SWIM and Horizon 2020 Support Mechanism

Working for a Sustainable Mediterranean, Caring for our Future

Environmental Technologies and chemical substitutions in tanneries

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This Project is funded by the European Union

Best practices for the tanning sector

Some of the following material is the output of a project we did for a high-end fashion brand based in Florence, Italy, and well known at the global level.

We have revised some of the ***latest available technologies*** through desk research and in-site visits, where possible.

We collaborated with an international expert for the chemical part and enlisted a series of ***recommended chemical practices*** per tanning phase.

Part 1 will be devoted to tanning technology

Part 2 will be dedicated to tanning chemical recommended practices

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Part 1. Tanning Technology

a. Automated chemical dispenser
b. Light weight drums
c. High precision spraying technology:
    I. Scan bar to detect the shape of the leather cut
    II. Controller with laser pointer and HD cameras for spray cabins
d. High precision guns
e. Pressurized spray booth
f. Rotary spray guns
g. Energy-saving drying machine
h. Drying tunnel with energy recovery system

Automatic computerized dispensing of chemicals in the drums

Automated chemical dispenser

- Recipes are inserted in the computer
- Chemicals are weighted and dispensed according to recipes

✓ It can be **loaded in advance**

✓ **No physical handling** of hazardous substances

Light weight drums

Polypropylene drums

- ✓ Easier to clean
- ✓ Easy to change colors
- ✓ Ok to perform highly corrosive processes;
- ✓ Higher loading capacity: 10-15% higher than in a wooden drum of the same sizes;

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High precision spraying technology 1/2

(I) Scan Bar

- The spraying machine has at the **entrance** a bar to scan the size of the leather cut, in order to activate only those spraying guns necessary for the size and type of cut.
- This avoids **overspraying:** reducing VOC emissions and consumption of solvents and dyes
- The **innovativeness** depends on how close photocells are placed: the more the photocell are placed close to each other, the better the precision.
    - A bar is considered to be **innovative** if the photocell are placed at least **20 mm** away from each other. It is possible to find the most innovative bars with only 6mm distance.

High precision spraying technology 1/2

(I) Scan Bar

High precision spraying technology 2/2

(II) Cameras controller

- **Controller** for **spray cabins** opposite to the traditional reading bars placed under the conveyor belt.
- This reading system uses a laser pointer and HD cameras.
- It is possible to **wash** the cabin **without damaging** the reading systems. Most of all, the problems linked to the sedimentation of painting on the reading bar are solved.
- All the parameters and functions can be regulated through a touchscreen panel.

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(d.) Pressurized spray booth

If the **spray booths are <u>NOT</u> pressurized**, the sucked air is taken from the working environment causing:

- in winter it causes an **increase in energy consumption** to heat the working area;
- a **deterioration of indoor air quality** due to the increase in dust in the workplace.

The **pressurization of the spray booth avoids this**, as it takes air from outside

Rotary spray guns with energy saving system

Up to 3 spray guns per arm with separate paint circuits.

- ✓ Reduction of pollutant load by avoiding to waste the product into the spray booth still present in the circuit at the end of work
- ✓ Lower production costs thanks to a reduced use of solvents and a partial recovery of the paints
- ✓ In modern spraying machines there are automatic devices that allow the machine itself to go on stand-by during the phases in which the spray phase is not in progress (operator breaks, cleaning of color circuits, adjustment of guns)

High precision spraying gun

‘Aircom Eco’ high precision gun

- ✓ Reduced environmental impact due to higher precision
- ✓ Cost saving
- ✓ Modular design: easier to repair (3 main parts)

Energy-saving suction plant for drying tunnels

In the drying tunnel there are “esaustori" that is a suction plant that has the goal of returning air in the tunnel, especially to reduce the humidity that is created with the drying of the skin.

It is possible to equip the drying tunnel (or better the “esaustore”) of an air / air exchanger which allows to recover about 50% of the kcalories present in the extracted air.

The recovered thermal energy is generally reused in winter for heating the rooms, in the summer it is fed back into the drying tunnel to reduce its energy consumption.

Energy-saving infrared drying tunnel and energy recovery system 1/2

- High efficiency drying tunnel, with **heating by infra-red radiation**
- The tunnel heats using medium waves **infrared** lamps that reach the emission levels required in a very short space of time, thereby **reducing wait times for starting work**, to a minimum.
- Power is adjusted by an **electronic control system** (PLC) that guarantees **regulation of the radiating power**
- The control system monitors in continuous the temperature of the leather coming out from the tunnel, by an optical pyrometer
- Considerable **energy saving** is given by the power system sent to the lamps that automatically modulates to a minimum power.
- This tunnel works even **without the internal fan**. This **reduces** the possibility of **contaminating** leather surfaces **with dust**.

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Energy-saving infrared drying tunnel and energy recovery system 2/2

Part 2. Tanning phases

1. Leather as raw material

- Leathercuts arrive at the tannery from other industries;
- Removal of scraps and flesh;
- Curing and storage

2. Beamhouse treatments: pre-tanning of hides

- Liming and unhairing;
- Splitting;
- Deliming and bating;
- Bleaching, pickling, and depickling;

3. Tanning:

- Three main tanning methods:
  - Chrome (or blue)
  - Metal-based
  - Vegetable
- Dyeing and fatliquoring

4. Finishing:

- Drying and finishing

1. Leather as raw material

- The meatparts can be **removed** from the skins immediately when **received** or in the **slaughterhouse**;
- Skinning and trimming (legs, tails etc) can become inputs for **other production uses** (eg. jelly)
- At this stage they are **free of pollutants**
- In line with **Circular Economy** principles

2. Beamhouse: pre-tanning of hides

Liming

- Using an **anti-bacterial**: Replacement of dithiocarbonates with other substances such as for example with peroxides or iodine derivatives

- **Avoid use of NPEO** (Nonyl phenol ethoxylates), eg, substitution of ethoxylated fatty alcohols, use of enzymes)

- Use of a **low impact anti-wrinkle**:
  - Metrcaptoethanol→worse;
  - Ethanolamines→intermediate but always negative
  - enzymes and probiotics (biotechnology) → better

- **Detachment of hair and epidermis** by enzymes and with **limited use** of sulphide or hydrogen sulphide

2. Beamhouse: pre-tanning of hides

Deliming and pickling

- Avoid use of boric acid in deliming, replacement with other substance with less harmful
- Deliming with organic acids to obtain Ammonium reduction or elimination
- Avoid using salt during pickling, if possible

3. Tanning

Three types of tanning considered

A. Chrome tanned leather (wet blue)

Chrome tanning is the **most used** tanning method, due to its **fast** and **efficient** process. Leather tanned with chromium salts resulting in **soft hides**, suitable for **clothing and footwear**. Due to its use of heavy metals, this method is considered to be the least environmentally-friendly.

B. Other tanning methods (4 types considered)

Chrome tanning is under attack as it has a negative impact on the environment. Some tanneries adopt chrome-free tanning, still using metals, but avoiding chrome.

C. Vegetable tanned leather

Tannins used for this type of tan are derived from tree bark or other natural resources, which results in natural looking leather. This process is suitable for **suitcases**, **accessories** and **furniture**. Vegetable tanning takes more time than chrome tanning and may require more energy.

3. Tanning

A. Chrome tanned leather (wet blue)

Mix of techniques to reduce the environmental impact of chrome tanning:

- Which percentage of chrome is used
- Does your tannery have any practices to exhaust chromium?
- Does your tannery check the level of free chrome in the tanned leather?
- Does your tannery use recovered chromium?

3. Tanning

B. Metal-based tanned leather

→Titanium salts for tanning

The replacement of chrome with titanium salts, allows to obtain leathers with good resistance and appearance of dyeing. Versatile for all items. Limited penetration on full-thickness cowhide. Suggested split into tripe.

- Some practices to reduce its environmental impact:
  - Which percentage of titanium salts is used
  - Does your tannery have any practices to exhaust titanium salts?
  - Does your tannery check the level of free titanium salts in the tanned leather?

3. Tanning

B. Metal-based tanned leather

→Aluminum salts for tanning

Not recommended. Hard skin and mixed results on its impact on human health

- Some practices to reduce its environmental impact:
  - Which percentage of aluminum salts is used
  - Does your tannery have any practices to exhaust aluminum salts?
  - Does your tannery check the level of free aluminum salts in the tanned leather?

3. Tanning

B. Metal-based tanned leather

→Other inorganic tanning agents - Metal tanning agents (e.g. zirconium, iron)

Not recommended. Hard skin and mixed results on its impact on human health

- Some practices to reduce its environmental impact:
  - Which percentage of other metals is used
  - Does your tannery have any practices to exhaust the alternative metal used?
  - Does your tannery check the level of free metal in the tanned leather?

B. Metal-based tanned leather

→Glutaraldehyde tanned leather

If essential use, use with automatic dispensers and vapor prevention systems.

- Some practices to reduce its environmental impact:
  - Which percentage of glutaraldehyde is used
  - Does your tannery have any practices to exhaust glutaraldehyde?
  - Does your tannery check the level of free glutaraldehyde in the tanned leather?
  - Carefully monitor its handling, especially if not automatized

3. Tanning

C. Vegetable tanned leather

- Mix of techniques to enhance leather quality
  - Do you use pre-tanning agents to facilitate the penetration of natural tannins?
  - What is the percentage of synthetic tannin used?

All tanning methods

- Limit the use of biocides
- Biocide content on the skin:
  - above 500 mg / kg
  - between 200 and 500 mg / kg
  - under 200 mg / kg (**preferred**)

Dyeing

- Avoid/reduce use of resins made from formaldehyde or sodium solphate

- Complex metal dyes allow to obtain excellent resistance to light, washing, and hydrolysis. Complex iron dyes have no particular contraindications, while chromium dyes do not significantly alter the total content of metal on wet blue.
  - Do you use complex metal dyes? If yes, which metals do they contain? From worst to best:
    Nickel, (worst)
    Cobalt
    Chrome (intermediate)
    Copper
    Iron (best)

Fatliquoring

- Avoid/reduce use of: biocides, iodine, SCCP and MCCP, Phthalates, Phenolsethoxylates

- Optimization of the processing parameters to guarantee maximum absorption of the treatment chemicals, e.g. optimization of the temperature and speed ratio of drums

4. Finishing

- Water based solvents to be preferred
- Phthalates can be contained in finishing polymers as plasticizers. Choose low-phthalate products.
- Limit the use of biocides

Industrial symbiosis and by-product recovery

- Splitting in wet, wet blue or crust allows to reduce environmental impact in a preventive manner
- Use of split leather whose crust has been reused as a by-product or to make other leather items
- Hydrolyzed collagen, deriving from scraps of the tanning process, is used in a thermoplastic matrix in the production of transparent films, plastic for industrial use in packaging.
- Anticipate the scraps / cut-outs from the raw phase with respect to the finished product phase

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Thank you for your attention.

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