

# UNIVERSITY OF NAIROBI

## DEPARTMENT OF PUBLIC HEALTH, PHARMACOLOGY AND TOXICOLOGY

### BSC IN LEATHER SCIENCE AND TECHNOLOGY

#### JLS 104: RAW STOCK TECHNOLOGY TEACHING NOTES

## 1. DIFFERENT RAW MATERIALS USED IN THE LEATHER INDUSTRY

### 1.1 Introduction:

Tanners employ a variety of raw materials to produce the range of leathers required for use of modern society. By and large, the hides and skins of principal species of domesticated animals such as cattle, goat and sheep are converted into various types of leather.

The supply of hides and skins from these animals can be obtained regularly in commercial quantities. Hides and skins of other domestic animals e.g. horse, pig and camel can also be tanned in as much quantity as they are available. The supply of hides and skins from non-domestic animals is irregular and comparatively small. Among the non-domestic animals, skins of deer, kangaroo, wallaby, are tanned to a certain extent. Kangaroo and wallaby occur in Australia and their skins are tanned in that country.

Yak hides are tanned in small quantities in certain parts of the world. Yak is available in Tibet and Mongolia. Only one variety of bird skins is tanned, viz; the skin of ostrich. Ostrich is mainly reared in South Africa from where a small supply of ostrich skins is obtained. Among fish skins those of shark, salmon, cod and Nile perch are tanned as much as they are available. Dressing of furs is a separate industry pursued by furriers. Buffalo is domesticated in India and Pakistan and their hides are usually tanned in those countries.

## 1.2 Types of hides and skins and their characteristics:

Hides and skins of practical commercial importance in many countries of the world are cattle hides, calf, goat and sheepskins. Although in certain countries of the world other hides and skins such as buffalo and horse hides and reptile skins are important, these forms only a very small percentage of the leather produced in the world.

The standard definitions of raw hides and skins are as follows:

**Hide** – the raw skin (i.e. outer covering of a mature or fully grown animal of the larger type (e.g. cattle and horses).

**Skin** – the raw skin (i.e. outer covering) of a mature or fully grown animal of the smaller type (e.g. sheep, goats, pigs, reptiles, birds and fish) or of the immature animals of the larger species (e.g. calves and colts).

### 1.2.1 Cattle hides

Cattle hides are the skins from adult cattle and are generally considered to be greater than 13.5kg in weight. However, kips (i.e. light raw hide intermediate between calfskin, and mature hide) have similar characteristics to hides and for present purposes no distinction is made for this group. The weight of kips ranges from 5kg to 13.5kg. Calfskin weighs up to 5.5kg.

It is important to note the following definitions:

**Cow** – mature female cattle

**Bull** –mature uncastrated male cattle

**Steer** – young castrated male cattle

**Heifer** – young female cattle which has reached the age of calving or it is already in calf.

**The following characteristics apply generally to all the above categories of cattle hides except calfskins:**

- a) The grain is relatively thin, about one fifth of the total skin thickness and the functional organs are simple.
- b) The fibres and fibre bundles are well developed, strongly interwoven and compact.
- c) The angle of weave is low in the grain and near the flesh, but high in the corium major.
- d) Fat is present but in small quantities/amounts and evenly distributed throughout the corium.
- e) The hairs are thick and well developed.
- f) There is a thin layer of adipose tissue.

### 1.2.2 Calfskins

Calfskins are classified as such up to 5.5kg in weight, the skins between 5.5 and 13.5kg being classified as kips. Calfskins possess all the functional organs (hairs, hair-follicles, sweat glands, etc.) that are present in the mature hide. Although each is smaller than in the adult hide, the functional groups are packed close together, resulting in the finer texture of the calfskin grain, along with a degree of structural looseness.

#### **Characteristics of calfskins are as follows:**

- a) The grain constitutes about one third of the total skin thickness. Due to the presence and proximity of the various glands and relatively greater proportion the grain layer, calfskin is rather loose in the junction between the grain and the corium.
- b) The fibres and fibre bundles are not fully developed. They are finer and more compact in the corium major than those in adult hide.
- c) The angle of the weave is high, similar to that of adult hide.
- d) There is less fat in the corium of calfskin than in hide.
- e) There is relatively more adipose (flesh) tissue than in adult hide having a greater fat content.

### 1.2.3 Goatskins

The main feature of goatskins is the coarser grain texture and the two sizes of hair follicles because of the existence of fine hair and coarser guard hairs.

#### **Their characteristics are as follows:**

- a) The grain constitutes about half of the total skin thickness; the fat gland is many lobed and well-developed, contributing to the greasy nature of the skin.
- b) The fibres and fibre bundles are fairly thick, but not as closely interwoven as in adult cattle hide. More cellular tissue is present resulting in spongy leather.
- c) The angle of weave is low throughout the skin thickness.
- d) Large amounts of fat are distributed throughout the skin thickness.
- e) Two kinds of hair are present; a stiff, thick, well developed hair and a woolly type occur, each kind having its own follicles.
- f) The adipose tissue is loosely structured and very little residue flesh is left after flaying.

### 1.2.4 Wool sheepskins

Wool sheepskins are often processed with the wool on. The wool has more value than the skin after they have been separated because most Merino skins show "**ribs,**" (i.e. elevation of dense tissue) which render the skin useless for leather making because of the variations in skin substance.

#### **Characteristics:**

- a) The grain constitutes about half of the total skin thickness, the fat gland is many lobed, and contains large amounts of fat. The hair

follicles are folded and densely packed, especially in the rib area, thereby weakening the grain structure.

- b) The fibres are rather loosely arranged with a network of reticulin fibres binding them together.
- c) The angle of weave is low, the fibres being even more horizontal than in goatskins.
- d) The distinctive feature of merino sheepskin is the considerable amount of fat deposit in the junction between the grain and the corium which makes the skin exceptionally loose. The high content of fatty matter in the skin leads to serious difficulties in curing and tanning.
- e) Wool is the main hair covering and owes its crinkly nature to the folded hair follicle through which it is moulded.
- f) Considerable amounts of fat are located in the adipose tissue.

### 1.2.5 Hair sheepskins

Hair sheepskins are similar in many respects to goatskins. They are free from “ribbiness” are very smooth grained and hence ideally suited for clothing and gloving leather production.

#### **Their characteristics are as follows:**

- a) The grain constitutes about half of the total skin thickness, and none of the organelles in the grain are prominent.
- b) The fibres are fine but the skin structure is more dense and tighter than in goatskin or woolskin.
- c) The angle of weave is low.
- d) Very little fat is distributed through the corium, but large amounts are present in the adipose tissue layer.
- e) Both hair and fine wool are present; however, as the wool fibre is straight (not crimped) it is similar to fur.
- f) The adipose tissue is exceptionally fatty.

### 1.2.6 Pigskins

Pigskins are unique in many respects. The grain pattern is very characteristic. The bristles grow through the full thickness of the skin.

**Their characteristics are as follows:**

- a) No conventional grain layer is present. Since the base of the hair follicle is located in the adipose tissue, the skins consist entirely of grain. Functional organs are not prominent.
- b) The fibres are very fine, characteristic of those normally found in the grain layer.
- c) Since there is no corium major, the angle of weave cannot be readily distinguished.
- d) Greasy patches are found in pigskins, but these may be contamination from subcutaneous fat. The major deposits of fat are found in the adipose tissue.
- e) Coarse bristles are the usual hairy covering; they are sparser, longer and stiffer than hair.
- f) The adipose tissue is excessively developed and firm. It appears to replace the corium major and contains considerable quantities of fat.

### 1.3 Hides and skins normally used in the tanning industry:

Normally, hides and skins of domestic livestock namely cattle, sheep and goats are used in the tanning industry. This is because supply of these hides and skins is available regularly in commercial quantities as these animals are reared for milk, meat and agricultural purpose and their hides and skins produce the different types of leather which are in general demand. In most of the countries cattle are slaughtered for meat and the "slaughtered" hides and skins are obtained as a by-product of the meat industry. Hides or skins derived from dead animals are referred to as "fallen" stock, and are normally of poor quality. The "fallen" stock constitutes hides from animals which die of:

- a) Animal diseases;

- b) Old age;
- c) Seasons of drought;
- d) Accidental deaths;
- e) Deaths due to injuries of various nature.

There are also some cases of malnutrition of animals which have ceased to be useful. Goats and sheep are however raised and slaughtered by a large section of people for food. Goat and sheepskins are therefore available from slaughtered animals, and practically no "fallen" skin come on the market.

### **1.3.1 Production areas**

Contrary to other commodities, hides and skins are produced everywhere, in each village, town or metropolis, continent, and all seas and oceans produce hides and skins. Where there are people, independent from race or religion; there is always the production of hides and skins.

There isn't any animal in the world that doesn't have a skin or hide. However, they differ in structural characteristics and texture.

### **1.3.2 Flaying of hides and skins**

The process of "taking off" of hides and skins from carcasses is called "Flaying" and the men who are engaged for the purpose are called "Flayers." Flaying is the first operation which is performed on the animal after killing. It is usually referred to as hot flaying if it is done immediately after killing when the carcass is still warm. This has both practical and hygienic reasons. In some countries such as the USA, many carcasses are left unskinned when they have to travel over large distances in refrigerated railway wagons to places where the value of the meat is higher than in other places. Removal of the hide in this case is called cold flaying. Cold flaying requires more force and

normally damages the hide or skin, or at best interferes with the fibre structure of the hides. Flaying should be done as well as possible. Holes or deep cuts from knives reduce the value of a hide or skin, hence in order to obtain the highest possible value for a hide or a skin, the flaying should be done with care.

Slaughtering of animals for meat is usually done in all civilized countries in slaughterhouses which are constructed and specially equipped for the purpose. Before cattle are slaughtered they should preferably be allowed to rest and given a good drink of water. The drink somewhat loosens the hide from the flesh and makes flaying operation comparatively easier.

The killing of animals is usually done by cutting the throat of the animals. In modern slaughterhouses, the killing is done by shooting the animal on the forehead by a bolt-shot apparatus (captive-bolt) which is a small instrument operated by hand. When a lever is pressed a bolt strikes the forehead of the animal making a hole in it. The animal is thus stunned at once and falls on the floor. The throat of the stunned animal is then immediately cut and the blood that gushes out is collected in galvanized iron trays.

After allowing the animal to bleed the process of flaying is started. The following tools and equipment are required for flaying:

- 1) **An opening knife (ripping knife):** - this is a straight knife of narrow blade sharp-pointed at the end. This knife is used for ripping the hide open along conventional lines as shown in **Figure 1.1** with dotted lines.
- 2) **A flaying knife:** - usually a knife of straight blade is used. Such knives unless carefully used cause scores and gouge marks in the hide at the time of flaying. A proper flaying knife should have a convex curved blade and a blunt tip.
- 3) **Sharpening steels:** - these are steel rods for sharpening the knives. Sometimes sharpening files or sharpening stones (carborundum) may also be used.

- 4) **Wooden blocks with sloping edges:** - wooden blocks are required for wedging on both sides of the carcass as a support to keep it lying on its back and to expose the front i.e. belly, chest and neck, for ripping before the commencement of the flaying.
- 5) **Pulley blocks and chains:** - these are required for hoisting the partly flayed carcass to facilitate final "take off" of the main portion of the hide from the body by keeping the carcass at the height convenient for working.
- 6) **Tail Extractor of grip:** - this grips the tail and enables the hide to be detached from the tail root by pulling the hide down. Detachment of the hide from the tail root using flaying knife often produces flay cuts. Use of the tail extractor avoids this damage.

### **1.3.3 Flaying of large animals**

After the throat has been cut and the bleeding is over the carcass is put on the floor on its back wedged on both sides by wooden blocks against which the carcass rests. The flayer then makes a straight slit along the centre starting from the underlip down the throat, breast, belly and finishing at the tail. Then a cross slit is made at the breast right down to the joints of the forelegs. A similar cross slit is made at the lower part of the abdomen down to the joints of the hind legs. Then the hide is peeled off by hand, cutting the white membrane with a knife on the underside of the hide at places where it sticks so fast that it cannot be removed by pulling hard by hand or fisting.

If ripping is done as described above the hide will be of perfect square pattern and symmetrical on its two sides. If the flaying knife is carefully handled flaying damages are avoided.

### **1.3.4 Flaying of small animals (goat and sheep)**

Goat and sheepskins are often flayed without much use of a knife after slitting. The skins are loosened by thrusting with the fists. In some cases, the skin is drawn

off without even slitting it down the belly. Such skins are called “**Cased**” skins which do not contain any butcher cuts. The skin usually sticks at the chest and at this place it is separated by using the knife. The skins are slit along the belly and opened out at the time of curing and preservation.

### **1.3.5 Slaughter methods:**

Slaughter methods and situations are closely related to the flaying operation and subsequently the quality of the hide. Depending on the slaughter method one can obtain a higher or lower quality of flaying. There is a distinct difference between slaughter in an organized abattoir and a rural slaughter slab. Much depends on government dispositions that regulate slaughter mainly for hygienic and public health reasons. Some countries have very strict laws that regulate meat production; others have no laws at all and allow even backyard unsupervised slaughter.

Without exception well regulated slaughter provides for better flay quality in hides and skins. Unregulated slaughter provides as a first rule bad flay

quality. Good flay quality goes hand in hand with well-regulated hygienic slaughter operations. When a community produces good quality meat, it almost automatically produces also better flay quality for their hides and skins.

### **1.3.6 Hand flaying:**

Before mechanization all flaying was done by hand. The removal of the hide or skin is an operation that is ruled in many areas by tradition. In many countries small skins are pulled by hand from a hanging carcass, resulting in a skin that presents itself as a sort of tube, which you can compare to a coverall. Pulling a skin by hand produces a rather good quality flay.

With large animals or small animals (calf) whose skin is particularly firmly attached to the meat this sort of flaying is not possible, and one has to resort to flaying with the assistance of a knife. The knife is both a useful and a dangerous tool. If a flayer gives little attention to what he is doing, he can easily cause damage to the hide or skin by making cuts or even holes. Each bad cut and each hole reduces the value of a hide. Hides and skins with more than 10 deep cuts and/or holes fetch such a low price, if there is a demand at all, that it becomes economically unfeasible to collect such material, and it becomes then a total loss.

In order to make hand flaying a bit less risky, special flaying knives have been designed with a round rather than a pointed edge, but unless used with a certain circumscription and professionalism, also these particular knives do not guarantee a better flay quality.

Hand flaying is done simply by detaching the hide with a knife from the fat or meat of the carcass. The less fat or meat is attached to the hide or skin, the better it is for the butcher who sells the meat as it is obvious that the price per kilo of a hide is far less than that of the meat. The closer the flaying knife is held to the hide, the more likable it becomes that flay damage is done to the hide. Exception is made for game, fur, reptile and other exotic hides and skins, where the hide is the main product and the meat the by-product.

A typical hand flay of a goat or sheep takes about 5 minutes, whereas for large cattle a hand flay operation takes somewhere between 10 and 15 minutes. **Speed in flaying compares inverse with flay quality.** The slower the flaying operation is executed, the better is the quality, and hypothetically the higher is the price that can be fetched for the hide. In abattoirs that process a substantial quantity of cattle but not enough to warrant a mechanical hide puller, hand flaying can be done with specially designed knives (Jarvis knives) that vibrate and thus do not easily cause cuts or holes if properly operated.

### **1.3.7 Machine flaying**

In large abattoirs machine flaying has taken over from hand flaying. Machine flaying is enormously faster and at the same time gives an almost perfect flay quality, causing less fatigue. A few types of flaying machines have been invented. **The principle of these machines is an electrically driven rotating knife.** Among the first lot of these types of flaying machines to be invented was the pneumatic flaying knife, which consists of two circular toothed blades oscillating at a speed of 5000 vibrations per minute. The blades are impelled by compressed air by a simple mechanism and cuts in every direction.

Machine flaying refers to the most important part of a hide, the butt. Bellies and legs must be opened by knife; hence for a good flay quality the flayer must pay attention to his job.

The big drawback of machine flaying is that the machine costs a large amount of money, and needs some sort of power supply and is subject to continuous maintenance. These factors are of little relevance for a large city abattoir, but become an impossible handle for a small abattoir with a low production. An abattoir that produces less than 100 head of cattle per day rarely commits capital to buy such a machine.

There are several modern flaying machines currently available, from rather basic to very sophisticated ones running from US Dollars 15,000 to 25,000 and more. All produce hides without cuts or holes and take about one minute to pull a hide from a carcass. The operation is executed in a rather brutal way because the hide

is pulled from the carcass using the weakest link between hide and carcass namely the fat. Some fat remains on the hide, some on the meat. Some meat will also remain attached to the hide and in order to reduce the quantity of meat staying on the hide one has either to hand-assist the flaying or make use of a Jarvis knife.

### **1.3.8 Hand assisted machine flaying**

When a small abattoir or slaughter slab wishes to produce good quality hides, but cannot install for production and economical reasons a mechanical hide puller, there is a way in between. There are several low cost methods and devices that allow hides to be pulled, one as low as US Dollars 100/150; and apart from being cheap these devices can be made anywhere where there is (scrap) iron and where welders are available. The principle of these devices is the same as the principle of the mechanical hide pullers, with the difference being that the cost of these devices is much lower. The end result of the flaying quality of these devices is the same as the results obtained with mechanical hide pullers. If the device is used in a proper way, it can and will produce a perfect machine flayed hide without cuts or holes with great speed and little effort.

### **1.3.9 Vertical and horizontal flaying**

Whatever the method used, hand flaying or hand assisted machine flaying, there is a choice whether to perform the operation, or part of it, with the carcass lying on the ground, or with the carcass hanging vertically from a hook or rail.

Evidence and logic show that when a carcass is lying on the floor of a slaughterhouse or slaughter slab, the quality of the flaying is lower than when the flaying operation is executed on a hanging carcass. The flaying job on a hanging carcass is done easier, faster and with less fatigue. The fringe benefit of working on a hanging carcass is also improved hygiene and better food safety to the benefit of public health.

### **1.3.10 Fleshing**

Whether a hide is removed by hand or machine, there will always remain some meat and fat on the hide. On an average this accounts for an estimated 20 % of the green hide, and is undesired by the tanning industry.

Removing the fat and flesh before salting ensures that this sub-product, free of salt or other curing (conserving) agents, can be sold to other industries, like the cosmetic or food industry. A properly green fleshed hide allows furthermore for better and faster curing. Fleshing of green hides should be done immediately after flaying. This is meant to ensure that the flesh does not dry on the hide surface becoming sticky as a result and hence, very difficult to remove leading to high chances of causing hide damage. The operation requires a suitable fleshing machine.

In developing countries the (unprofessional) fleshing of hides and skins constitutes a major value reducing factor. Fat and fleshings are edible products with a relatively high commercial value. This means that after flaying unskilled workers descend on a hide to remove the meat and fat. The more weight they remove from the hide, including pieces of hide (trimmings), the more money they get for recovered product. The faster they work the earlier they can get their pay.

As a result a perfectly flayed hide can lose its premium value due to sloppy fleshing. As a matter of fact the great majority of machine flayed hides are ruined when submitted to hand fleshing in developing countries, dramatically reducing the value of the hide and neutralizing the beneficial effect of careful flaying. Abattoirs or the owners of the hide in general unfortunately don't pay attention to this very important phenomenon. If the fleshing cannot be avoided in order not to deprive people from making a living, then at least a proper workplace should be provided. This consists of a flat cement floor (or raised concrete cement platform), which avoids the possibility of inflicting cuts on the hide while the fleshing knife encounters an obstacle.

## 2.0CURING OF HIDES AND SKINS

### 2.1 Introduction

Hides and skins obtained after flaying contain water to the extent of two-thirds of their weight. At this stage they are called green or fresh hides. Protection against putrefaction of animal bodies ceases to exist from the moment when the animal is dead. The presence of so much moisture in the green hides and their chemical constituents consisting mainly of proteins make them very liable to bacterial attack which decomposes them. Putrefying bacteria, which are either present in the hides and skins or get access to them from the air, develop enzymes which diffuse through the cell membranes and degrade the molecular structure of the protein resulting in the formation of amino acids and finally ammonia. Ammoniacal odour from a pack of hides indicates that putrefaction has set in and immediate action should be taken to either process the stock or correct the curing, preferably with some preserving agents.

The author is indebted to M/s. Sandoz Ltd., Basle (Chemical department), for the following information on the curing of hides and skins:

'Bacteria which operate in weakly alkaline or neutral conditions on fresh pelt include;

Staphylococcus	pyrogenes aureus	
Trichophyton	purpureum violaccum sulfureum	
Sarcina	lutea Litoralis	
Serratia	salinaria cutirubra marcescens	'Red Heat'
Micrococcus	luteus roseus	
Myxococcus	rubescens	'Red Heat'
Rhodococcus	several varieties	

As regards moulds, the following, amongst others, occur in neutral and, above all, acid conditions during the different tanning processes:

Penicillium  
Aspergillus

Mucoraceae  
Types of Candida

## **2.2 Effects of bacteria and mould attack on raw hides and skins**

Only a limited number of types of bacteria directly attack the fresh hide protein but many types produce proteases and peptases, enzymes which are capable of attacking and degrading protein substances.

Moulds can develop on unpreserved hides or skins and on leather especially if the pH value falls below 7.

If the growth of these micro-organisms is not prevented, they will damage both grain and flesh sides of the pelts, then attack the reticular network, the interfibrillary proteins and the collagen fibrils. This leads to a greater or lesser degree of degradation.

The attack reveals itself externally by the development of the customary odours, hydrogen sulphide, ammonia, etc., and by the development of coloured stains, varying from red-brown to violet, on the flesh side.

## **2.3 Counter measures to the development of moulds and bacteria on raw hides and skins:**

Apart from cold storage, the most important measure lies in salting the raw goods. In several countries, this is applied as 30% solution but, in general, it is common to spread 30-40% of dry salt on the flesh side.

The salt dehydrates the skins and hides to a moisture content insufficient to support growth of moulds and bacteria.

## **2.4 Development possibilities of micro-organisms on hides or skins treated with salt alone:**

The following is known regarding the influence of salt:

By its dehydrating action, salt serves as a preservative.

The water content of fresh hides is of the order of 60-65%

If with salt the water content is reduced to

35-40%, little or no development of mould takes place. Some bacteria are also inhibited.

At 40-45% water content, development of mould and bacteria begins.

At 45-50% water content, the conditions are favourable for strong growth of moulds and bacteria.

It is clear that, unless the water content is carefully controlled, it can lead to suitable conditions for bacteria and mould growth.

Whilst salt prevents the growth of most moulds, it doesn't do so with all strains of bacteria; for instance, aerobic and anaerobic bacteria (e.g. gelatin liquefiers).

Moreover different types of:

Trichophyton  
Staphylococcus  
Sarcina  
Micrococcus

are not hindered from developing. Indeed, with certain strains it is even an advantage to have a high salt concentration.

## **2.5 The influence of salt quality on preservation:**

As well as the amount of salt, the quality itself, varying according to source, can markedly influence the preservation.

**Rock salt is most suitable.**

**Sea salt**, by comparison, has several disadvantages:

- It contains unknown quantities of potassium, calcium and magnesium salts which serve as nutrients for certain halophilic types of bacteria, particularly the red and violet hide staining varieties.
- The magnesium chloride content of sea salt interferes with dehydration, resulting in a somewhat more difficult and frequently worse preserved hide.
- Due to the method of preservation, sea salt contains already halophilic aerobic micro-organisms, which provide additional inoculation.

**The principle underlying curing methods is the elimination of moisture from hides and skins.** A moisture content above 12% helps the growth of bacteria and the application of this principle has led to the development of the following three processes of curing which are practised in the hide and skin trade. It is important to remember that the slaughtered hides are required to be cooled down to atmospheric temperature since, if curing is done before dissipation of body heat, bacterial action on the hide will be encouraged.

The three processes of curing which are practised in the trade are:

- i. Wet-salting
- ii. Dry-salting
- iii. Drying.

The presence of adhering flesh prevents penetration of curing agents into the hides and makes the curing less effective. Hence the loose flesh must be scrapped off before curing. Dung, dirt and blood which adhere to the flayed hides promote growth of bacteria. Such hides should be washed clean with salt water and the excess water allowed to drain off before curing proper. Actual curing now begins.

**Wet-salting;** the preservation of hides and skins by wet-salting process consists of sufficiently dehydrating the fresh hides and skins in order to prevent the development of bacteria causing putrefaction, and storing them in a pile in such a way that the pickling brine resulting from the dehydration can be easily drained off. Dehydration by wet-salting is carried out by means of a homogeneous mixture of salt and chemicals to which antiseptic products have been added to avoid development of defects of microbial origin such as red spots, hair slip and run fresh etc.

Before salting, the hides and skins should be carefully washed in cold water. After washing of the hides or skins, salting should be started as soon as possible (in case of slaughtered animals, not later than 5 hours after the animal has been flayed). Salt mixtures may contain:

- (a) 100 parts salt + 2 part naphthaline + 2 part sodium carbonate OR
- (b) 100 part salt + 1 part naphthaline + 1 part boric acid. Before use the salt and the antiseptic are thoroughly mixed. A quantity of the mixture equal to at least 40% of the mass of the hides and skins should be distributed, evenly over the fresh sides and rubbed well onto the hides or skins. The second hide is now spread out, upon the first one and treated with salt as before.

The operation is continued until a pile of 75 or 100 hides is obtained. The height of the spread out skin can be one or one and a half metre. Taking into consideration of a high ambient temperature of tropical countries like India, this limit of height should be lowered. It is preferred to pile up the salted hides with flesh side upwards; but for the light skins it is possible to pile the with flesh to flesh. The piling should be distributed in such a way that that the brine resulting

from the hydration can be easily dried off. The pack is now allowed to cure for at least 10 days or longer.

Green hides and skins contain about 60-70% moisture. After wet salting they contain about 40-50% moisture. Some salt is, however, absorbed by the hide but as a whole the hide loses weight. The loss in weight varies between 10-20% on the weight of the greener hide. About 13-17% of salt (on the wet salted weight) is retained by the cured hide and the rest of the salt runs off with expelled brine carrying with it brine-dissolved blood, lymph, and other soluble proteins.

At the time of packing for dispatch to the tannery, place the flesh side of the hides or skin used as wrapping to the outside.

Quantity of salt that should be used for curing is between 35% and 50% on the green weight of hides and skins. Calf, goat and sheep skin require more salt (about 50% on their green weight) than cattle and other hides because the former contains more moisture.

Either rock salt or sea salt can be used for curing. The grains of the salt for curing should neither be too fine or too coarse. Finely powdered salt dissolves too quickly and the brine so formed by its dissolution flows out and the salt is absorbed not to the extent desired. The International Council of tanners have stated that the ideal size of grain is 2-3 mm; but for calf skin a mixture containing not more than 25% of fine grain salt (under 0.5 mm) and about 50% of medium grain (1-2 mm) has been suggested.

Sea salt has often been the cause of infection of 'Red heat' which makes the flesh side of the hide red through the development of homophillic bacteria, organisms which possess a salt tolerance. Sea salt contains chlorides and sulphites of Calcium and Magnesium. If these impurities are present in the salt in higher quantities than 1%, the curing property of the salt is deteriorated. Rock salt is usually of coarser grain and does not develop 'Red heat'

**Frigorificos process of wet-salting** : this process of curing is carried out in Argentina. According to this method, the hides which have been previously green fleshed and washed are soaked in brine (33%) for 24 hours. Water comes out of the hides and dilutes the brine. The reduced concentration of brine is restored by addition of fresh salt. After brining, the hides are taken

out and piled to drain off. The brined hides are subsequently wet-salted using only 20% of salt on the weight of hide.

This method of curing is also called brine curing. Used brine can be reused several times after boiling, filtering and allowing it to settle out.

There are numbers of advantages which can be claimed from brine curing of hides:

- i. Brine curing requires only a day in contrast to the wet-salting method requiring 5-7 days.
- ii. Brine curing can be done on concrete or wooden vats or in rotating wooden drums if mechanization is preferred.
- iii. Cost of curing can be significantly reduced if a process of regeneration and purification of the brine is followed.
- iv. Bactericidal additives to the curing agent which are essential for tropical climate can be applied more uniformly to the hides.

Hides cured by either of the above methods of wet-salting remain in sound condition for a long time if they are stored in a well ventilated cellar with low humidity.

Hides and skins can also be stored in a refrigerated room for a long period. But according to O'Flaherty and Roddy<sup>7</sup> salting followed by storage in a refrigerated room is preferable to either of the two methods alone. Refrigerated rooms are maintained at a room temperature below 10°C or 50° F.

Attempts are being made to increase the preservative action of curing salt by adding to it substances with antiseptic properties. Zinc chloride, Sodium trichlorophenate, Sodium orthophenylphenate and many other phenolic substances have been tried. A number of proprietary chemicals are now being used as additions to the salt. About 3-4% of these chemicals on the weight of salt will give complete protection against bacteria and would mould damage for a

fairly longer period. The following chemicals have been in use. **Antimucin** HK (M/s. Sandoz Ltd., Basle), Preventol( M/s. Bayer)

To prevent 'hair slip' of wet hides during transit in Summer months, some Indian tanners use Zinc chloride. 2-5% solution of Zinc chloride is brushed on fleshed side of the salted hides. This treatment prevents hair slip but hides treated with Zinc chloride present difficulty in unhairing and a little amount of Sodium sulphide is necessary to promote easy unhairing. Das, Dhavale and Pal<sup>8</sup> cured lizard skins with a 2% Zinc chloride solution in which 10-25% of Sodium chloride was dissolved and obtained excellent results.

**Denatured salt:** In many countries, an excise duty is levied on edible salt. In such countries, duty free salt is made available to industries in denatured condition. The salt is denatured by mixing with it substaces which make it inedible. Denaturing substances are those which give salt a bitter taste, a strong scent and colour. In some countries denaturing agents are prescribed by law. For instance, in Germany, before the Second World War tax free salt (Die- Lederindustrie, 1935, No. 21) used to be delivered to the tanning industry after being compulsorily denatured<sup>9</sup>.

In one of the important tanneries of West Germany of Calf skin is done with a mixture of 97% Common salt, 2% soda ash And 1% Naphthalene.

In France, Naphthalene and white spirits are prescribed. In Holand, 0.5% paraffin (white spirit ) and 0.1% Naphthalene are prescribed by law, for denaturing salt. In Italy, the materials used are Soda, Naphthalene, Praffin, Sodium Sulphate, Copper Sulphate and red Ochre

### **Khari salt**

Khari salt is one of the most efficient curing agents available in India. It is an efflorescence on the soil which occurs in the Muzaffarpur and Motihari districts of Bihar (India). The naturally occurring Khari salt is sold in the market in form of hard lumps which are crushed in to powder befor use. Khari salt is mainly used for dry-salting hides and skins. When used for wet-salting, it is frequently mixed with common salt.

Khari salt mainly consists of soluble sulphates of Sodium (about 65%) and Magnesium (about 15-20 %). It also contains insoluble earthy matters (about 8-10%) and a small amount of Sodium Chloride.

### **Wet-salting with khari:**

For wet-salting cattle and buffalo hides, the powdered Khari salt is dissolved in water and the salt solution is liberally sprinkled on the flesh side. When the first coat has been absorbed by the hide, a second coat is sprinkled. In this way, the hide is coated 3-5 times after which they are folded along the back bone line and piled for a week. After a week they are spread on the ground and salted with dry common salt. The application of both Khari and common salt preserves the hide longer than common salts alone. This is one of the reason why hides are often cured, during the summer season in India with both Khari and common salt.

### **Dry-salting with common salt.**

In India, dry-salting of hides and skins is carried out mostly with Khari salt. As already mentioned, the chief constituent of Khari salt is Sodium sulphate which is not hygroscopic and does not absorb atmospheric moisture even in the monsoon. Hides and skins cured by dry-salting with Khari salt remain dry for several months. Large quantities of Indian goat skins known in the International trade as Muzzafarpores, Daccas etc., were exported in dry-salted conditions, the dry-salting having been done with Khari salt.

The usual processes for dry-salting are described as below:-

**Cow and Buffalo hides:**-If the hides have been previously wet-salted with common salt, they are washed in water and piled up to drain. The washing removes a portion of the curing salt or dirt, if any. They are then spread out on the ground, flesh side up. Losing fleashes which are still adhering in the hide are removed by a knife. A solution of Khari salt is made by dissolving one part of Khari in two Parts of water. The solution is sprinkled on the flesh side and rubbed well by hand. The hides are then dried out and when nearly dry, the flesh is rubbed by a burnt brick which open out the pores. A second coat of the Khari solution is then applied and rubbed as before. In this way, six to ten coats are applied. If the curing is required to be heavy, it should require 10-12 coats of Khari solution. For medium and light curing, 6-8 coats are regarded as enough. The whole curing requires 2-3 days. This method of curing deposits a thick crust of the salt and earthy matter and the hides so cured are called 'plastered hides'. 'Plastered hides

remain in sound condition for a fairly long time and do not get wet in the monsoon.

**Goat skins :-** Goat skins are usually flayed in the form of bags and the skins are lightly salted with common salt for temporary preservation. The exporters or the dealers treat them in their godowns in the following manner:-

The wet salted skins are slit along the belly and opened out. They are then washed to remove salt and adhering dirt, if any. The actual curing process is done as in the case of cow and buffalo hides. Goat skins require about four to six coats. With the least coat some chalk is mixed to whiten the flesh. The curing is completed in one day and the drying is done in the sun.

About 800 lbs of Khari salt is required for 1000 goat skins.

Skins dry-salted with Khari salt in the manner described above can be normally preserved for a long period of six months without any sign of deterioration. The dry-salted skins exported from India are sometimes stored in the warehouses of the importing countries even up to twelve months without seriously affecting the quality of the skins. Since Khari salt is natural earthy deposit, the composition varies from place to place. Moreover, it is contaminated with earthy matters. Due to these reasons, and also due to its little or no bacteriostatic action (Symposium on leather auxiliaries, 1958,) a thorough study on the curing property of Khari salt has been undertaken from time to time. Das, Dhavale, and Pal recommended a mixture of 5 parts anhydrous Sodium sulphate plus 45 parts Magnesium sulphate might be the best substitute. These mixtures make the dry-salted hides and skins cleaner in appearance and also prevent any opportunity of increasing the weight of the cured hides with foreign matters.

### **Salt stains:**

Hides are sometimes found to be stained with Red, violet and blue discolourations. These stains which may appear both on flesh and grain sides are particularly visible on the flesh side of wet or dry-salted hides. When is done with lime alone the stains appear brownish yellow, but if sulphide is used they look dull green in colour. In the vegetable tan liquor these stains turn greenish blue, but are partially reduced in the tanning process by the acid formed in the tann liquor;

nevertheless showing themselves to some extent in the finished leathers. These stains are caused by certain putrefactive bacteria which offer high resistance to salts and become used to salt conditions. Used salt contains putrefactive bacteria and under no circumstances such salt should be used for curing hides and skins. To guard against salt stain damages it is strongly recommended to add a mixture of 2% soda and 1% naphthalene powder to the curing salt. The addition of soda inhibits the growth of putrefactive bacteria and naphthalene prevents to a great extent red and violet discoloration. Small quantity of soda and naphthalene present in the curing salt does not materially affect the nature and quality of finished leather. Moreover, the soda ash also tends to precipitate iron salts so that they cannot stain hides.

### **Curing with used salt**

Although curing with used salt is not a healthy practice it can be re-used under compelling circumstances after taking certain precautions. This include among others, the treatment of the hides, skins or the salt with sodium silico-flouride. Here again the used salt should be mixed with 50-60% new salt in order to maintain the iron and other impurities content as low as possible. About 2% sodium silico- fluoride should be mixed with the salt to guard against appearance of salt stains.

### **Curing by drying**

Hides and skins are also cured by drying. Two methods of drying are followed in India. They are:

- a. Frame drying, and
- b. Ordinary drying (Mamoolies).

**Frame drying:-** In frame drying the hides are stretched out by tying them to a rectangular wooden or bamboo frames. Usually the hides are stretched out more lengthwise more than breadthwise. The stretched hides are dried out under mild sun in the open yard so that drying takes place in a good current of air. The frames stand against a fixed pole in an inclined plane so that only the flesh side of the hide is exposed to the sun. The drying is done in the morning and in the afternoon. When the midday sun is very hot, the hides are kept under a shed to avoid exposure to the hot sun which will cause rapid drying on the flesh and grain surfaces forming a hard crust and thus prevent drying of the internal layers of the hides. Too rapid drying causes damage due to the outer layers becoming horny and the inner layers glutinous due to excess moisture remaining in the interior of

the hides. The hides are thus putrefied at different places which appear as blisters after soaking and liming. The blisters are caused due to putrefaction of the inner layers of the hides. Besides forming blisters rapid drying under hot sun coagulates the albumins in the hide and makes them insoluble. Although drying at higher temperature does not coagulate fibres but it makes them resistant to water absorption. Hides which have been dried out in the hot sun are soaked back with great difficulty. Whether or not a hide has been dried under the hot sun can be ascertained from the colour of the flesh. Slow drying under mild sun and in a good current of air keeps the hides softer and the flesh side yellowish in color. Rapid drying under hot sun makes the flesh side yellowish in colour. The frame dried hides are known in the trade as 'framed hides' or 'formas' and are regarded to be better than the ordinary dried (cramped) hides.

**Ordinary drying:**-Petty collectors of hides in the Indian villages do not dry the hides on frames. Usually they spread out the hides on the ground and allow them to dry out under the hot sun. This causes the hides to shrink and crumple up in the course of drying. Such hides are known in the trade as 'crumpled hides' or 'sukties', the great bulk of which are from the fallen stock.

Sometimes fallen stock are also dried by pegging them on the ground. Small slits are made at convenient distances all round the edges. Pointed pegs are inserted through the slits and the pegs are hammered down to the ground. Being pegged all round, the hides dry out in the stretched condition.

### **Suspension drying**

Suspension drying method which is more or less similar to Indian frame drying is followed in Kenya (East Africa). In this method, the hides are suspended from a horizontal pole by tying the tail and hind legs to the pole and suspending the neck downwards. The neck portion of the hide is then drawn out from the vertical position by strings which are fastened to it and the strings are fixed down with pegs on the ground along the line of shadow of the horizontal pole. The flesh side of the hide is exposed to the sun in a slanting position. Framed or suspension methods of drying produce good quality of dry cured hides.

### **Degree of drying**

The degrees of drying or the amount of moisture remaining in the dried hides depend on the amount of Relative humidity of the air at the time of drying. If the relative humidity is more the amount of moisture left in the hide is greater. Sun dried hides contain about 10% moisture. Sun dried hides or flints are relatively slow to absorb water. The difficulty which is usually met with such classes of hides is the non-uniformity of soaking.

### **Arsenication of dry-hides:**

Tanners are often vexed by the growth of insects in dry-cured hides. These insects which are called Hide Beetles cause much damage to the hair and flesh side of the hide. The damages done on the hair side is more harmful as it destroys the grain. Removal of hair in patches or even holes right through the hide are some of the signs which indicate that the hide has been attacked by the beetle. Ravages of hide or skin beetle (*Dermestes Vulpinus* F.) and Larder Beetle (*Dermestes Lardarius*) are great problems to the hide and leather trade. Hide Beetle and Larder Beetle which are world-wide in distribution live on materials rich in proteins and cause extensive damage to hides and skins, and to the baled

goods. The female beetle is reported to lay as many as 100 eggs in 25 days. The eggs hatch in from 3-5 days in to the larvae which are more ravenous feeders of the hides and leathers.

To prevent damage by these insects, the dry-cured hides are dipped in 0.25%-0.3% of sodium arsenate for a minute or two and the hides re-dried by spreading in the sun. Alternately, the hides may be immersed in the arsenic solution immediately after flaying. The hides may then be dry cured as usual. Solution of sodium arsenate is prepared by reacting white arsenic or arsenious oxide, with a solution of either caustic soda or sodium carbonate in water, as follows;

- a. *Solution by caustic soda*:- 10 lbs. of caustic soda is dissolved in a small volume of water. This causes the solution to become hot. While the liquor is still hot, 35 lbs. of arsenious oxide,  $As_2O_3$  are stirred in to the solution. The sodium arsenite solution thus formed is made up to 50 gallons with cold water. This forms the stock solution
- b. *Solution by sodium carbonate*:- 35 lbs. of sodium crystals  $Na_2CO_3$ , 10  $H_2O$  (Washing soda) or 12.9 lbs. of soda ash are dissolved in 25 gallons of boiling water. To this is added 35 lbs. of white arsenic and the boiling continued until dissolved. The solution is then made up to 50 gallons by adding cold water which forms the stock solution.

**Arsenicating bath**:-Sufficient quantity of stock solution is taken in a masonry pit and diluted 30 times with cold water. This forms 0.25-0.3% solution ready for use.

**Application of naphthalene**:-Protection against insect attack may also be achieved if the hides are sprinkled with a liberal quantity of naphthalene powder. Hides cured by heavy salting are not attacked by beetles.

### **3.0 DEFECTS OF HIDES AND SKINS**

#### **3.1 ANIMAL BREED, AGE AND NUTRITION**

A wide variety of factors contribute to hide, skin and leather characteristics and quality, ranging from physiological influences (animal breed, age and nutrition) to downgrading resulting from mechanical, bacterial and insect damage. The cumulative effects of all these factors often results in considerable economic losses due to downgrading of the resultant hide, skin and leather.

It is generally realized that the quality of hide or skin is connected with breed of the animal, and in this respect the average quality of the hides and skins in south Africa is not of the best because a large number of cattle and sheep are of inferior breeds. Only recently has the improvement due to the introduction of superior breeds been generally recognized, but nevertheless the condition of the animal, and hence the condition of its skin, is very dependent on its environment. Poor nutrition cause a hide or skin to be thinner and of poorer substance, whereas well fed animal have larger collagen fibre bundles with a higher angle of weave. Stall fed animals which have a rich diet with little exercise have good strong fibres, but tend to be rather fatty with the attendant difficulties of the excessive fat deposits experienced in processing.

In merino sheep reared mainly for wool, the skin is thin and weak and there is always a tendency of ribbiness which renders the skin virtually useless for leather making. Another defect due to breed is the presence of excessive fat deposits in the merino type of skin, but in hair sheep the fat deposits are usually located in the adipose tissue. Skins from cross-bred sheep are generally thicker than merino and less ribby but the best leather is made from hair-sheep from the hot, dry areas; this give fine-grained, good substance leather.

The climate in which the animal is raised has an effect on the substance of the hide or skin and also on the grain of the resultant leather. Animals raised in warmer parts have short hair and the leather is more compact with a smooth fine grain. Cold areas result in skin with longer hair and the skin tends to be more open-textured because of the fat deposits and the grain pattern is coarser.

#### **3.2 TYPES OF DEFECTS**

We see that for leather making, breed, nutrition and climate are important determining factors of the quality of leather but this cannot be normally

controlled. However, there are defects which occur on the skin which are avoidable, and these can be divided into four groups depending on the stage at which the defects occur.

- a) On the living animal
- b) During slaughtering and flaying
- c) After flaying and during curing
- d) During transport and storage

### **3.2.1 DEFECTS ON THE LIVING ANIMAL**

Diseases of animals need not necessarily cause eruptions or lesions of the skin, but diseased animals lose vitality and weight, the skin becomes flabby and empty and the resulting leather may be loose and lack substance. Where the disease results in eruptions of the skin, these conditions persist in the finished leather varying in intensity from poor and coarse grain to scrubs, scar tissue and even holes.

Tick bites are common on south African hides. Ticks are parasitic insects which attach themselves to the skin, puncturing the dermis and sucking blood. The female remains attached to the skin as long as two months engorging itself and causing irritation in the region of the bite. Although relatively inconspicuous on the hide, the bite of the tick shows up very prominently on the grain side of the leather. Moreover, tick-ridden cattle are usually in an inferior condition and the general quality of the hide is also affected. The presence of small scars or pits, especially on the shoulder or flank areas of the hide, is characterized as tick damage and may cause rejection of large areas of leather.

**Scratches** vary in intensity depending on what caused the scratch. **Barbed wire scratches** are deeper and more serious than those inflicted by thorns, but damage which falls into this category can be caused by steekgras, blackjack AND BURR. Whilst it is improbable that thorn or seed damage can be eliminated, better veld management will reduce the incidence; barbed wire scratches should not be tolerated.

**Horn marks** are caused mainly when cattle are herded together, especially when they are transported by fall. Considerable damage is done to both hide and meat because of horns and 75% of the cattle slaughtered in controlled areas still have

horns. **Whip lash** and **goad marks** also arise from bruising of the skin and underlying tissue.

BRAND marks are one of the most difficult forms of defects to contend with. Enormous losses arise due to irresponsible branding since the most valuable part of the hide- the butt area (corresponding to the rump of the animal) yielding the best leather, is usually damaged. It is common to find hides bearing 2 or more brands of varying sizes, frequently on both sides of the animal. The scar tissue which forms is very deep and in some cases penetrates right through the flesh. These marks cannot be camouflaged by the tanner and in any case the normal fibrous nature of the hide is destroyed in the region of the brand. Over 80% of the cattle slaughtered in controlled areas are branded on the butt.

### **3.2.2 DEFECTS DURING SLAUGHTERING AND FLAYING**

a wide variety of defects originate at the abattoir and in many cases the skin is damaged or loaded with blood or dirt before it is removed to be cured.

Offloading from delivery vehicles is often done in a hurry so that the frightened animals jostle each other causing horn damage or bump up against rickety fences and are herded into badly designed and overcrowded pens. From the stunning boxes the animals are frequently carelessly dumped onto the floor which results in bruising. In some cases, due to bad abattoir design, the animals have to be dragged across dirty rough floors so that mechanical damage is done to the hide(drag marks) and the hide also becomes contaminated by being coated with manure and filth. In the case of hides, such dirt may be washed off, but the washing is seldom done efficiently if at all. Sheep-skins cannot be washed because the wool or hair will absorb much water that drying becomes very difficult.

Adhering blood or dirt retard the rate of salt penetration in curing and are sources of bacterial infection.

Improper facilities for bleeding results in the contamination of the hide, and lack of bleeding rails results in inadequate blood drainage and the small cutaneous blood vessels will remain full of blood. Any blood retained by the blood vessels will be denaturing causing stains which often persist to the final leather.

The recognized opening procedure should be carefully observed since a good pattern hide is essential if wastage and excessive trimming is to be avoided.

The quality of flaying in Arid and Semi-Arid Lands(ASALs) of the country is generally low. Careless use of the knife or the use of incorrect flaying knives spoils the shape of the hide and causes disfigurement through cuts, scores, gouge marks and holes. Bad flaying also results in patches of fat and meat being left on hides and skins which are seldom removed by fleshing before curing. Such fat and flesh retard salt penetration and result in bad appearance of cured stock. It can be said that with application of moderate degree of skill on the part of the flayer, there is no reason why the vast majority of flaying defects should be avoided.

### **3.2.3 DEFECTS AFTER FLAYING AND DURING CURING**

Damage to skins often results BECAUSE the skins are not quickly cooled and washed to reduce bacterial attack and remove contaminating substances. More important damage will result if the curing operation is too long delayed so that bacterial putrefaction commences and proceeds unchecked. Curing should commence immediately the body heat has gone, because apart from bacterial action, localized drying of parts of the hide results in patchy cure.

Badly designed curing shades may result in considerable losses. Rough floors will damage hides being dragged over them, and incorrect staking may give thin, papery flanks or result in permanent folds. Inadequate drainage causes hides or skins at the bottom of stacks to lie in pools of dirty brine.

In salting, bad curing may result if the salt is impure and if excessive blood is retained in the hide. Used salt is impure and may cause salt stains which are usually pink or blue in colour when the hair has been removed; in advanced cases, the grain surface is usually pitted. Salt stains are caused by halophilic bacteria acting in conjunction with iron in the blood and the stains are scattered over both flesh and grain.

In brining, the proper concentration of salt must be maintained, dirt must not be allowed to accumulate and sufficient antiseptic agent must be present to keep the brine sterile.

Drying as a cure is fraught with risks. Up to 35% of ground dried hides have to be discarded by the tanner because they are unusable and this method of curing is condemned because of the following defects;

- a) Decomposition results because bacteria thrive in blood, dirt and moisture. Any part of the skin which touches the ground dries more slowly resulting in putrefaction and damage to the grain side.
- b) Excessively rapid drying of the surfaces traps moisture causing blistering and gelatinization.

- c) Exposure to the sun can cause over drying which gives brittle stock impossible to wet back properly.
- d) Exposure to the sun may melt the fats causing them to penetrate the skin. Subsequent processing of these areas will be difficult.
- e) Suspension drying in frames while though superior to ground drying, may result in misshapen or distorted material if laced too tightly.

### **3.2.4 Defects caused during transport and storage.**

At the transportation stage, damage can be caused by insect attacks, rats and mice, leaking roofs or poorly ventilated storage rooms, dampness from cement floors, overheating or excessive drying (if stored or shipped too close to boilers) and contamination from other merchandise or packing material.

An **enormous amount of damage** is done by **hide beetles** (Dermestidbeetles) and in the case of woolskins also frying moth (Teneid moth). The use of suitable insecticides to protect the skins from insect attack is complicated by the fact that the insects develop immunity. Rats and mites are usually more easily controlled, but the amount of damage caused by rodent infestation is considerable.

Improperly constructed or inadequate store rooms can cause extensive damage. Leaking roofs may let in the rain, washing away the curing salt and increasing the moisture level to permit bacterial activity. In the same way dampness from cement floors may permit mould growth and putrefaction and goods intended for long storage should be stacked on slatted wooden platforms with adequate air circulation.

Skins that aren't protected from the drying action of hot dry winds may become excessively dry and difficult to wet back. Unduly high temperatures as, for example, close to boiler rooms, may cause denaturation and gelatinization.

Bundling or bailing for transport should be performed carefully and the bailing should be neither too loose nor too tight. The correct bailing should be used, and should not be wire, as this may cut the goods or strain them with iron. If the skins are to be transported with other goods, they should be protected from contamination. Hessian is frequently used as wrapping material, but is not ideal.

## 4.0 IDENTIFYING HIDE AND SKIN DAMAGE

**Mechanical damage** is usually easy to see. Barbed wire and thorn scratches, brands, flay cuts, horn rakes, are all **clearly visible on the raw hide**. Diseases especially those causing lesions on the skin, and tick damage can also be seen during hide sorting. Other diseases and the results of **poor nutrition are not so readily identifiable** on the skin although hides these animals are generally thin and empty with loose, flabby flanks.

**Bruising and drag marks** caused during slaughtering are not so easy to identify, although there is generally blood staining on the flesh of the skins from bruised animals. Skins that are obviously dirty with accumulation of blood and filth or caked with manure must be viewed with suspicion since these have probably not been bled properly and have probably from poorly controlled slaughterhouses. **Large areas adhering fat** and flesh will probably completely raw with putrefaction and degradation occurring.

**Delayed cure or undercuring** may be detected by a tendency to hair slip and an offensive odour, but this evidence may also point to hides damaged by wetness leaching out the curing salt. The presence of red or pink discolourations on the flesh is an indication of "red heat" which in itself is not a serious condition, but if the red heat bacteria can thrive, other bacteria of the type that degrade hides may also be present.

Any indication of horniness means that there has been fibre collapse and possible gelatinization. These areas will either not rehydrate properly or will dissolve and leave holes in the leather.

Mould growth probably means that the hides have been kept in a damp store for a long time and are stale, but the damage may not be extensive. **Beetle damage is very obvious** and the damage they can do is well known to all who work in tanneries.

To sum up, damage will occur if the hide is not a reasonable amount of care by prompt curing. Hides having a low salt content or showing hair slip should be processed immediately. Likewise those skins badly contaminated or showing red heat or having an offensive smell should not be stored for fear of aggravating any damage already present.