side



## LEATHER TYPES

- full grain
- snuffed grain
- corrected grain
- nubuck

## LEATHER TYPES

- splits
- suede
- PU splits



# WHAT IS A TANNERY?

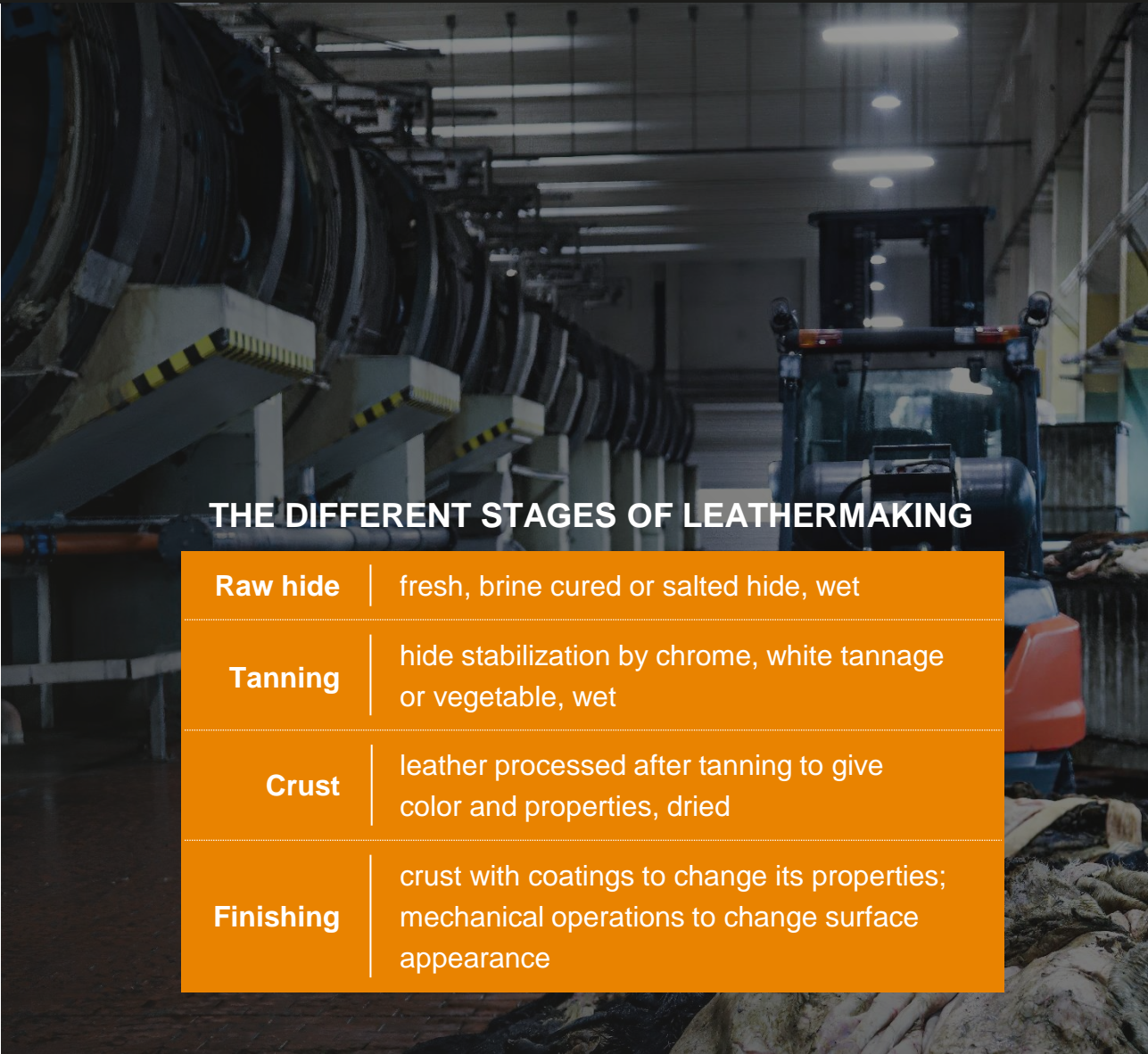
**Tanneries are leather processing units that comprise chemical and mechanical processes alongside waste treatment.**

**Tanneries can be classified by size**

- small:** up to 500 hides/day
- medium:** 500 to 2,000 hides/day
- large:** more than 2,000 hides/day

## Types of tannery

- Complete** | from raw to finishing
- Tanning** | from raw to tanning (also called blueing; can also be white tanning and vegetable)
- Wet End** | from tanned leather to crust (or to finishing)
- Finishing** | from crust to finishing

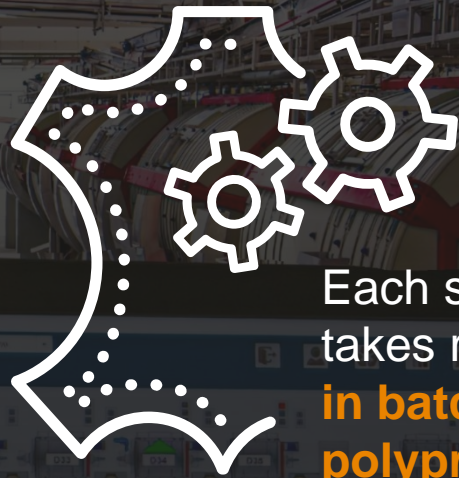


## THE DIFFERENT STAGES OF LEATHERMAKING

<b>Raw hide</b>	fresh, brine cured or salted hide, wet
<b>Tanning</b>	hide stabilization by chrome, white tannage or vegetable, wet
<b>Crust</b>	leather processed after tanning to give color and properties, dried
<b>Finishing</b>	crust with coatings to change its properties; mechanical operations to change surface appearance

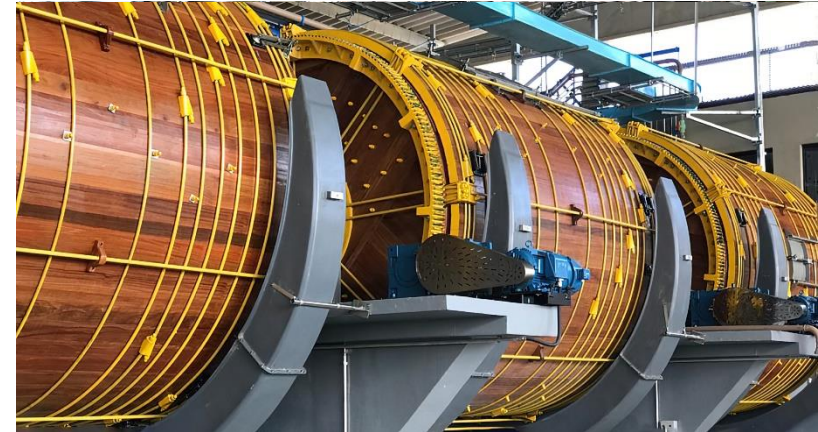


# MAIN PROCESSING EQUIPMENT



Each stage of the process that takes raw hide to crust is **done in batches. Wood and polypropylene drums** offer the mechanical action needed for the chemicals to react with the hides or leathers. **Mixers** ('Canbar®') can be used in the beamhouse

## DRUMS



## MIXER





# MAIN TYPES OF TANNAGE AND WHAT THEY DO



**Tannage is essential for stabilizing** the hides. After the first and main tannage the leathers can then be re-tanned with other chemicals **to change their properties**. Chrome leathers are commonly **re-tanned with vegetable extracts**

## VEGETABLE

---

This is the **oldest method of tanning**, dating back more than 2000 years. It uses **only natural plant extracts**. These leathers are **light brown in color** and dense, making them suitable for shoe uppers and soles, belts, handbags, watch bands, and leather goods. **They keep their shape very well** and age beautifully.

## CHROME

---

Was developed in the 1900s. **The process uses chrome (III) salts** and produces leathers of a blue color that **can be dyed to a range of other colors**. **Produces soft to medium temper leathers**. Can be used for a variety of articles from garments, upholstery, shoes, handbags, to other leather goods. It is the **most common tannage**, accounting for about 80% of leather produced. The intermediate product of the leather **is called 'wet blue'**.

## WHITE (chrome-free)

---

Most white tannage is made using a **synthetic product called glutaraldehyde**. It produces a leather that has a **light-yellow coloration**. This leather **needs to be processed further with other chemicals** like vegetable extracts, syntans, acrylics to give a **final level of finish and performance**.

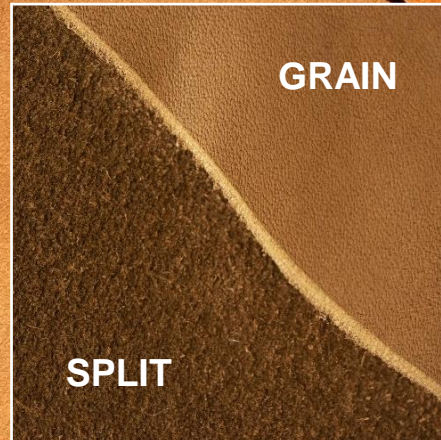


# DIFFERENT TANNAGE PROPERTIES

	CHROME	VEGETABLE	WET WHITE
<b>Color of the intermediate</b>	Blue	Light brown	Light yellow
<b>Lightfastness</b>	Excellent	Good/Fair	Good
<b>Temper (softness)</b>	Soft to medium	Medium to firm	Medium
<b>Print retention</b>	Poor	Excellent	Good
<b>Versatility</b>	Excellent	Good	Good
<b>Waterproofness</b>	Possible	Fair	Fair
<b>Elongation</b>	Good	Fair	Fair
<b>Mechanical properties</b>	Excellent	Excellent	Good
<b>Soil resistance</b>	Excellent	Good	Good
<b>Washability</b>	Yes	No	No



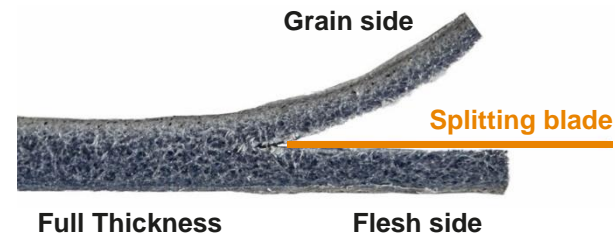
# HOW DO WE MAKE LEATHER SO THIN?



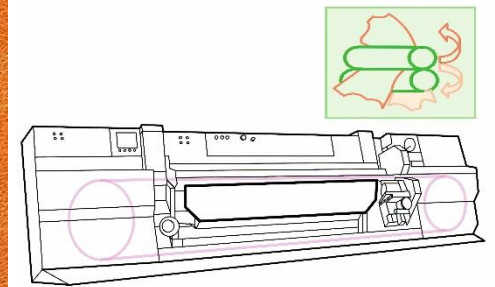
The hide (or leather) in the wet stage can be split horizontally after hair removal or tanning **by a large 'splitting machine'** making two uniform slices.

The **top side** is called '**grain side**' and the **bottom part** is called '**split**' or '**flesh side**'. The grain side is the most used, to make **full grain leathers**. The flesh side can be finished or used as **suede leather**.

Diagram of leather splitting



Splitting machine





# THE CHANGING APPEARANCE OF LEATHER

## as it goes through the wet end



### WASHING

**Cleans the tanned leather intermediate (wet white, wet blue),** uniformizes the moisture and pH, removes some natural fats and salts

### NEUTRALIZATION

Reduces the leather's acidity and prepares it for retanning: **1 to 3% of chemicals are added here.**  
  
Percentages are based on the shaved weight of the leather

### RETANNING

**A combination** of retanning chemicals is added to **transform the leather's properties.** Typically, 10 to 30% chemicals are added at this stage

### COLORING

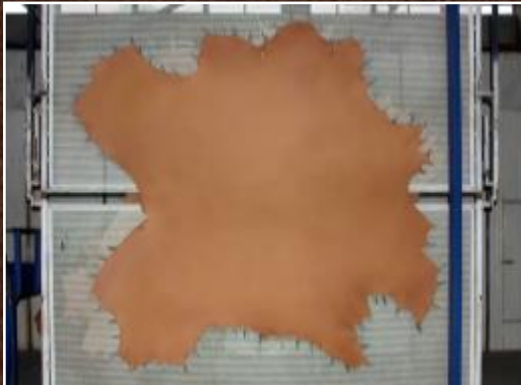
Dyes are used to **give color.** Usually a **mixture of dyes** is used to **give the color.** A typical amount is from 0.5 to 4%

### FATLIQUORING

Mixtures of **natural and/or synthetic oils and waxes** are added to **soften the leather.** Usually, the amount is between 6 and 20%



# TYPICAL LEATHER DRYING METHODS



## TOGGLE

Leather is hooked in a **perforated screen** that stretches to increase area. The screens are put on an oven for uniform drying



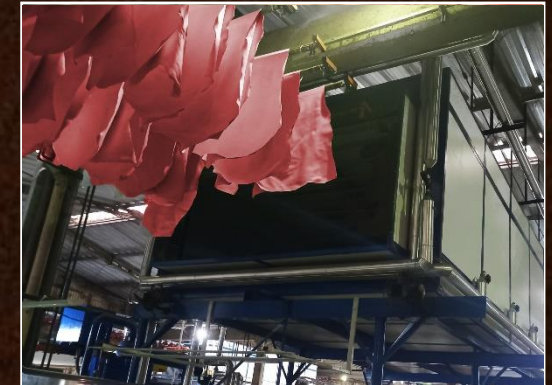
## AIR DRYING

Leathers are hung on moving **racks below** the tannery roof, providing the most natural form of drying



## VACUUM DRYER

Leather is stretched over a **hot plate** in a vacuum chamber and the water vapor is sucked out



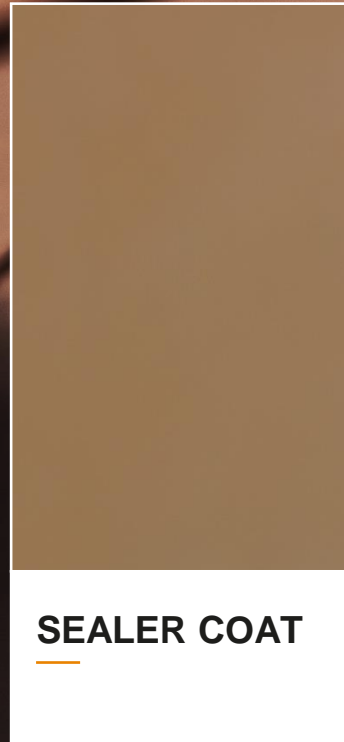
## OVEN DRYING

Leathers are hung up on **racks** as they are for air drying, and these racks go inside a hot air tunnel for forced – and quick – drying



# HOW DIFFERENT STAGES OF FINISHING APPEAR

from crust to topcoat





# TYPES OF FINISHES



## DIFFERENCE BETWEEN DYE AND PIGMENT

<p><b> Lorem </b> DYE</p> <p>(soluble in water or solvent, transparent)</p>	<p><b> Ipsum </b> PIGMENT</p> <p>(insoluble particles dispersed in water, non-transparent)</p>
---	--

## BASIC TYPES OF FINISHES (REPRESENTATION)

Lorem ipsum dolor sit amet, eu est lau

<p><b>Aniline</b></p> <ul style="list-style-type: none"> <li>- Transparent coat</li> </ul>	<p><b>Semi-aniline</b></p> <ul style="list-style-type: none"> <li>- Low pigment coat</li> <li>- Transparent coat</li> </ul>	<p><b>Semi-pigmented</b></p> <ul style="list-style-type: none"> <li>- Medium pigment coats</li> <li>- Transparent coat</li> </ul>	<p><b>Pigmented</b></p> <ul style="list-style-type: none"> <li>- Full pigment coats</li> <li>- Transparent coat</li> </ul>
--	---	---	--



# THE MAIN FINISHED LEATHER TYPES



## **ANILINE**

These leathers require the best grades and are the most expensive. They look very natural; dyes can be applied alone or with a transparent finish that may include oil and waxes. In the best examples all leather pores are visible. This leather type must not be sanded



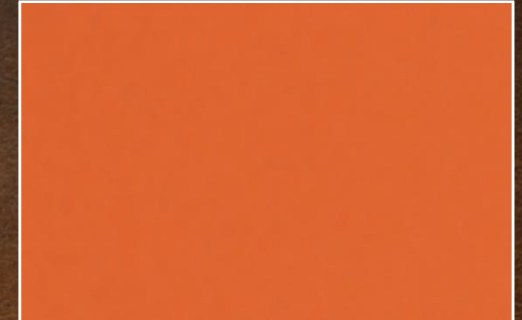
## **SEMI-ANILINE**

Small amounts of pigments are added to the coating, reducing the transparency and uniformizing the leather to improving the cutting yield. These leathers are still high value and can be used in very expensive leather articles. The leather pores are still visible



## **SEMI-PIGMENTED**

More pigments are added to the coatings to improve the uniformity. The leather pores are less visible, and quality is still high



## **PIGMENTED**

Additional pigment coats are applied to the leather and pores are not visible. Stamps can give effects to simulate pores or other textures. These leathers have much better cutting yield and are still valuable. Many automotive leathers come from this category

**Note:** Crust type and quality, thickness, finish and mechanical operations dictate the price of the finished product. All these types can produce outstanding quality, high value leathers



# EMBOSSING EFFECTS

– creating textures





# COLOR MANAGEMENT

## in the tannery

**Color is one of the most important parameters for leather**

**Standard swatches are made to be the color and article reference.**  
Color can be visually compared to the standard in a calibrated light source.



White light temperatures can be selected for proper visual color comparison on the light cabinet.



International color standards can be used as reference.





# COLOR MANAGEMENT

## in the tannery 2

**Color can also be measured by spectrophotometers** where color is measured and expressed in a color space, eg, CIELAB. This way the color can be measured and compared to the stored standard and transmitted and stored digitally

LAB SPECTROPHOTOMETER



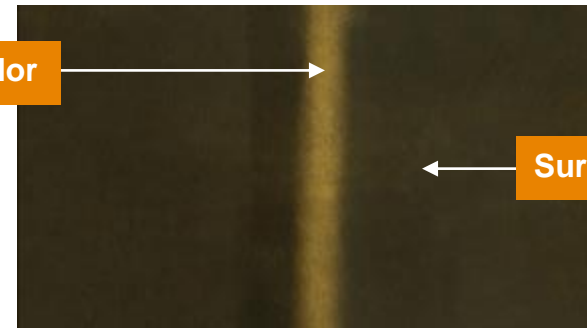
PORTABLE SPECTROPHOTOMETER  
FOR USE IN THE TANNERY



**PULL UP LEATHERS HAVE A DIFFERENT COLOR WHEN FOLDED (PULL UP COLOR). SURFACE AND PULL UP COLOR NEED TO MATCH**

Pull up color

Surface color





# LEATHER BIODEGRADABILITY

- **All leather is biodegradable/degradable.** For example, very few ancient Egyptian, Chinese, Indian, Greek and Mesopotamian leathers have survived from antiquity
- **The breakdown time varies** – with a commonly quoted time 0.05 to 45 years
- **Type and degree** of tannage, re-tannage, finish composition and thickness **affect leather's biodegradability**
- **The tannage order of biodegradability:** vegetable (least) < chromium < wet white < *chamois* (most biodegradable)
- **New biodegradability studies** are being carried out now and, in a few months, we will have more data





# TABLE OF ESTIMATED BIODEGRADABILITY\*

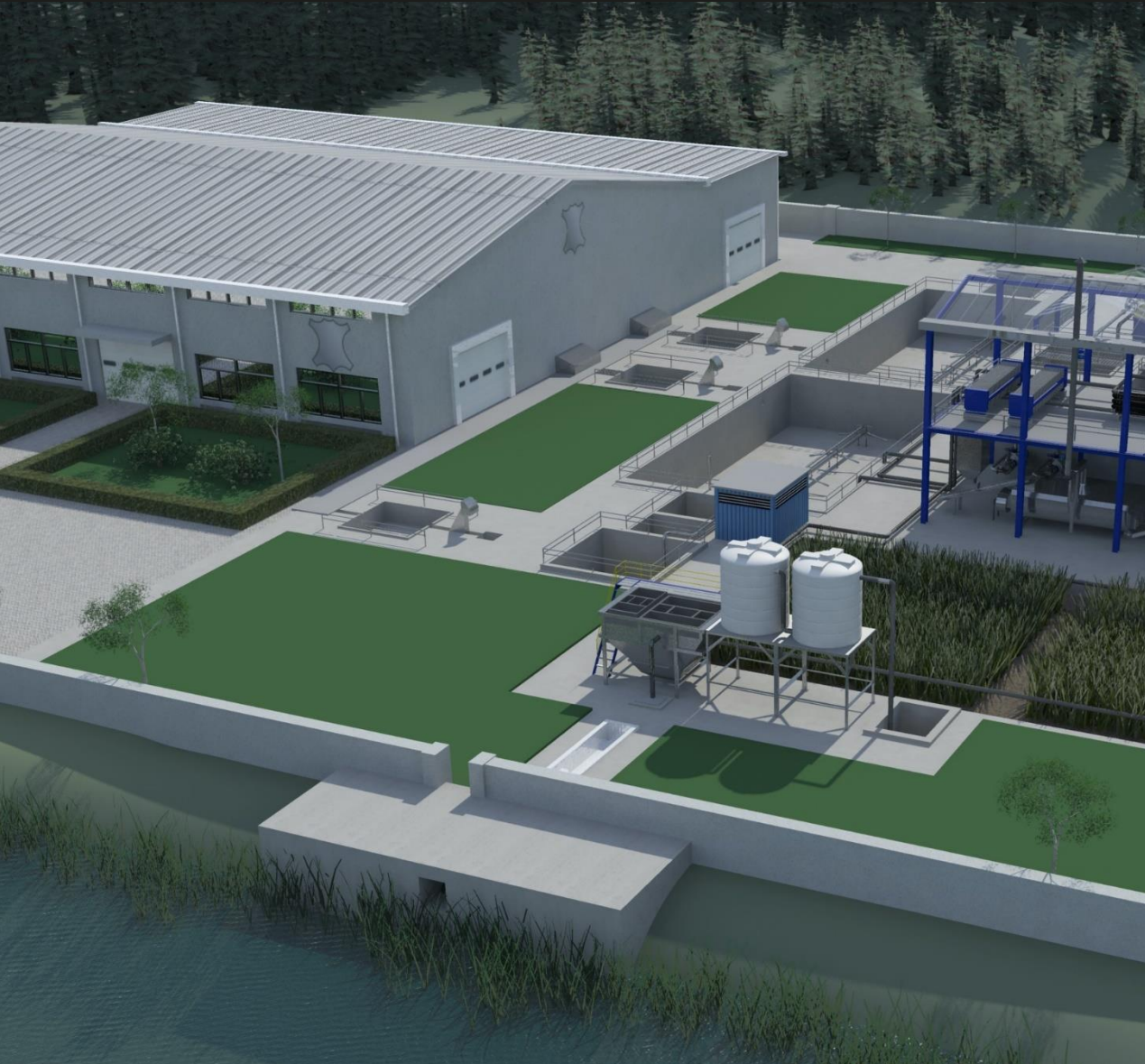
Material	Time in Years	Material	Time in Years
PVC	Forever	Acrylic	10 to 100
Polystyrene	+ 1,000	Leather	0.05 to 45
Polypropylene	+ 1,000	Paper	2 to 5 months
PE Low density	100 to 1,000	Cotton	1 to 5 months
Polycarbonate	100 to 500	Banana peel	10 days
Polyester and PU	20 to 200		

\* This is an estimate only. There are numerous variables in the materials and the conditions of biodegradability which are not directly comparable.





# BEST ENVIRONMENTAL PRACTICES for tannery effluent treatment



**Tannery wastewater is a complex mixture** of organic substances derived from the hide and organic and inorganic substances which are added during leather processing. The challenge for tanneries is to **reduce environmental impacts by:**

**improving**  
chemical uptake

**reducing**  
chemical and water use

**Increasing**  
efficiency  
of treatments

**recycling**  
process chemicals  
and water

**reducing**  
energy requirements

**reducing**  
emissions and  
sludge generation

**Tanneries worldwide are continuously improving their environmental performance** and are modernizing their effluent treatment plants to fulfil consumer demand, to achieve strict new norms and regulations and to continuously improve their environmental situation and sustainability.

Key current environmental technologies applied by tanneries are shown on the IUE webpage:

<https://iultcs.org/tannery-effluent-treatment-videos>



# LEATHER REPAIR AND REDRESSING

## **Repairability is one of leather's best qualities.**

Leather articles can be rejuvenated at home with the simple use of consumer polishes, stains, waxes and oils. Even waterproofness can be restored with consumer grade products. Professional repair work is available all over the world when any mechanical damage to a leather item needs doing. Here are some examples of before and after:

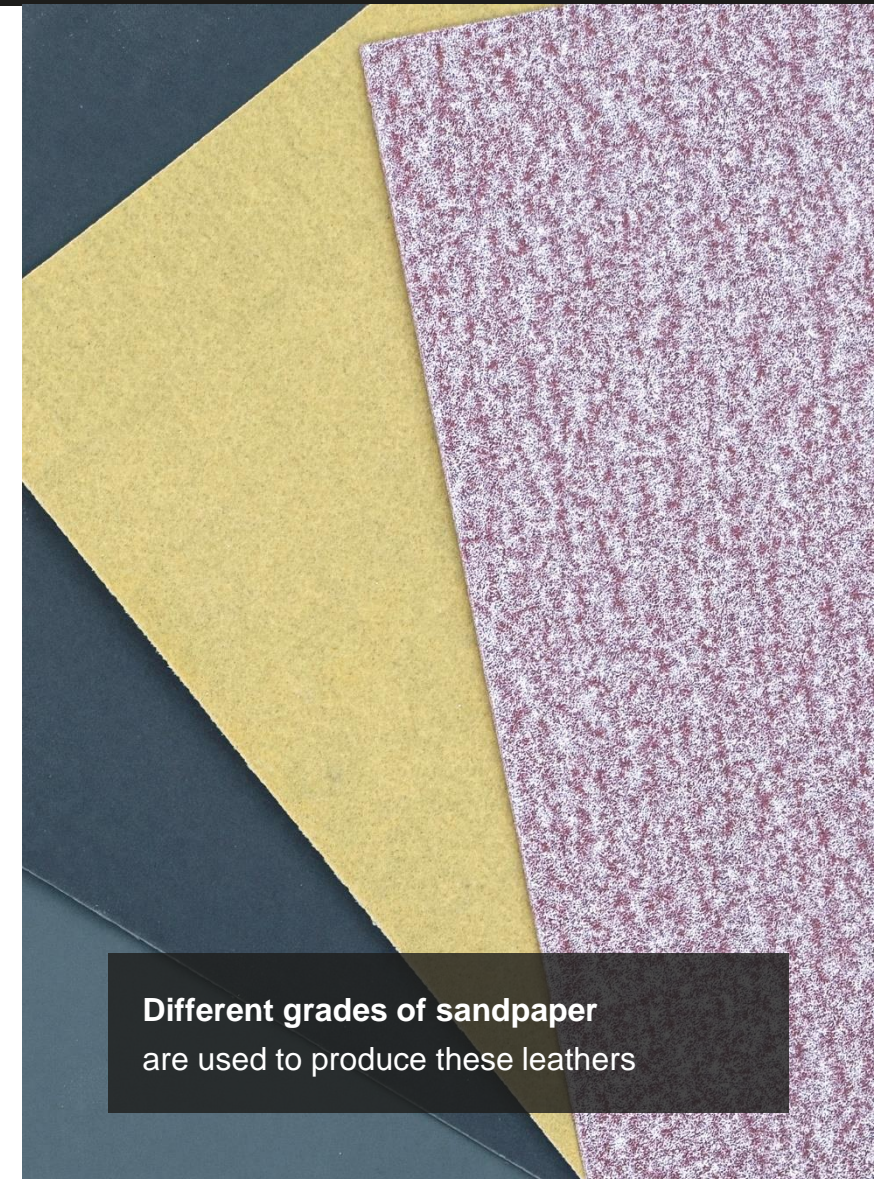




# MAIN TYPES OF LEATHER

<b>Full Grain</b>	Leather with the grain (surface) intact
<b>Snuffed Grain*</b>	Leather with light sanding on the surface to uniformize and reduce defects
<b>Corrected Grain*</b>	Leather with heavier sanding on the surface to reduce defects It can be finished, oiled/waxed or impregnated to make box leather
<b>Nubuck</b>	Type of corrected grain leather with deep coarse buffing that has no finish but can be oiled/waxed
<b>Split</b>	Leather from the lower split part of the leather, sanded Can be unfinished, finished or oiled/waxed
<b>Suede</b>	Leather from the lower split part of the leather, sanded, not finished Can have wax/oils or other superficial treatments
<b>PU Split</b>	Leather from the lower split part of the hide coated with a polyurethane (PU) film less than 0.15 mm thick

\* **Top Grain** leathers can have **Snuffed** or **Corrected Grain**



**Different grades of sandpaper**  
are used to produce these leathers





**THANK YOU** FOR YOUR ATTENTION