

# TANNERY AND POLLUTION



# GENERALIZED PROCESS FLOW FOR TANNED LEATHER

## - Chrome Tanned Leather -



# GENERALIZED PROCESS FLOW FOR TANNED LEATHER

## - Veg Tanned Leather -

Strap & Russet  
Upper Leather

Curing & Storing

Soaking

Liming & Unhairing

Fleshing & Splitting

Deliming, Bating  
Washing & Dripping

Veg Tanning Pit

Dripping, Washing & Samming

Shaving

Fat Liquoring

Retanning, Dyeing  
Fatliquoring

Staking, Buffing

Togglng & Ironing

Sole Leather

Curing & Storing

Soaking

Liming & Unhairing

Fleshing & Trimming

Deliming & Bating

Veg Tanning Pit

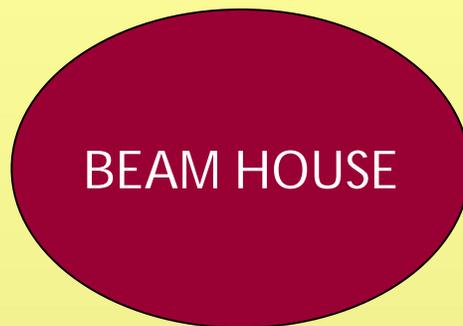
Washing & Samming

Fatliquoring

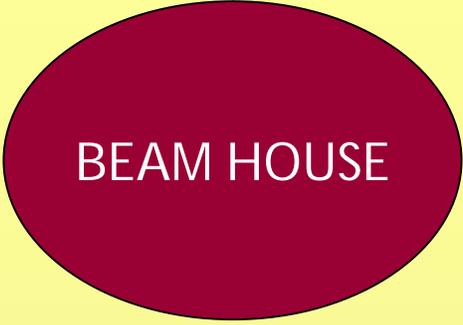
Drying

# TANNERY PROCESS

*The tanning processes are  
classified into three main stages*



# TANNERY PROCESS



## BEAM HOUSE

*Pre-tanning or Beam House Operations are:  
The removal of constituents such as hair, flesh, fat and some interfibrillary material, leaving a concentrated network of high-protein collagen fibres, greatly dispersed and softened with water*

### Liquid Wastes

*The beam house liquid wastes includes:  
Aqueous effluent containing suspended and dissolved organic matter, curing salt and greases in addition to unused process chemicals and consequently*  
**HIGH OXYGEN DEMAND**  
**HIGH DEGRADABLE WASTEWATER**  
**TDS RELEASE**

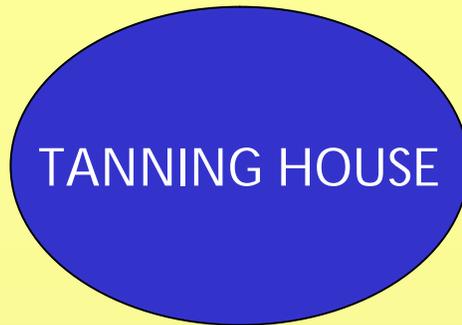
### Solid Wastes

*The solids and semisolids wastes are hair, hide trimmings and fleshings*

### Air Emissions

*Hydrogen sulphides, particulate and dispersed powders  
ammonia, odours*

# TANNERY PROCESS



*Treating the hide with agents that displace the water and combines with the collagen fibres, greatly increasing resistance to heat, hydrolysis and deterioration. The process involve a tanning and a post-tanning operations based upon the quality of leather.*

**TANNING TURNS HIDE INTO A NON-PUTRESCIBLE MATERIAL  
RESISTANT TO BACTERIAL DEGRADATION**

## Liquid Wastes

*The tanning house liquid wastes includes:*

*Aqueous effluent containing suspended and dissolved organic matter, spent tanning bath and greases and in general produce*

**HIGH OXYGEN DEMAND**

**GOOD DEGRADABLE WASTEWATER**

**TDS RELEASE**

**HEAVY METAL RELEASE (CrIII)**

## Solid Wastes

*The solids and semisolids wastes are tanned trimmings and cutting  
Chrome*

## Air Emissions

*Hydrogen sulphides, particulate and dispersed powders  
Ammonia, Odours*

# TANNERY PROCESS



## FINISHING HOUSE

*Finishing the tanned leather to achieve the desired level of quality of the final product. It involves a series of mechanical/chemical operations to donate The required physical and aestethich characteristics to the leather.*

### Liquid Wastes

*The finishing house liquid wastes includes:*

*Aqueous effluent containing dispersed pigments and polymers*

*Pasting and wash up generates a high strength low volume wastewater*

*HIGH OXYGEN DEMAND*

*LESSTDS RELEASE*

*WEAK DEGRADABLE WASTEWATER*

### Solid Wastes

*The solids and semisolids wastes are finished trimmings and cutting*

### Air Emissions

*Huge emissions of organic solvents and particulates*

# GENERALIZED PROCESS FLOW FOR TANNED LEATHER



# SPECIFIC PROCESSES

## CLEAN TECHNOLOGY OPTIONS

### Curing & Storing



Preservation is not performed in tanneries. The preservation agents are washed out during the first production step in the beam house, mainly with the soak effluent.

## Conventional Process

### SALT CURING

It is the most common method of preserving cattle hides. In this method the freshly hides are spread out, flesh side up, on a concrete floor and well sprinkled with salt (NaCl, Sodium Chloride). Coarse or round grained salt is preferred to fine salt, as the former spreads better, whilst the latter forms patchy wet cakes. The second hides is placed on the first one and is also sprinkled with salt. This is repeated until stack reachesthe height of 5-8 feet, the top hide is overlaid with salt.

- Salt used is normally 15-30% of Raw Hide Weight.
- About 60% of tannery chlorides (Cl-) originates from salted used for curing; the remaining comes from pickling and tanning processes.
- May involve the use of biocides as:
  - PCPs, DDT
  - Benzene Hexachloride
  - HCH
  - Dieldrin
  - Mercury and Arsenic based chemicals

# SPECIFIC PROCESSES

## CLEAN TECHNOLOGY OPTIONS

### Curing & Storing



Preservation is not performed in tanneries. The preservation agents are washed out during the first production step in the beam house, mainly with the soak effluent.

## Clean Technology Options

### **AIR DRYING (+)**

One of the standard method of preservation of most reptile, goat and fur skin and of a very large percentage of the hides and skins obtained in the tropical areas, especially in Africa.

Most practical in areas where salt is expensive and a small number of skins are to be cured

### **PROCESSING OF FRESH HIDES AND SKINS (++)**

The best alternative in terms of chloride load to the effluent. No use of chemicals and bactericide results in better quality of effluent. Soaking procedure washing procedure only. "Green Fleshing" is with a further reduction of use of chemicals. However time elapsing between slaughtering and further treatment must not exceed few hours especially when air temperature is high.

### **CHILLING OF RAW HIDE AND SKINS (++)**

Allow long preservation time as compared to the processing of the raw hides and skins which, depending upon the temperature applied may last upto 3 weeks. Some of the disadvantages include energy consumption, necessity of freezing equipment and cold storage.

### **PRESERVATION WITH BACTERICIDES**

Can be used only for short time preservation as bactericides have severe ecological impacts if released to nature as well as to wastewater treatment plant (toxicity). Further to this there is nowadays a strict legislation which request their minimization.

# SPECIFIC PROCESSES

## CLEAN TECHNOLOGY OPTIONS

### Curing & Storing



Preservation is not performed in tanneries. The preservation agents are washed out during the first production step in the beam house, mainly with the soak effluent.

## Clean Technology Options

### **SALT RECOVERY AND USE MINIMIZATION (+++)**

Salt curing still remain the mostly widely used method for preservation of hides and skins. Although not considered a clean technology and despite intensive research works, no alternative process of comparable economic and ecological efficiency could be found.

Further options to achieve this goal are:

- Preflesh in the slaughter house (Green Flething) and consequently reduce the amount of salt to be used
- Shaking the salt hides in sieve drums or similar devices or even manually and return the recovered salt to the curing process again
- Introducing a washing step before soaking and after shaking the hides and to collect the effluent for sun drying in open dishes to achieve a dry salt to be reused in curing.

A desalting drum in AISI304



# SPECIFIC PROCESSES

## CLEAN TECHNOLOGY OPTIONS

### Soaking



Soaking is to wet back the dehydrated preserved skins. It is generally accomplished by placing the skins in water which may contain additives to facilitate the dispersion of water in the skin structure.

### Conventional Process

Before soaking skins are trimmed in order to remove nose, ears, tails etc. Soaking may be performed in drums, paddle and pits. Wetting agent is commonly used.

- Water consumption may vary from 200% (on raw weight) to 3000% depending on the source of the raw material and the state of contamination with dirt and dung
- Biocides are added especially at high temperature at a rate of 0.1% on raw weight
- Enzymes and surfactants may be added to improve the soaking efficiency
- Further chemicals added may be:
  - Sodium Hydroxide (NaOH)
  - Sodium Hypochlorite (NaClO)
  - Sodium Bisulfite (NaHSO<sub>3</sub>)
- About 60% of tannery chlorides (Cl<sup>-</sup>) originates from salted used for curing; the remaining comes from pickling and tanning processes.
- May involve the use of biocides as:
  - PCPs, DDT
  - Benzene Hexachloride
  - HCH
  - Dieldrin
  - Mercury and Arsenic based chemicals

# SPECIFIC PROCESSES

## CLEAN TECHNOLOGY OPTIONS

### Soaking



Soaking is to wet back the dehydrated preserved skins. It is generally accomplished by placing the skins in water which may contain additives to facilitate the dispersion of water in the skin structure.

### Clean Technology Options

#### **SOAKING IN DRUM WITH SEQUENTIAL WASHINGS (+++)**

The use of pits or paddles for soaking operations results in a higher consumption of water, mainly for the washing phase which are much less efficient than when using drums. Even with drums it is recommended to operate with sequential washing instead of continuous rinsing which leads to the savings of enormous amount of water at this stage.

#### **SOAKING UNHAIRING IN A SINGLE STAGE (++)**

Reduction in water consumption can be achieved by matching the first two step in the same stage.

#### **GREEN FLESHING (++)**

Green Fleshing represent the shifting of the fleshing operation just after a deep soaking and before the liming process. This allow a good saving in chemicals as well as the production of a suitable by-product (fleshing) to be reused for fats and proteins production

# SPECIFIC PROCESSES

## CLEAN TECHNOLOGY OPTIONS

### Liming & Unhairing



Liming and unhairing are performed in one single operation to remove, hair, fats and unwanted proteins and to "open up" the skin fibres to the following processes.

### Conventional Process

Hair removal is commonly carried out in pits and drums. The sodium sulfite ( $\text{Na}_2\text{S}$ ), sulfhydryte ( $\text{NaHS}$ ) and lime ( $\text{Ca}(\text{OH})_2$ ) are introduced in the reactor. Hair destruction take place within a very short time (fifteen minutes). The hair destruction system requires a strong sulfide solution (3% on raw weight) with 6-7% hydrated lime.

After this process hides are washed to remove the sulphide and treated with additional lime for liming purposes.

- A typical process involves the use of
  - 300-600% of water
  - 3-4% of lime
  - 2.5-4% of  $\text{Na}_2\text{S}$
  - At a pH of 13-13.5
  - Duration may vary from 16 to 48hrs

- Unhairing and liming process is responsible for:
  - 55% load of COD
  - 70% load of BOD<sub>5</sub>
  - 40% load of nitrogen
  - 100% load of sulphides

- Upon acidification, solution containing sulfides, even in trace amounts will release  $\text{H}_2\text{S}$  gas into atmosphere. The gas is heavier than air and may accumulate in sewers or wherever solutions from acid processes and sulfide unhairing system come together.  $\text{H}_2\text{S}$  at a very low level has a noxious odor and at high enough levels could be fatal, paralyzing the nerves and fatality may result without warning.

# SPECIFIC PROCESSES

## CLEAN TECHNOLOGY OPTIONS

### Liming & Unhairing



Liming and unhairing are performed in one single operation to remove, hair, fats and unwanted proteins and to "open up" the skin fibres to the following processes.

### Clean Technology Options

#### HAIR SAVING METHODS (+++)

Hair saving systems use smaller quantities of sulphide as compared to hair destruction system and allow an easy separation of the proteins constituted by the undissolved hairs and hence imply less pollution than hair destruction process. In this process the hair is loosened and removed from the hides but not pulped or dissolved in the float.

The installation of a screen is required to remove the hair from the unhairing liquor.

Screening for Hair Saving Method



# SPECIFIC PROCESSES

## CLEAN TECHNOLOGY OPTIONS

### Liming & Unhairing



Liming and unhairing are performed in one single operation to remove, hair, fats and unwanted proteins and to "open up" the skin fibres to the following processes.

### Clean Technology Options

#### **LIMING LIQUOR RECYCLING (+++) - See PRACTICAL CASE SECTION -**

The technique allow a reuse of the spent liquors after decantation and/or filtration to separate sludge containing lime, fat, proteins and the recharging with chemicals according to the recipes.

The nr of recycling steps depends on the efficiency of the clean-up process for the spent liming liquor and on the desired level of quality of the leather. The liquor may be reused upto 30 times. Sludge produced may be reused in agriculture. The procedure allow huge savings of water, sulphide and lime.

#### **SULPHIDE OXIDATION (++)**

A separate pre-treatment of the toxic sulphide salt and organic sulphide compounds formed during liming-unhairing is the oxidation to non-toxic sulphate. The procedure helps to avoid the formation of toxic gas as well as contributes to a higher and better economy of the final effluent treatment.

#### **LIME SPLITTING AND TRIMMING (++)**

Splitting and trimming is usually carried out after tanning which results in by-products of low quality containing chromium in it. If these procedures are carried out with pelt, the produced by-products can be sold easier in the market than than the the wet-blue.

The non tanned by-product will be a good raw material for the manufacturing of gelatin or animal feed stuff.

#### **ALTERNATIVE UNHAIRING METHODS**

- Dimethylamine Sodium Hydroxide System (DSH)
- Oxidative System
- Enzymatic Unhairing

# SPECIFIC PROCESSES CLEAN TECHNOLOGY OPTIONS

## Fleshing & Trimming



To eliminate the excess connective tissue and fat from the flesh side of the hides.

### Conventional Process

Fleshing is usually carried out after liming process reflecting in largest quantities of wet fleshings.

From 10 to 40% of the weight of hides and skins are removed as wet fleshings.

### Clean Technology Options

- **GREEN FLESHING (RAW FRESH AND CHILLED HIDES/SKINS)**

Overall less consumption of water and chemicals in all the process

- **GREEN FLESHING (SOAKED-SALTED HIDE/SKINS)**

Overall less consumption of water and chemicals in all the process

# SPECIFIC PROCESSES

## CLEAN TECHNOLOGY OPTIONS

### Splitting



To split the leather into grain layer and flesh layer

### Conventional Process

Splitting creates a grain layer and a flesh layer. If the flesh leather is thick enough it can be processed into particular types of leather, such a suede. Sometimes, the flesh layer will be split again depending on the thickness of the split and the end-use of the splits.

A wastewater stream is normally derived from this operation. This soapy water is leading to the production of an acidic waste stream containing surfactants.

### Clean Technology Options

#### •LIMED PELTS

Overall less consumption of water and chemicals in all the process. However, tanneries do not always split in the limed stage for technical reasons or the specifications of the final product.

# SPECIFIC PROCESSES

## CLEAN TECHNOLOGY OPTIONS

### Deliming and Bating



To prepare the unhaired hides chemically and physically for tanning.  
Deliming is the removal of absorbed calcium salts and pH adjustment for bating.  
Bating is an enzymatic action for the removal of unwanted hide components.

### Conventional Process

Deliming process solubilize the absorbed calcium and bring the skin to the desired pH level. Calcium has a good solubility in ammonium sulfate ( $(\text{NH}_4)_2\text{SO}_4$ ) and ammonium chloride ( $\text{NH}_4\text{Cl}$ ). Lime is gradually removed from the skin and the swelling effect are kept at a minimum level. Skin is also prepared for right pH for bating.

Some of the chemically resistant, fibrous protein must also be removed in order to obtain proper grain texture and leather softness. Bating refers to the action of enzyme on these components.

- A typical process involves the use of
  - 200% of water
  - 2-3% of ammonium sulphate or chloride
  - 2% auxiliary surfactants
  - 1 -5% pancreatic of bacterial enzymes
  
- Deliming and Bating process is responsible for:
  - Release of  $\text{H}_2\text{S}$
  - 40% of load of nitrogen

# SPECIFIC PROCESSES

## CLEAN TECHNOLOGY OPTIONS

### Deliming & Bating



To prepare the unhaired hides chemically and physically for tanning.  
Deliming is the removal of absorbed calcium salts and pH adjustment for bating.  
Bating is an enzymatic action for the removal of unwanted hide components.

### Clean Technology Options

#### **CO<sub>2</sub> DELIMING (+++)**

A good removal in nitrogen load produced in deliming process can be achieved by using CO<sub>2</sub> gas as neutralizing agent. It also help in avoiding a further increase in COD value.

The CO<sub>2</sub> is injected directly in the axle of the drum.

The application rate is 1 to 1.5% of the weight pelts.

#### **WEAK ACID DELIMING (+)**

Optional deliming agents are weak acid as lactic acid, acetic acid, etc, but their cost limits their application to specific cases. This cost is 50 to 100% greater than conventional scheme.

# SPECIFIC PROCESSES CLEAN TECHNOLOGY OPTIONS

## Degreasing



For skins particularly greasy a degreasing stage is required before tannage. Excessive amounts of dye cause difficulties in finishing processes, and show dark greasy patches in the finished leather.

### Conventional Process

Degreasing of skins is particularly important before chrome tannage, where chrome salt can react with some grease to produce chrome soap. For degreasing purpose solvents or surfactants are used as main degreasing agents. Enzymes and hot water may be applied as auxiliary agents. To be noticed that normally bovine hides do not require any degreasing stage.

### Clean Technology Options

- **RECYCLING OF DEGREASING SOLVENT**
- **DEGREASING WITH SURFACTANTS**

# SPECIFIC PROCESSES

## CLEAN TECHNOLOGY OPTIONS

### Pickling



Pickling refers to the treatment of the hide with salt and acid to bring the skin to the desired pH for either preservation, for some time, or for tanning. At the end of the pickling operation the skin is theoretically a purified network of the hide protein.

### Conventional Process

Hides and certain skins are pickled in salt and acid in order to prepare them for the tanning process. The combination of acids added to the pickle depends on type of tanning employed and the desired properties of the tanned leather. The most common acids used sulphuric and formic. Other acids may be used as hydrochloric, boric and weak acids as acetic or lactic.

- A typical process involves the use of
  - 80 to 100% of water
  - 0.5-3% of acid
  - 6% salt
- Pickling process is responsible for:
  - Very low pH spent bath
  - High amount of chlorides

### Clean Technology Options

#### •RECYCLING OF PICKLING FLOAT

Mainly to reduce the amount of discharged chlorides is a well proven technology. After collection the used float is sieved and its acidity is controlled by lab test. After pH readjustment.

Technology leads a reduction in salt discharge of about 80%  
Technology leads a reduction in acid consumption of about 25%

# SPECIFIC PROCESSES

## CLEAN TECHNOLOGY OPTIONS

### Tanning - CHROME



Tanning is the treatment of hides and skins for preservation and conversion into useful articles of commerce.

### Conventional Process

Many ways to achieve this target are mineral tannage, vegetable tanning, aldehyde tannage and oil tannage. Other agents like aluminium, titanium and zirconium are also available for tanning.

Nowadays the chrome tanning methods employs the use of prepared trivalent chromium compounds both liquid and solids. Most of the times a combination chrome tannage/ vegetable retannage is seen.

- A typical process of mineral tanning with chrome is
  - 150-200% of water
  - 8-12% of chrome
  - 1% basifying agent as  $\text{NaHCO}_3$
  
- Tanning process is responsible for:
  - Release of chrome
  - Release of salts
  - Low pH wastewater
  - 40% of load of nitrogen
  
- Exhaustion of original chrome in traditional tanning procedure is below 70%

# SPECIFIC PROCESSES

## CLEAN TECHNOLOGY OPTIONS

### Tanning - CHROME



Tanning is the treatment of hides and skins for preservation and conversion into useful articles of commerce.

## Clean Technology Options

### **DIRECT RECYCLING OF CHROME TANNING FLOAT (+)**

Small firms may adopt this technology after screening of the exhausted bath they can reuse the same in a new tannage. This may lead to a 20% save of the total chrome used in the process.

Although the system does not completely eliminate the chromium being discharged through the effluent or sludge, it can be seen as a part of a general environmental plan for a tannery.

### **RECYCLING AFTER PRECIPITATION (+++) - See PRACTICAL CASE SECTION -**

Best option especially in case of medium-large size firms. After collection, screening and storage, the floats are precipitated with different types of coagulants including sodium hydroxide (NaOH), sodium carbonate (Na<sub>2</sub>CO<sub>3</sub>), magnesium oxide (MgO). A flocculation with polyelectrolite may follow. A dewatering system of the chrome sludge may also follow. A 90% recovery of the discharged chrome may be achieved

### **TANNING PRODUCTS THAT IMPROVE THE EXHAUSTION RATE (++)**

A wide range of chemicals and recipes are available on the market to perform a tanning cycle inducing only small chromium wastes. These products are developed with the aim of bringing about the complete fixation of the chrome onto the protein fibres so that the exhausting chrome tanning contains little or no chrome. It works only on split hides

# SPECIFIC PROCESSES CLEAN TECHNOLOGY OPTIONS

## Tanning - VEGETABLE



Tanning is the treatment of hides and skins for preservation and conversion into useful articles of commerce.

### Conventional Process

The techniques employed are based on controlled penetration of the vegetable tanning materials into the hide or the skin. In heavy leather where filling action and weight increase are important, in sole leather vegetable tanning is predominant due to the property of moldability required to the sole and for the building up of solid materials inside the hide to give more physical weight and greater wearing characteristics

- Tanning process is responsible for:
  - Release of tannins
  - Higher pollution load compared to chrome
  - Colored effluent
- Exhaustion of original chrome in traditional tanning procedure is below 70%

### Clean Technology Options

#### •TANNINS RECYCLING

# SPECIFIC PROCESSES

## CLEAN TECHNOLOGY OPTIONS

### Retanning, Dyeing & Fatliquoring



RETANNING is to transfer different properties in the final leather products

DYEING to give the desired colour

FATLIQUORING is to give the desired "hand" to the final leather

## Conventional Process

### RETANNING

Many chemicals combine with, or affect, skins and cause resistance to putrefaction and impart a number of desirable properties. These includes salts of heavy metals, products of aromatic substances treated with formaldehyde and sulfuric acids.

Other materials including urea, di-cyanamide, bisphenol, triphenyl naphthalene sulfonic acid, benzyl alcohol etc. Vegetable tanning materials are also applied as retanning agents as well as syntans.

Retanning is carried out most commonly after splitting or shaving.

### DYEING

In conventional dyeing processes, the dye is dissolved in water and the leather is treated with this solution. During dyeing the color fixes chemically to the leather, leaving the water colorless. Under ideal conditions all the dye offered is fixed to the leather and subsequent washing of the dyed leather with water should not remove any color. The dyeing is then said to be 100% wash fastness.

### FATLIQUORING

Whatever the course of pretreatment and the tannage, the leather at the time of completion of the tannage does not contain sufficient lubricants to prevent it from drying into a hard mass.

Therefore proper lubrication of the leather fibres is one of the most important factors in determining the characteristics of the leather, both from a utilitarian and an aesthetic point of view.

# SPECIFIC PROCESSES

## CLEAN TECHNOLOGY OPTIONS

### Retanning, Dyeing & Fatliquoring



RETANNING is to transfer different properties in the final leather products

DYEING to give the desired colour

FATLIQUORING is to give the desired "hand" to the final leather

### Conventional Process

- A typical process of re- tanning with:
  - 30-100%% of water
  - chemicals of various nature as above reported
  
- A typical process of fatliquoring:
  - 30-100%% of water
  - chemicals of various as sulphonated or sulphated oils, bisulfited oils, cationic, anionic, non-ionic emulsions
  
- Retanning, Dyeing and Fatliquoring are responsible for::
  - Release of chrome and tannins
  - Release of residues of dyes, fatliquors and tannery agents
  - A various series of heavymetals contained in retanning agents as well as in dyes as cadmium
  - Release of phenols

# SPECIFIC PROCESSES

## CLEAN TECHNOLOGY OPTIONS

Retanning, Dyeing & Fatliquoring



RETANNING is to transfer different properties in the final leather products

DYEING to give the desired colour

FATLIQUORING is to give the desired "hand" to the final leather

### Clean Technology Options

#### **HIGH EXHAUSTION OF THE FLOATS (+++)**

It can be seen from above mentioned processes description that the proper penetration of the material used in these processes is very important factor for the proper utilization of the chemicals and also for avoiding their serious environmental impacts.

Various substitutes are available commercially for this purpose. Some of the products have been developed which must be added to the fatliquoring oils. The oils are then converted into micro emulsions producing a significant reduction of COD in fatliquoring wastewater

# SPECIFIC PROCESSES

## CLEAN TECHNOLOGY OPTIONS

### Drying, Buffing, Trimming

Drying is more than the simple removal of the moisture to bring the leather to a practical, usable form; it also contributes to the chemical reactions of leather making. The drying of leather is one of the most important steps in practical leather quality.

### Conventional Process

A range of techniques is available for this purpose:

#### -Air Drying

Skins are hung on hooks or sticks or placed on horizontal racks. Leather is dried by the natural passage around it. It has the advantage of low capital investment, no heat input, little chance of case hardening

#### -Tacking

A variation of the air drying. Leather is stretched out on boards and tacked. As the leather dries, the fibres tend to draw together and area loss results: this avoided by tacking.

#### -Tunnel Drying/Pasting or Hanging

Leather is pasted on large sheets of the plate glass, porcelain or metal. By this means the leather can be fully extended. The pasting plates are sent through a tunnel dryer keeping temperature and humidity under control.

Capital cost and operational cost are high

#### -Vacuum Drying

The most significant advancement in the drying technique. Leather is spread out, grain down, on a smooth, usually chromed plated, polished steel surface. Heat is applied to this surface under the table. The temperature and drying conditions are kept under control.

It is the most competitive in terms of cost as compared to paste dryers and especially considering the constance of results achievable.

### Clean Technology Options

#### •POWER SAVE AND INSULATION (+++)

Power consumption may account to 10% of the total production costs, hence all efforts should be made on insulating pipelines and control equipment for temperature and humidity levels

Simone Galluzzi for PISIE - Italy

# SPECIFIC PROCESSES

## CLEAN TECHNOLOGY OPTIONS

### Finishing

It concerns with imparting suitable physical properties to the leather for the particular end-use in mind, together with applying a decorative surface finish. Finishing imparts also durability and beauty of leather.

### Conventional Process

A range of techniques is available for this purpose part of which will be analyzed in detail in the Mechanical Operations slides:

#### -Spray application

Medium large tanneries are using the automatic spray plant with drying chamber. The water circulation system is also provided. It captures unused finishing materials and hence provides better environmental conditions. Use of solvent and water based finishing material is done

### Clean Technology Options

#### •WATER BASED CHEMICALS and ROLL COATING (++)

The environmental impact of finishing operations is mainly related to finishing chemicals (dyes and pigments dispersed in binder) which can reach effluent or are emitted to the air, like solvents or formaldehyde, which also causes occupational health problems.

Halogen containing hydrocarbons have to be replaced by water based finishers. Roll coating results in reduction of VOC's in the work place and financial savings.

# GENERALIZED PROCESS FLOW FOR TANNED LEATHER INPUT & OUTPUT

Curing & Storing



## Inputs

- Salt
- Energy for cooling/drying
- Biocides

## Liquid Wastes

- Refer to Soaking

## Solid Wastes

- Salt

## Air Emissions

- Odours

# GENERALIZED PROCESS FLOW FOR TANNED LEATHER INPUT & OUTPUT

Soaking



## Inputs

- *Water*
- *Alkali*
- *Wetting Agents*
- *Surfactants*
- *Enzymes*
- *Biocides*

## Liquid Wastes

- *COD, BOD, SS, DS from proteins, dung, blood etc*
- *Salts*
- *N-org*
- *AOX*
- *Emulsifiers, Surfactants*
- *Biocides*

## Solid Wastes

-

## Air Emissions

-

# GENERALIZED PROCESS FLOW FOR TANNED LEATHER INPUT & OUTPUT

## Liming & Unhairing



### Inputs

- *Water*
- *Lime, Alkali, Sulphides*
- *Thioalcohols*
- *Enzymes*
- *Surfactants*

### Liquid Wastes

- *Sulphides*
- *COD, BOD, SS, DS from fat, proteins, hair*
- *Lime*
- *High pH*
- *N-org, N-NH<sub>4</sub>*
- *Biocides*

### Solid Wastes

- *Hair*
- *Sludges from liming effluents*

### Air Emissions

- *Hydrogen Sulphides*
- *NH<sub>3</sub>*
- *Odour*

# GENERALIZED PROCESS FLOW FOR TANNED LEATHER INPUT & OUTPUT

Fleshing & Trimming



## Inputs

*-Water*

## Liquid Wastes

*-COD, BOD, SS, DS from fat, proteins and grease*

## Solid Wastes

*-Fat, connective tissue, lime*

## Air Emissions

-

# GENERALIZED PROCESS FLOW FOR TANNED LEATHER INPUT & OUTPUT

## Deliming



### Inputs

- *Water*
- *Ammonium slats*
- *Organic and Inorganic Acids*
- *CO<sub>2</sub>*
- *Enzymes*

### Liquid Wastes

- *COD, BOD, SS, DS from epidermis and skin*
- *Excess bating agents*
- *N-NH<sub>4</sub>*
- *Sulphides*
- *Calcium Salts (mainly sulphates)*

### Solid Wastes

--

### Air Emissions

--

# GENERALIZED PROCESS FLOW FOR TANNED LEATHER INPUT & OUTPUT

Degreasing



## Inputs

- *Water*
- *Surfactants*
- *Organic Solvents*

## Liquid Wastes

- *COD, BOD, SS*
- *Fat*
- *Surfactants*

## Solid Wastes

--

## Air Emissions

- *NH<sub>3</sub>*
- *H<sub>2</sub>S*
- *Dust from bating agents*

# GENERALIZED PROCESS FLOW FOR TANNED LEATHER INPUT & OUTPUT

## Pickling & Tanning



### Inputs

- *Water*
- *Organic and Inorganic Acid Salts*
- *Fungicides*
- *Basifing salts*
- *Complexing agents*

### Liquid Wastes

- *COD, BOD, SS, DS*
- *Salt*
- *Low pH*
- *Chrome*
- *Tannins*

### Solid Wastes

--

### Air Emissions

- *H<sub>2</sub>S*
- *Acid fumes*

# GENERALIZED PROCESS FLOW FOR TANNED LEATHER INPUT & OUTPUT

Samming & Splitting

Shavings



## Inputs

--

## Liquid Wastes

- COD, BOD, SS, DS
- Salt
- Low pH
- Chrome
- Tannins

## Solid Wastes

- Split
- Shavings and Trimmings

## Air Emissions

- Dust in case of dry shaving

# GENERALIZED PROCESS FLOW FOR TANNED LEATHER INPUT & OUTPUT

Retanning, Dyeing & Fatliquoring



## Inputs

- *Organic and Inorganic Acid Salts*
- *Fungicides*
- *Basifing salts*
- *Complexing agents*
- *Synthetics – mineral based oils*
- *Sulphonated animal vegetable oil and fish oil*
- *Chlorinated organic compound*

## Liquid Wastes

- *COD, BOD, SS, DS*
- *Salt*
- *Low pH*
- *Chrome*
- *Tannins*

## Solid Wastes

--

## Air Emissions

- *H<sub>2</sub>S*
- *Acid fumes*

# GENERALIZED PROCESS FLOW FOR TANNED LEATHER INPUT & OUTPUT

Drying, Buffing & Trimming



## Inputs

- Energy
- Biocides

## Liquid Wastes

---

## Solid Wastes

- Trimmings

## Air Emissions

- Dust

# GENERALIZED PROCESS FLOW FOR TANNED LEATHER INPUT & OUTPUT

## Finishing



Finishing operations includes a series of mechanical operations which may vary depending of the finished leather characteristics as: staking, milling, coating, by-casting etc

### Inputs

- *Water*
- *Lacquers (solvent based)*
- *Lacquers (water based)*
- *Binder and cross-linking agents*
- *Auxiliaries*

### Liquid Wastes

- *COD, BOD, SS from finishing agents in aqueous solution*
- *Organic solvents*
- *Heavy metals*
- *Auxiliares*

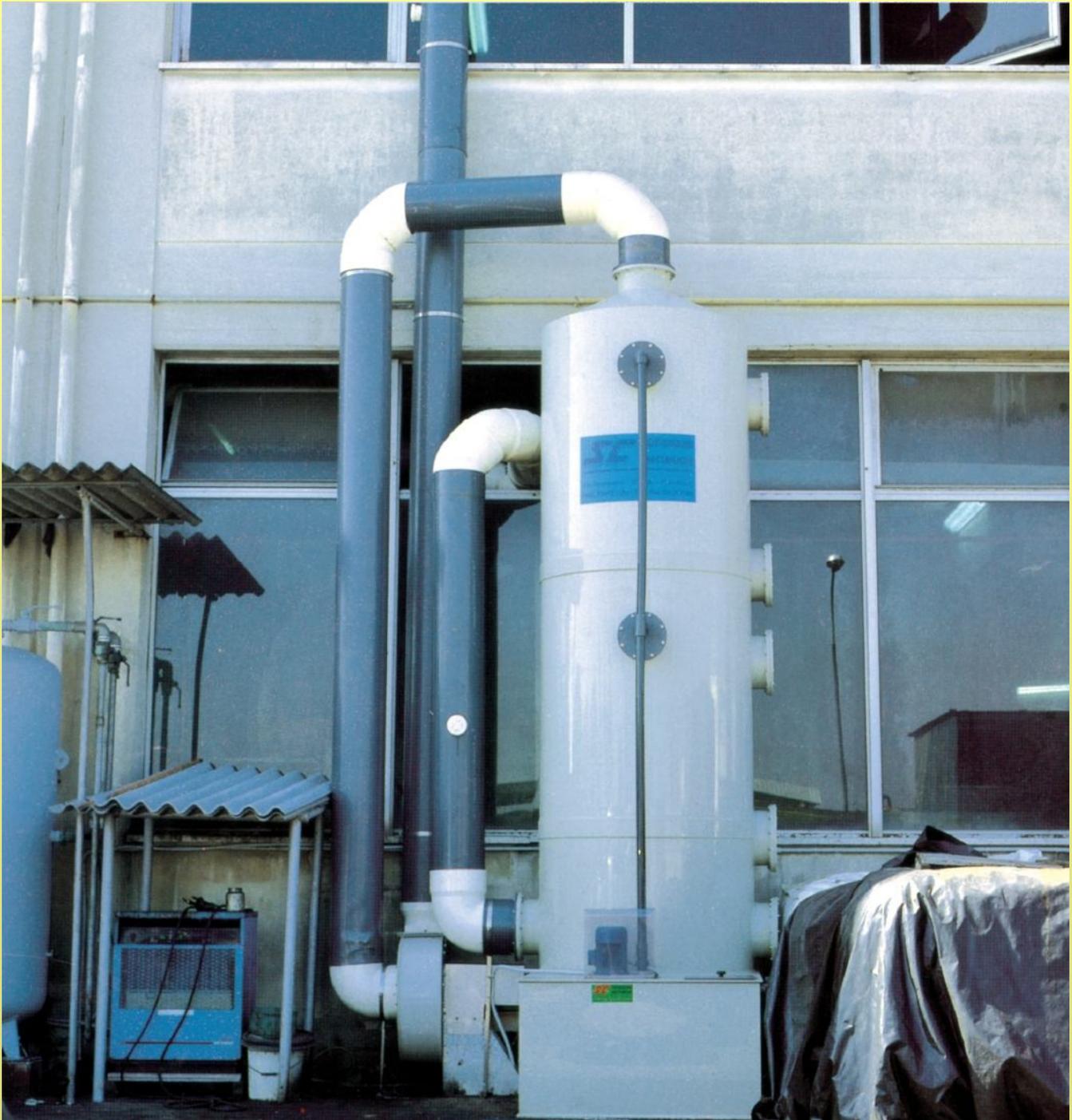
### Solid Wastes

- *Wastes from wet scrubbers*  
*Trimming*

### Air Emissions

- *Organic solvents*
- *Aerosols*
- *Fixing agent as forlmadehyde*
- *Dust*

# A FOCUS ON AIR EMISSIONS



A Scrubber System for H<sub>2</sub>S Abatement

# A FOCUS ON AIR EMISSIONS

Air emissions occurs generally in relatively small quantities. Traditionally tanneries have been associated with odour rather than any other emissions, although the emissions of organic solvents are a major problem.

Emissions have effect beyond the tannery site, but also affect the workplace and possibly the health of the tannery workforce. Apart from odours, particular mention should be made for organic solvents, aerosols and dust emissions.

The main emissions to the environment in general arise from odour, organic solvents (VOCs) and total particulate, though emission limit values are also set for ammonia and sulphides.

## • PARTICULATE

Definition ...

The majority of particulate emissions arise from dry processes such as milling, buffing and spray finishing operations.

## • ORGANIC SOLVENTS

Definition ...

The source is from finishing operations. Tanneries using solvent based degreasing processes (mainly sheepskins) have also organic solvent emissions requiring special abatement.

## • HYDROGEN SULPHIDE

The chemistry of H<sub>2</sub>S is pH dependent. H<sub>2</sub>S can be formed in Deliming processes and Pickling processes and any time streams containing sulphides are mixed with acidic effluent. An important source of H<sub>2</sub>S is often the ETP premises, especially in storage tanks and in anaerobic treatment if any.

## • AMMONIA

Ammonia can be formed in Deliming processes and in Dyeing processes.

## • ODOUR

Normally arises from degradation of organic matter or from chemical substances. From storing hides and skins, from beamhouse operation (the "concept" of odour is almost completely related to the emission of H<sub>2</sub>S and Ammonia)

# A FOCUS ON AIR EMISSIONS

## Particulates



The majority of particulate emissions arise from dry processes such as milling, buffing and spray finishing operations.

## Clean Technology Options

### IN-HOUSE DUST EMISSIONS CONTROL (+++)

For the effective control of dust and to prevent fugitive emissions:

- Dust must be controlled at source
- Dust producing machine/operations should be grouped as much as possible
- Centralised collector and treatment system lower initial and running costs

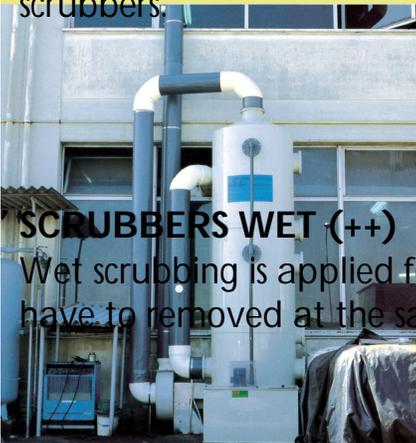
### CYCLONES (++)

Allow efficient collection of most coarse and fine dust and have relatively low capital and running costs. May be utilized in combination with bag filters and scrubbers.



### SCRUBBERS WET (++)

Wet scrubbing is applied for particulates especially if organic solvents and/or odours have to be removed at the same time



### EXTRACTIONS FAN (+)

Centrifugal fans are often used. A focus has to be made on their efficiency which normally is max 50%.



# A FOCUS ON AIR EMISSIONS

## Organic Solvents



The source is from finishing operations. Tanneries using solvent based degreasing processes (mainly sheepskins) have also organic solvent emissions requiring special abatement.

## Clean Technology Options

### **WATER SOLUBLE SOLVENTS (+++)**

Best option to reduce the VOCs emissions alongwith solvent-saving finishing techniques.

### **SCRUBBERS WET (++)**

Wet scrubbing is applied for particulates especially if organic solvents and/or odours have to removed at the same time

### **BIO FILTERS (+)**

Among biological filter systems, bio-filters are increasingly used. Besides removing odours they can be used to oxidise organic solvents such as alcohol, ketones, esters and ethers. For reliable operation bio-filters requires a relatively high pollution load in the gas stream and is of only limited efficiency. The effectiveness depends on the vapour pressure of the solvents (or the mixtures). The condensate can be recycled or has to be disposed off.



# A FOCUS ON AIR EMISSIONS

## Ammonia and H<sub>2</sub>S



The chemistry of H<sub>2</sub>S is pH dependent. H<sub>2</sub>S can be formed in Deliming processes and Pickling processes and any time streams containing sulphides are mixed with acidic effluent. An important source of H<sub>2</sub>S is often the ETP premises, especially in storage tanks and in anaerobic treatment if any.

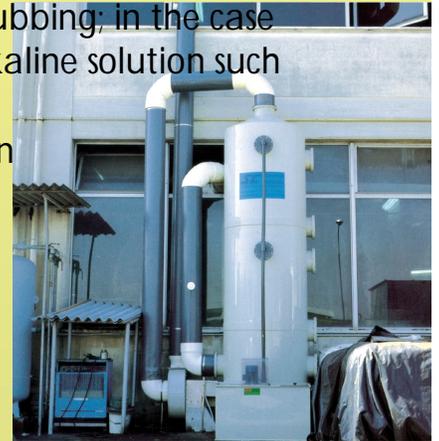
Ammonia can be formed in Deliming processes and in Dyeing processes.

## Clean Technology Options

### SCRUBBERS WET (++)

After all primary measures for ammonia and H<sub>2</sub>S reuction have been used these substances are usually treated by good ventilation or by wet scrubbing; in the case of ammonia with acidic solutions and in the case of H<sub>2</sub>S with alkaline solution such as NaOH.

For H<sub>2</sub>S released into the wastewater refer to wastewater section



# STANDARDS IN TANNERY WASTEWATER

*The meaning of the main standards parameters utilized in wastewater characterization and their specific meaning in tannery.*

## *The key-7 Parameters*

 COD (Chemical Oxygen Demand) as  $\text{mgO}_2/\text{lt}$

 Settable Solids as  $\text{ml/l}$

 Suspended Solids as  $\text{mg/lt}$

 Sulphides as  $\text{mgS}^=\text{lt}$

 CrIII as  $\text{mg/lt}$

  $\text{N-NH}_3$  Or  $\text{N-NH}_4$  as  $\text{mg/lt}$

 TDS (Total Dissolved Solids) as  $\text{mg/lt}$

# STANDARDS IN TANNERY WASTEWATER

*The meaning of the main standards parameters utilized in wastewater characterization and their specific meaning in tannery.*

## *The key-7 Parameters*



### **COD (Chemical Oxygen Demand) as mgO<sub>2</sub>/lt**

*It represents the Demand of Oxygen to oxidize Chemically al the oxidable substances being in dissolved, in suspension or as colloidal form in a sample of wastewater.*

- Its way of expression is as mgO<sub>2</sub>/lt.*
- Its ratio with BOD is in tannery wastewater:  
BOD<sub>5</sub>/COD = 0.5 to 0.6*
- Its ratio with SS is in tannery wastewater:  
1 mg/l of SS = 0.8 to 1.1 mgO<sub>2</sub>/lt of COD*
- Its testing can be done before and after filtration (on a 0.45um paper)  
CODunfiltered: represent the strenght of a raw wastewater  
COD filtered: represent the strenght of a pre-treated wastewater*
- With good approximation a CODfiltered is equal to BOD<sub>5</sub> of tannery ww*

# STANDARDS IN TANNERY WASTEWATER

*The meaning of the main standards parameters utilized in wastewater characterization and their specific meaning in tannery.*

## *The key-7 Parameters*

### **Settable Solids as ml/l**

*It represents the amount (as volume) of Solids which are settling in an Imhoff cone (1liter) after 1 hour*

- Its way of expression is as ml/l.*
- It gives the amount of coarse solids present in raw wastewater*
- It provides with good approximation the information to establish the volume and surface of a pre-settling tank as well as of a Primary Sedimentation*

# STANDARDS IN TANNERY WASTEWATER

*The meaning of the main standards parameters utilized in wastewater characterization and their specific meaning in tannery.*

## *The key-7 Parameters*



### Suspended Solids as mg/lt

*It represents the amount of Solids which are stopped on a 0.45um paper filter. They are also call as Not-Filterable solids to differ them from the Filterable Solids*

- Its way of expression is as mg/lt.*
- It gives the estimation in an indirect way of the Turbidity of the wastewater*
- It gives the amount of MLSS (Mixed Liquor Suspended Solids) when tested on a biomass sample from an oxidation tank*
- It gives the amount of MLVSS (Mixed Liquor Volatile Suspended Solids) when tested on a biomass sample from an oxidation tank, which are, with good approximation the estimation of the amount of live material (bacteria) present in a biomass system*

# STANDARDS IN TANNERY WASTEWATER

*The meaning of the main standards parameters utilized in wastewater characterization and their specific meaning in tannery.*

## *The key-7 Parameters*

### Sulphides as mgS<sup>=</sup>/lt

*It represent the amount of Sulphides present in a wastewater as S<sup>=</sup>. Sulphides are present in tannery wastewater due to their direct use in the process (as NaHS) as well as due to their release especially in Unhairing process due to their presence in the Hair Structure)*

- Its way of expression is as mg/lt.*
- It represents an important estimation especially when designing an oxidation system due to their high demand of oxygen to be converted in Sulphates.*
- Sulphides is an health harming agent due to its toxicity and absence of smell when at high concentration*

# STANDARDS IN TANNERY WASTEWATER

*The meaning of the main standards parameters utilized in wastewater characterization and their specific meaning in tannery.*

## *The key-7 Parameters*



### Chrome III as mg/lt

*It represents the amount of Chrome as CrIII in tannery wastewater. It differs from CrTot and it has not to be confused with CrVI which is anymore present in tannery wastewater.*

- Its way of expression is as mg/lt.*

# STANDARDS IN TANNERY WASTEWATER

*The meaning of the main standards parameters utilized in wastewater characterization and their specific meaning in tannery.*

## *The key-7 Parameters*



**N-NH<sub>3</sub> Or N-NH<sub>4</sub> as mg/lt**

*It represents the amount of ammonia as NH<sub>3</sub> or as NH<sub>4</sub> present in wastewater. Ammonia is an agent which derives from direct use as well as development in the tannery process.*

- Its way of expression is as mg/lt.*
- It represents an important estimation especially when designing an oxidation system due to its high demand of oxygen to be converted in Nitrate (NO<sub>3</sub>) and to establish the criteria of designing of a Nitro-Denitro system*

# STANDARDS IN TANNERY WASTEWATER

*The meaning of the main standards parameters utilized in wastewater characterization and their specific meaning in tannery.*

## *The key-7 Parameters*



TDS as mg/lit

*It represents the amount of Total Dissolved Solids in wastewater.*

- Its way of expression is as mg/lit.*
- With good approximation it gives an estimation of the amount of salts which are dissolved in wastewater*
- Its value may be derived by the measurement of Conductivity as  $\mu\text{S}/\text{cm}$*

# STANDARDS IN TANNERY WASTEWATER

*Examples of Standards Values in Tannery Wastewater*

From Raw to Finish (value after Screening)	
CODunfiltr.	7250 mg/lit
CODfiltr.	4000 mg/lit
Settleable Solids	90 ml/lit
SS	3000 mg/lit
Sulphides	250 mg/lit
CrIII	80 mg/lit
N-NH3	120 mg/lit
TDS	8000 mg/lit

From WB to Finish (value after Screening)	
CODunfiltr.	3500 mg/lit
CODfiltr.	2500 mg/lit
Settleable Solids	20 ml/lit
SS	900 mg/lit
Sulphides	nil
CrIII	45 mg/lit
N-NH3	60 mg/lit
TDS	6500 mg/lit

# STANDARDS IN TANNERY WASTEWATER

*Examples of Standards Values in Tannery Wastewater*

From Crust to Finish (value after Screening)	
CODunfiltr.	3000 mg/lt
CODfiltr.	1500 mg/lt
Settleable Solids	45 ml/lt
SS	2000 mg/lt
Sulphides	nil
CrIII	nil
N-NH3	15 mg/lt
TDS	2100 mg/lt

From Raw to WB (value after Screening)	
CODunfiltr	8500 mg/lt
CODfiltr	5000 mg/lt
Settleable Solids	20ml/lt
SS	4000 mg/lt
Sulphides	250 mg/lt
CrIII	120 mg/lt
N-NH3	100 mg/lt
TDS	6500 mg/lt

# PRACTICAL CASES

## - CHROME RECOVERY – Technology Application

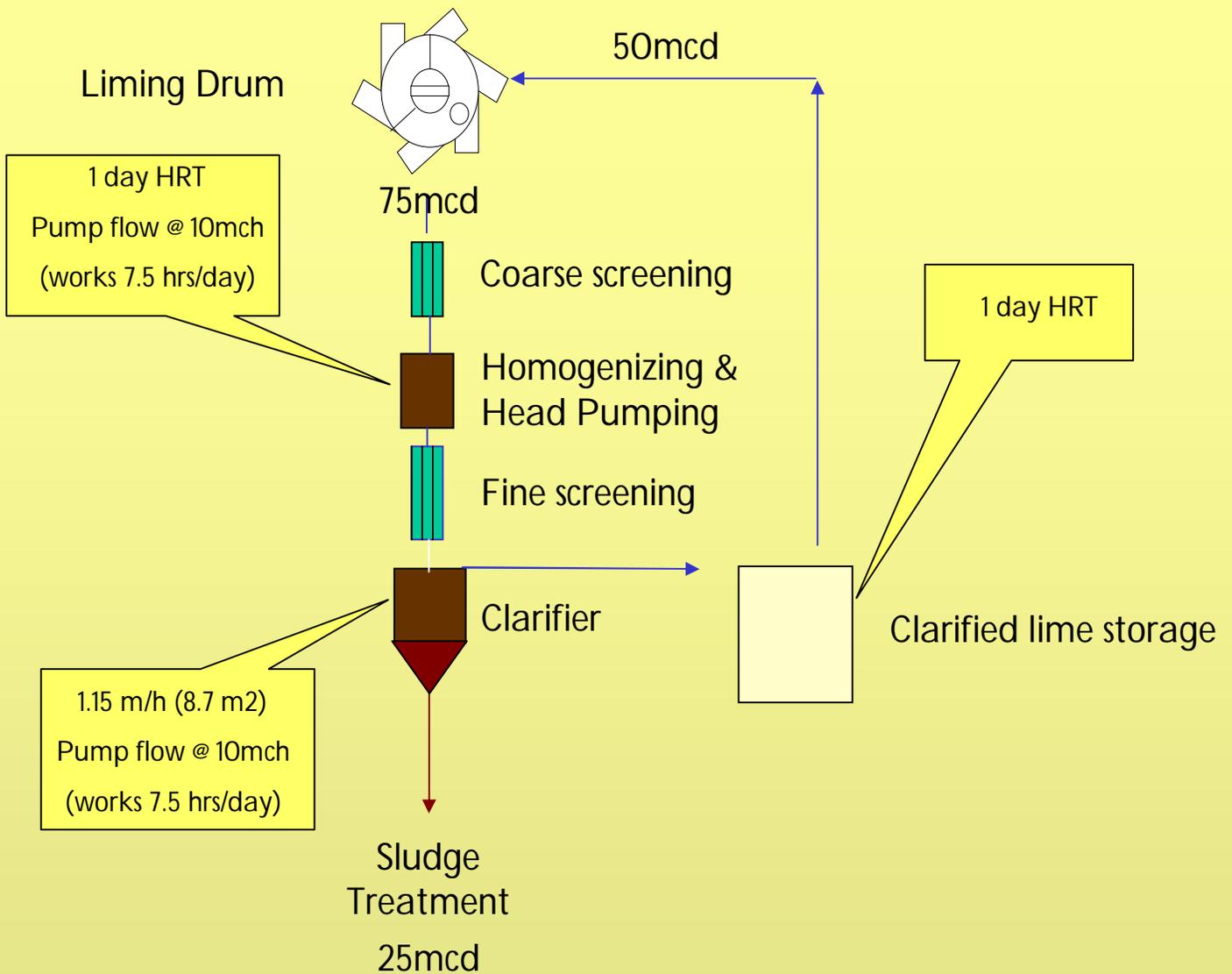
The technique allow a reuse of the spent liquors after decantation and/or filtration to separate sludge containing lime, fat, proteins and then recharging with chemicals according to the recipes. The nr of recycling steps depends on the efficiency of the clean-up process for the spent liming liquor and on the desired level of quality of the leather. The liquor may be reused upto 30 times. Sludge produced may be reused in agriculture. The procedure allow huge savings of water, sulphide and lime.

IT IS GIVEN THE CASE OF A 25,000KG SKINS/DAY PROCESSED  
WATER @ 300% → 75M3/DAY

Chemicals	Initial Float	Residual Float
Na <sub>2</sub> S	3.0%	1.5%
Ca(OH) <sub>2</sub>	2.0%	1.2%
TKN		0.5%
NaCl		0.8%
Fat material		0.35%
pH	12.8	12.7
COD		60.4g/lt
Suspended Solids		42.9 g/lt

- 50% reduction of initial Na<sub>2</sub>S
- 40% reduction of initial Ca(OH)<sub>2</sub>
- Huge load of COD and SS

# Technology Application



## Economy Balance

**Na<sub>2</sub>S** 3% x 25000 kg/day = 750 kg/day -50% =

375 kg/day Recovered in the system

375 x 30 = 11,250 kg/month @ ...Rs/Kg = Rs/month Save

# **PRACTICAL CASES**

## **- CHROME LIQUOR RECYCLING – Technology Application**

Best option especially in case of medium-large size firms. After collection, screening and storage, the floats are precipitated with different types of coagulants including sodium hydroxide (NaOH), sodium carbonate (Na<sub>2</sub>CO<sub>3</sub>), magnesium oxide (MgO). A flocculation with polyelectrolite may follow. A dewatering system of the chrome sludge may also follow. A 90% recovery of the discharged chrome may be achieved

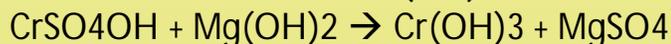
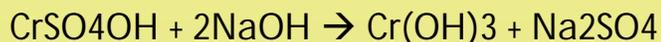
IT IS GIVEN THE CASE OF A 25,000KG SKINS/DAY PROCESSED  
WATER @ 150% → 26.5M<sup>3</sup>/DAY

GIVEN AN AVERAGE CONTENT IN THE EXHAUSTED BATH OF  
4 g/lit as Cr<sub>2</sub>O<sub>3</sub>

THEORETICAL AMOUNT OF CHROME TO BE RECOVERED IS  
106 kg/day

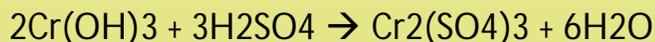
Reaction involved are for

### **PRECIPITATION OF THE RESIDUAL CHROME**

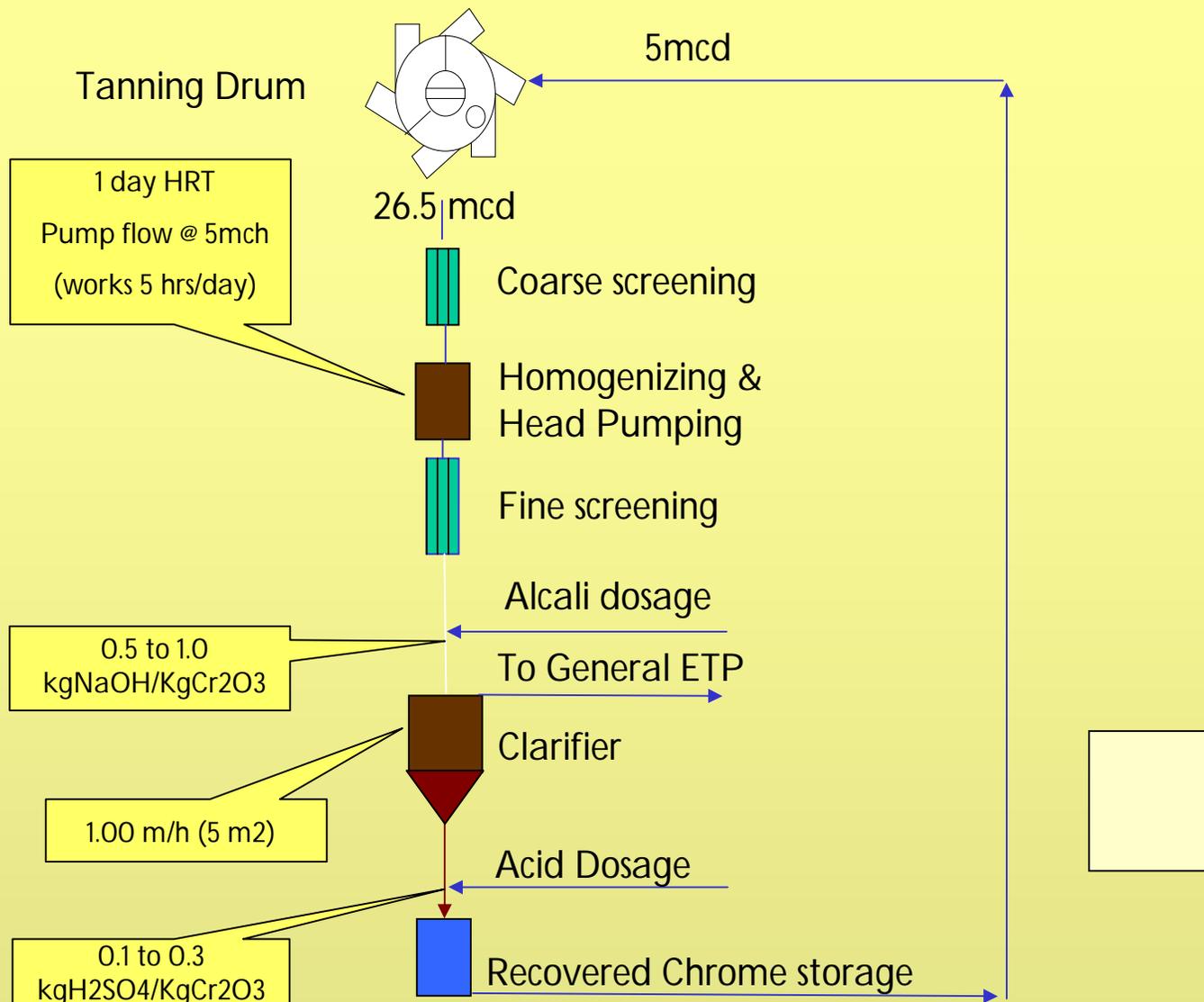


The precipitation occurs at pH values among 8.0 to 8.5

### **REDISSOLUTION OF THE PRECIPITATED CHROME**



# Technology Application



## Economy Balance

Na2S 3% x 25000 kg/day = 750 kg/day -50% =

375 kg/day Recovered in the system

375 x 30 = 11,250 kg/month @ ...Rs/Kg = Rs/month Save

# A FOCUS ON SOLID WASTE



Fleshings collected at a Fleshing Processing Unit

# A FOCUS ON **SOLID WASTE**

Only 20-25% of the weight of the raw hide is processed to leather, depending on, among other things, the animal species and product specification. The rest of the weight plus the chemical input end up as either waste or by-products, assuming that emissions are not discharged by wastewater.

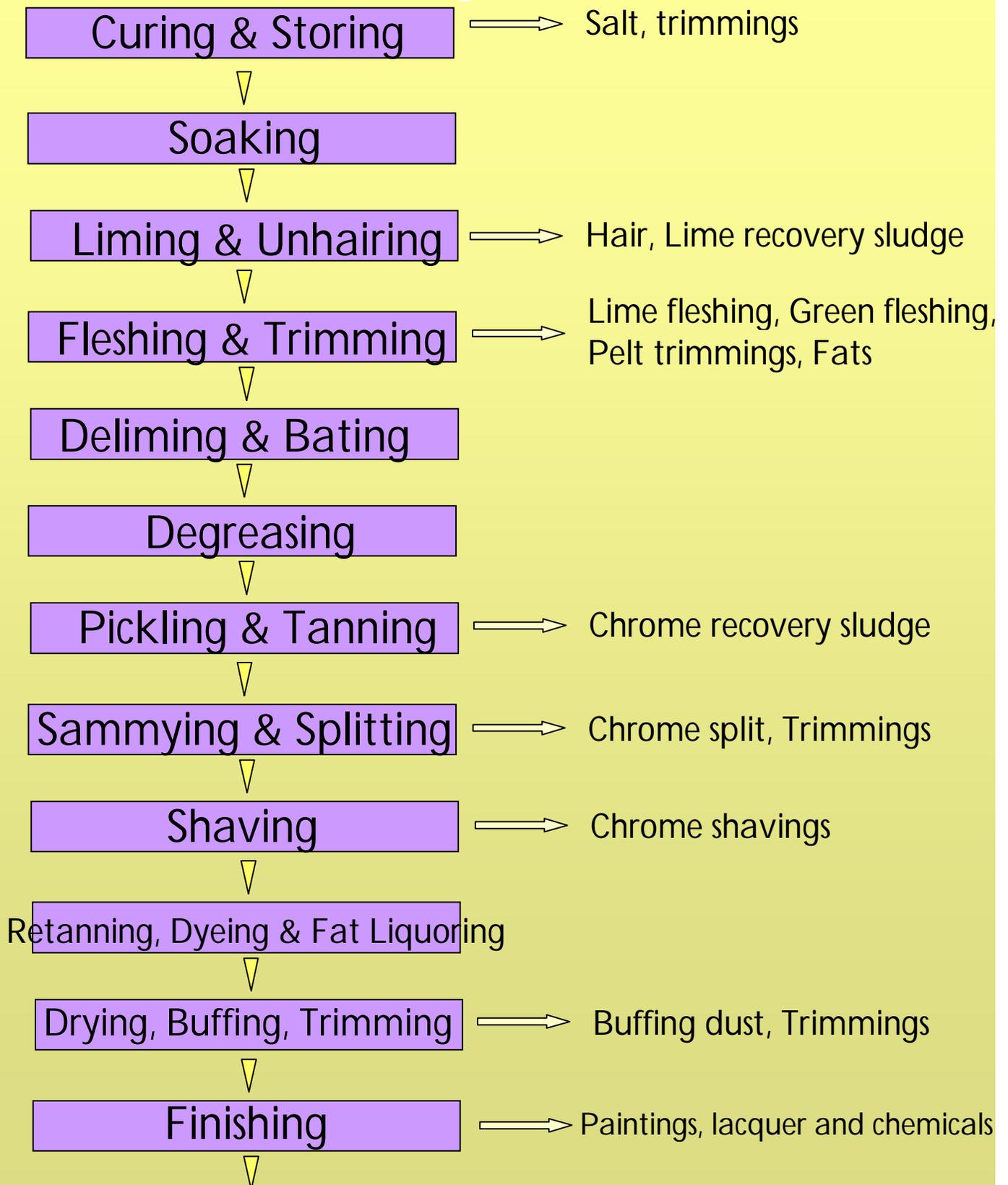
Nature of residue solids may be resumed as:

- **SALT**
- **HAIR or WOOL**
- **TRIMMINGS**
- **FLESHING**
- **SPLITS**
- **SHAVINGS**
- **FATS & GREASE**
- **WASTE MACHINERY OILS**
- **SLUDGE FROM WWTP**
- **SOLIDS FROM AIR ABATEMENT**
- **PACKAGING MATERIAL**

From the technical point of view, further treatment, re-use or disposal options depend on the contamination the respective waste fraction carry. This contamination and the amounts of waste might vary significantly according to the process chosen for tanning or wastewater treatment

# SOURCE OF SOLID WASTES IN LEATHER PROCESS

## categories



# SOURCE OF SOLID WASTES IN LEATHER PROCESS distribution

Wastes fractions are separated or merged in different ways depending on the options for re-use/recycling and disposal.

Data for the percentage of various wastes fractions with respect to the total waste production for salted bovine hide are compiled in the table below.

	% on raw hides weight
Trimmings from raw hides	2 – 5
Lime fleshing	10 – 40
Lime split and pelt trimmings	10 – 20
Chrome shavings	20 – 30
Chrome split	
Chrome leather trimmings	
Buffing dust	0.2 – 1.0
Painting, laquer and other chemicals	0.5
Sludge from wwtp	40 – 50
Packaging	1.5

# MASS ESTIMATION INPUT/OUTPUT

## INPUT

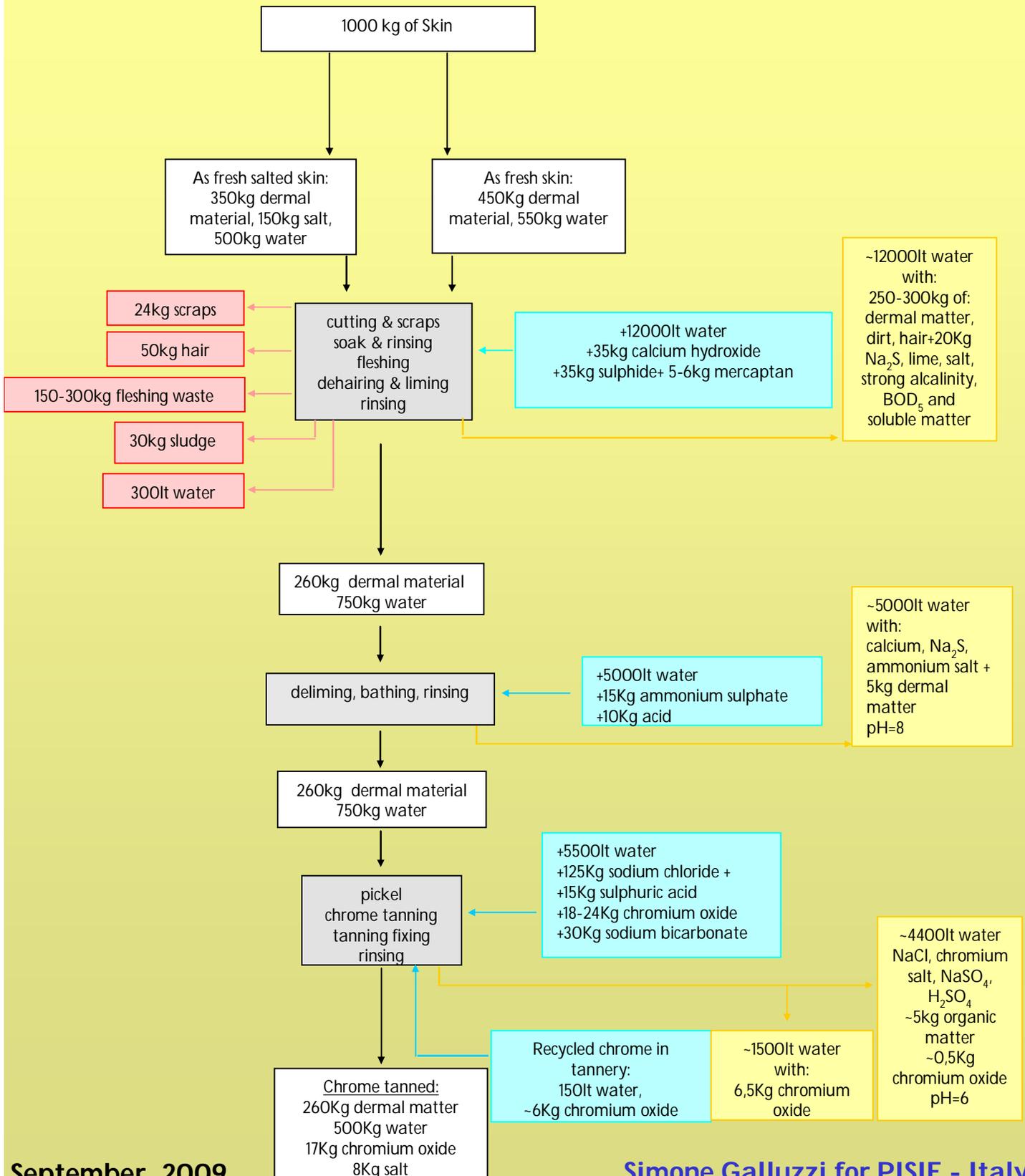
## OUTPUT

Raw Hide 1 Ton	Leather 200 – 250 kg	
Water ~ 15 – 50 m <sup>3</sup>	Water ~ 15 – 50 m <sup>3</sup>	COD 230-250 kg BOD ~ 100 kg SS ~ 150 kg Chrome ~ 5-6 kg Sulphide ~ 10 kg
Energy 9.3 – 42GJ		
	Solid waste ~ 450 – 730 kg	Trimmings ~ 120 kg Fleshings ~ 70-350 kg Splits ~ 225 kg Shavings Dust ~ 2 kg Sludge(40%ds) ~ 500 kg
Chemicals ~ 500 Kg		
	Air ~ 40 kg	Organic Solvents

# MASS BALANCE IN LEATHER PROCESSING

## - A REAL CASE -

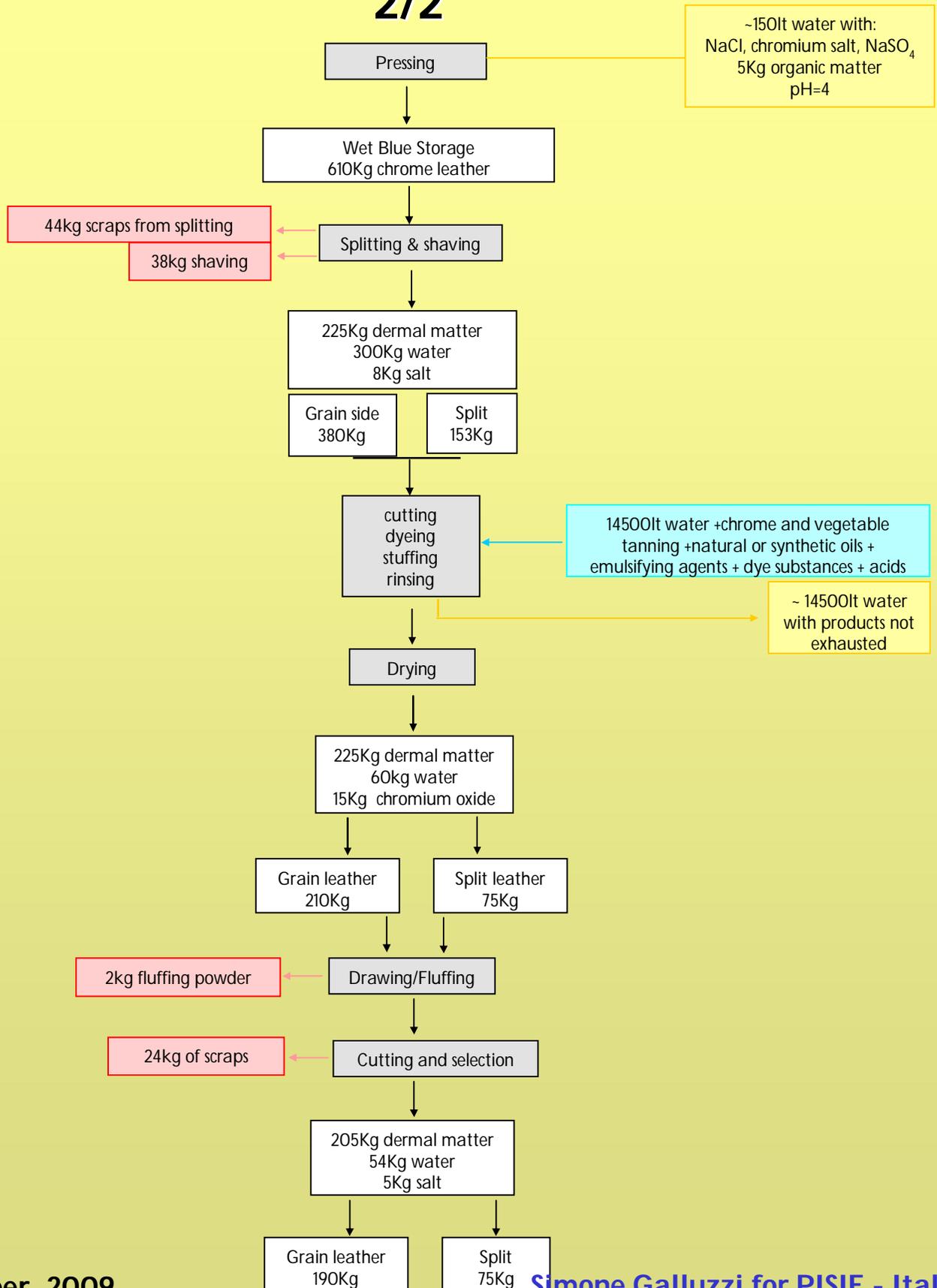
1/2



# MASS BALANCE IN LEATHER PROCESSING

## - A REAL CASE -

2/2



# A FOCUS ON SOLID WASTE - Fleshing -

Fleshing may represent from 15 to 30% of the initial raw hide weight (ie 150-300 kg on 1000 kg raw weight), its chemical composition consists of water, fat, proteins (containing impurities due to the treatment of the leather with lime), sulphides.

## Nature & Analysis of the solid waste

A Standard composition is as:

- 10% about of fat
- 7% of proteins
- 2% of not nitrogenous substances
- 8% of mineral salts
- Remaining is water

The mineral salts are, mainly, calcium salt and sodium, the first one added as an oxide in the liming operation, the second one coming from the salting of the leather. This composition represents anyhow an average indication as the various origins of the hides and the different pre-treatments make very variable the fleshing produced, especially with regard to the contents of fat and the residual chemical agents used

## Clean Technology Options

### •FLESHING FOR CONCRETE/ BRICK PRODUCTION (+)

The elimination of fleshing through the production of cement or bricks, even if possible, has to be considered as a waste of by-products. This utilization could be justified in case for some reasons there is a content of heavy metal or harmful substances which are not allowing the reuse of proteins and grease for food/agriculture industry.

### •COMPOSTING (+)

The mixtures of fleshing and wood sawdust, while fermenting, has given raise to a good quality product, to be used profitably for agricultural purposes as it could also contain some microelements, very important for the plants growth. The contribution of undesirable elements would be scarce or null as this type of composting is coming from fleshing (a natural, organic product of an animal origin) and wood (also an organic material of a vegetable origin). This type of elimination needs a long time to allow the fermentative exothermic process, necessary for the stabilization of the composting, so that it is not applicable to so high quantities produced per day.

# A FOCUS ON SOLID WASTE - Fleshing -

Fleshing may represent from 15 to 30% of the initial raw hide weight (ie 150-300 kg on 1000 kg raw weight), its chemical composition consists of water, fat, proteins (containing impurities due to the treatment of the leather with lime), sulphides.

## Clean Technology Options

### •**PROTEIN AND FAT EXTRACTION (++)**

Fleshing consists of substances having a good economic value: fat and proteins extraction of these products is industrially and commercially viable especially when the amount of fleshing is above 100 Ton/day. Under specific operations and practices it is possible to achieve the extraction of Purified Proteins to be sold as animal food and Purified Fat for soap industry.

### •**FLESHING DEWATERING BEFORE REUSE (+++)**

Whatever is the choice for reusing the fleshings byproducts a high concern is on its initial content of water which may vary from 55 to 75% and which represent the most influential characteristics for the reuse.

There are suitable recent technologies to allow a maximum reduction in water content in the fleshing which have a justification especially when the tannery is part of a cluster system and is paying (on weight basis) for disposing this by-product