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Environmentally Sound Leather Tanning

By: Jaap Kok

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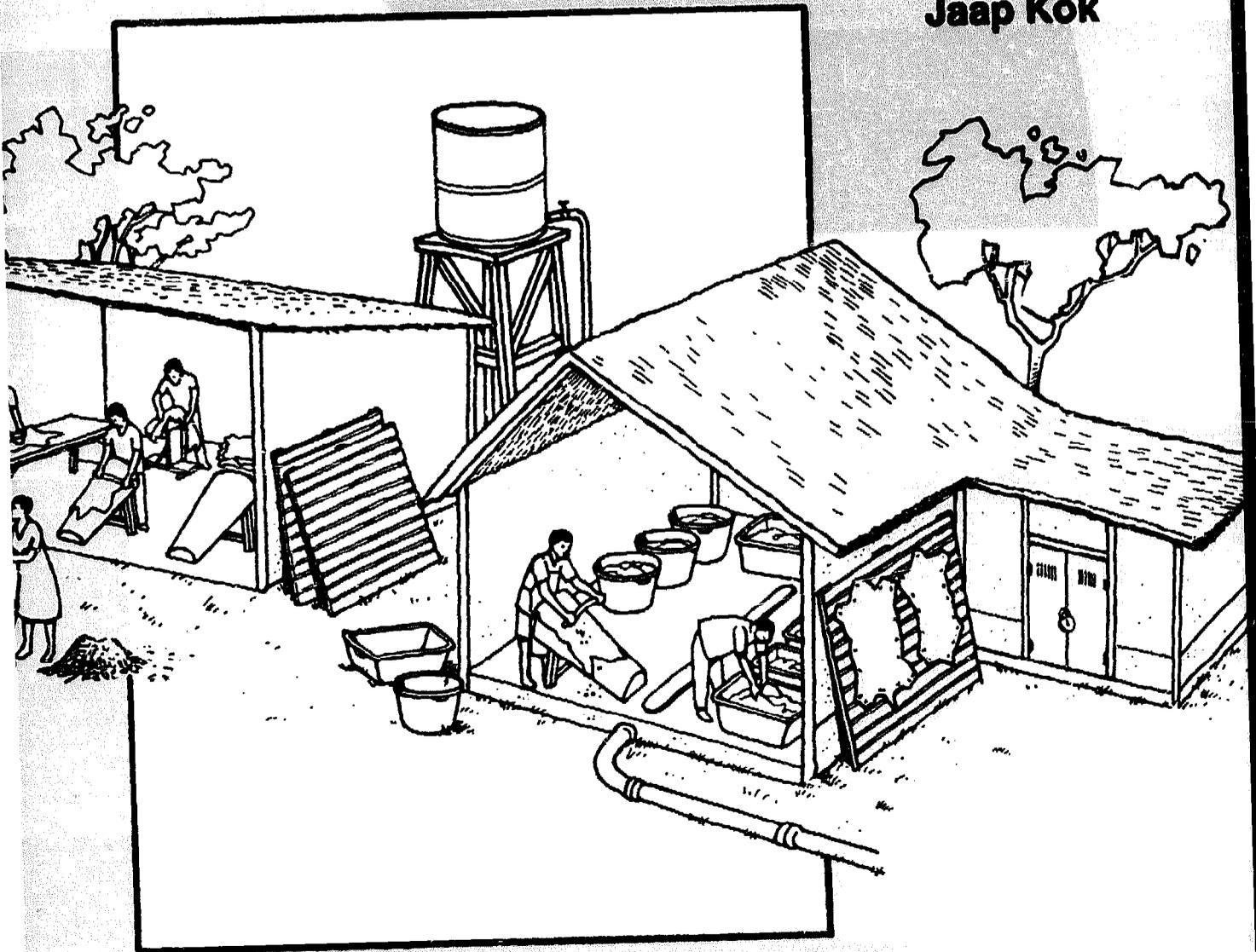
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Environmentally Sound Leather Tanning

**A course on small-scale techniques
and management**

Jaap Kok



TOOL

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Environmentally sound leather tanning

**A course on small-scale techniques
and management**

Jaap Kok



Transfer of Technology for Development – Amsterdam

Environmentally sound leather tanning is aimed at people in developing countries, starting a small tanning enterprise or intermediaries supporting these people. Besides tanning theory and techniques, this publication discusses practical guidelines for the establishment of a small-scale or even a micro-scale tannery. The tanning method described uses local available, vegetable, and therefore environmentally sound base materials. The tools needed, do not require big investments and can be locally made. Special attention has been paid to cost calculation and pricing.

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1 Preface

This book is based on a tanning course, given by the author to a group of people involved in the Msekhocika Village Orientated Development Program in Zambia. The book is aimed at people wanting to start a tanning enterprise, but who find it hard to start with the knowledge they obtained from more theoretical books. Books which probably describe advanced methods of tanning. Methods to be applied on an industrial level in big factories, with machines, chemical products and big investments.

This book is meant to be a course and a practical guideline for those who want to tan five or ten goatskins that can be obtained from the local butcher weekly, with material from around the village and with tools that require a small investment. In this book the word *practical* will be more important than the word *scientific*. However, we give simplified background information on the steps involved in the process of transforming a skin into a piece of leather.

The first four chapters discuss the theory. We think the reader needs to know a little about the theory to be able to understand the tanning process. The rest of the book describes tanning in practice.

We describe the tanning of goatskins, because they are small and therefore easy to handle. The leather can be used for many purposes. And once someone knows how to make his or her own goat leather, it will not be very difficult to tan other types of skins, since tanning principals are the all same.

In general, this book describes one method of tanning, the one applied in Msekhocika, Zambia. However, there are many ways of tanning and other possibilities are being discussed as well.

1.1 Acknowledgements

Special thanks to Malami Cambai, Sang da Costa, Alfonso da Silva and the colleagues of Bachil (Guine Bissau) for all the knowledge transferred.

1.2 How to use this book

This book is divided in two parts: *Tanning in theory* and *Tanning in practice*. Read

the book carefully before you actually start tanning, to get a good idea of what is all involved in tanning.

If you want to start tanning, the chapters in part *Tanning in practice* will be your guideline. It is very important you make the inquiries described in chapter 7. Therefore this will be the first chapter you will put into practice. Using the results from your inquiry you will have to make some calculations using chapter 14. At this point you have to decide whether you are able to manage a profitable leather tanning enterprise.

From chapter 8 the aspects of vegetable tanning are described, from preparatory activity, daily work and finishing up to trouble shooting.

The last chapters give more and very important information on environmental and economical aspects of vegetable leather tanning.

Tanning in theory

2 History of leather

Since many, many ages people have used the skins of animals for clothing and footwear. Since a skin is not very useful when dried – it is hard – the first use of skins was probably after people discovered that when the skin was smoked, its characteristics changed and it would not easily rot any more.

It did not take a long time before people discovered that the use of a solution with animal fat and brains in which the skin was held for some time improved the waterproofness and suppleness of leather. Even nowadays there is still a technique of tanning which is based upon the use of fats.

In various regions of the world, different methods for tanning were invented, since conditions like climate, vegetation and the availability of minerals were different.

It is very likely that vegetable tanning, the way of tanning explained in this book, was invented in Africa. The leather produced in this way is recognized as one of the best kinds of leather.

We all know the importance of leather as it is useful for shoes, belts, harnesses (for animal traction), strings, furniture, clothing and so on. Methods of leather tanning are:

- 1 ***Vegetable tanning***
This method uses materials from plants like bark and pods.
- 2 ***Chrome tanning***
This method uses chromium-salts.
- 3 ***Synthetic tanning***
This method uses artificially made tannins.
- 4 ***Other methods***
Like oil tanning or aluminium tanning.

In modern tanneries several tanning methods are used together in different combinations.

Leather is the skin of animals, prepared and conserved in such a way that even after being in wet condition for some time, it will not start rotting and it will keep its qualities like suppleness, strength and resistance to temperature. Simply said:

Skin + Tannin = Leather

3 Vegetable tanning

As we have seen at the end of the first chapter, we can prepare a skin in such a way that it turns into leather. This can be done using one of many possible products. In vegetable tanning we use products which we can prepare out of plants or parts of plants.

Skin + Vegetable tanning material = Leather

We choose to promote the method of vegetable tanning because:

- The required base materials can be found in the neighbourhood. Nothing has to be imported from remote areas.
- All kinds of leather can be produced using this method, like upper leather for shoes, harness leather and even sole leather.
- Vegetable tanning does not harm your environment, if you are careful with wastes and trees. Wastes like lime and leached-out bark can be used for making compost. Treated waste water can be used for spraying the vegetable garden.

Vegetable tanning can be done on a very small scale with simple tools. There is no need for machines, even when preparing larger quantities.

The quality of the leather can be controlled in many ways, as we will see. The quality depends on the skills and the care taken by the tanner.

Tannin, one of the products we use in tanning, is the most important product when turning a skin into leather. This tannin is found in a lot of trees or parts of trees. In the Msekhocika area in Zambia the following tannin resources were found and used in tanning experiments:

- The seeds of *Dicrostachys Cinerea* = *Kalumpangala*.
- The bark of *Piliostigma Thonningii* = *Msekese*.
- The bark of *Pterocarpus Angolensis* = *Mukwa*.

- The bark of *Brachystegia Speciformis* = *Mputi*.

Certainly there are many other trees to be found, which can be useful.

The most common solution of tannin is black tea. In some areas it is used for tanning. Some people will know that tea without sugar is a cure for diarrhoea. In fact it tans the intestines a bit, which causes the cure. Local medicine men know herbs with the same effect. In order to find out which barks or roots are useful for tanning, you might consult a local doctor or perform some try-outs.

A try-out involves putting a piece of prepared raw skin (refer to chapter 4) into a solution of ten parts of water and one part of dried and grounded bark or pod sample. This solution will have a brownish colour and should be stirred or shaken from time to time. Twice a day you take out the piece of skin and stretch it. After stretching you put it back into the solution.

After five days you take it out, wash it in clean water and dry it. When more or less dry, you try to knead and stretch it to see if it turns soft and supple. If so, you know that there is tannin in your sample. If it stays hard or if it breaks, there is probably no or not enough tannin in your solution.

Perform these try-outs in plastic or glass jars and do not use tins or iron utensils, because iron will stain the leather.

Good books on trees also give information about the tannin contents of different parts of the tree. At the end of this book you will find a summary of well-known tannin sources.

4 Skins

Skins are a valuable raw material. During life the skin protects the animal from cold, heat, diseases and violation. Skins of different animals have different qualities. You can distinguish the leather from a cow from the leather from a goat. The design of the hair side (grain) is different. But there are other differences like thickness, handle and feel.

The skin can be divided into three layers:

- 1 Outer layer = *epidermis*
- 2 Leather part = *corium* or *dermis*
- 3 Connective tissue = *hypodermis*

An enlarged skin, seen from aside under a microscope, looks like the drawing in figure 1. Only the leather part, the corium, is used for leather production. The outer layer, the hair and the connective tissue have to be removed before the actual tanning. This is done in a chemical and mechanical way during the so-called beam house process.

The corium consists of bundles of fibres of a protein called *collagen* (this protein forms glue when boiled). These bundles of fibres are more interwoven at the outside of the skin and form the so-called grain layer: the smooth hair side of the leather. On the inside the bundles are coarser and wider. This is the more fibrous flesh side of the leather.

In between the fibres and the bundles of fibres is a cementing substance. This substance functions as a greasing factor in a live skin, but glues the fibres together when the skin is dried. This makes a dried skin so hard and therefore useless for leather work. This substance is also removed during the beam house process and is replaced by tannin in the tanning process (refer to figure 2).

4.1 Preservation of skins

If after slaughtering of the animal the skin is not processed immediately (within a few hours), it has to be preserved. Otherwise it will start to decompose and rot.

To preserve a skin we have to stop the growth and development of microbes, which can putrefy the skin. Microbes require a certain amount of moisture. Therefore a skin

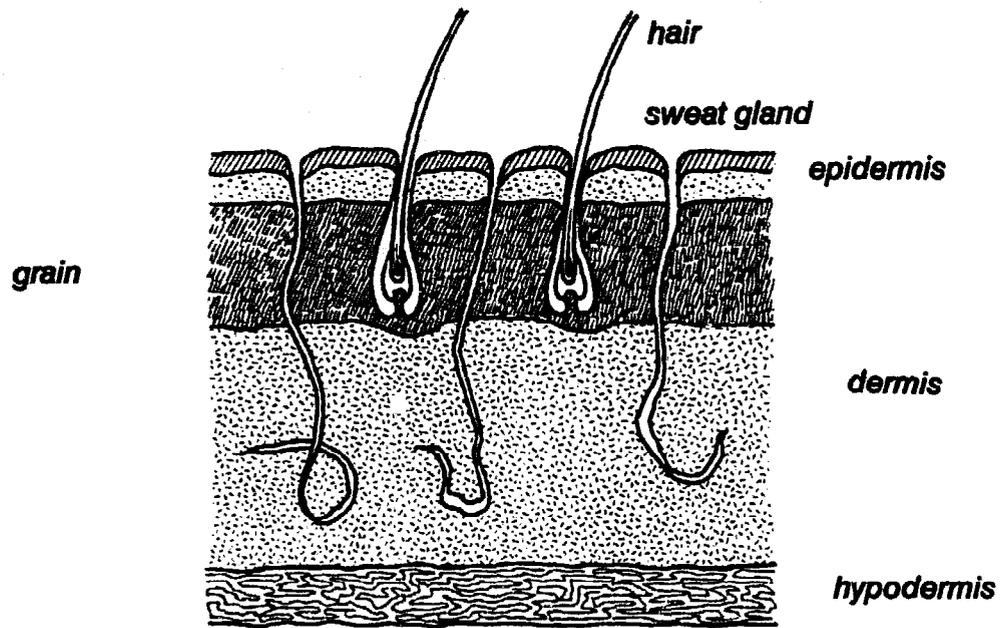


Figure 1 – Skin as seen under a microscope

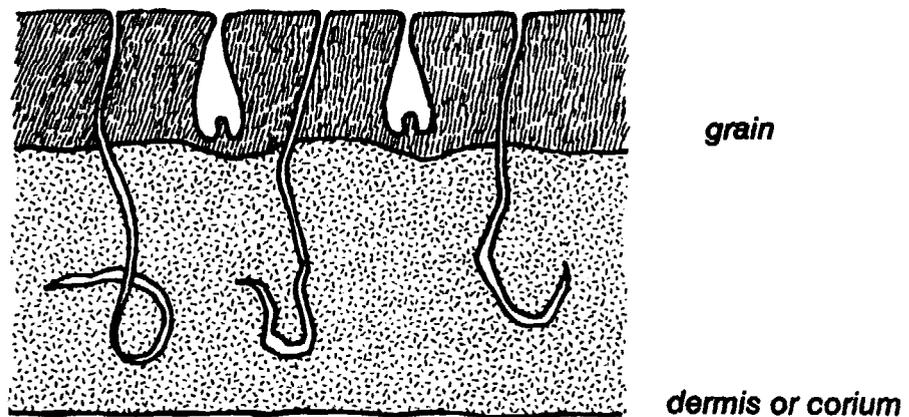


Figure 2 – A prepared skin

can be protected against decay or putrefaction by drying it. So long as it remains dry, it is immune for decay, because the microbes cannot be active.

There are more ways to preserve a skin than just drying. Preservation is also possible using salt (30% salt on the green (live) weight of the skin) or dry salting, which is a combination of salting and drying.

These methods will only have good results, when executed properly. In some regions salt is expensive and hard to get. Because drying is a good method, we will describe this preservation method.

4.2 The drying of skins

For drying wind is more important than sunshine. Drying of skins can be done by nailing the skins, with the flesh side up, on a frame or a board. These frames can be put outside, in an upright position (refer to figure 3). If we lay the frame on the floor, the sunrays will beat too hard on the skin and heat it too much. This heat will damage the skins unalterably.

If the frames are in an upright position, the skins will not moisten that fast when it starts to rain unexpectedly. If the sun is very hot, it will be better to put the frames in the shade.

Two other methods are shown in figure 4. Watch the position of the skins in regard to the sun's position and movement. The skins are placed in such a way that the sunrays will never fall on them in an angle of 90° to prevent the skins from getting too hot.

The advantage of using frames or boards is that you can put these in the shade or inside when the sun is too hot or when it rains. It is also better to put the skins inside at night, so that dew will not moisten them in the morning.

The skins should be completely dry before you store them. In very hot or dry climates the skins may appear to be dry, but only the outside of the skins may be dry and at the inside they might be still damp, so microbes still can damage them!

4.3 Quality and defects of skins

The quality of leather depends a lot on the quality of the skins. Defects on the raw skins are discussed in the next paragraphs.

Defects caused during life of the animal

The skin may suffer from attacks by other animals or by rubbing against a tree or scratching against barbed wire.

Also man may do harm to the skin, by beating the animal with a stick. Cowhides

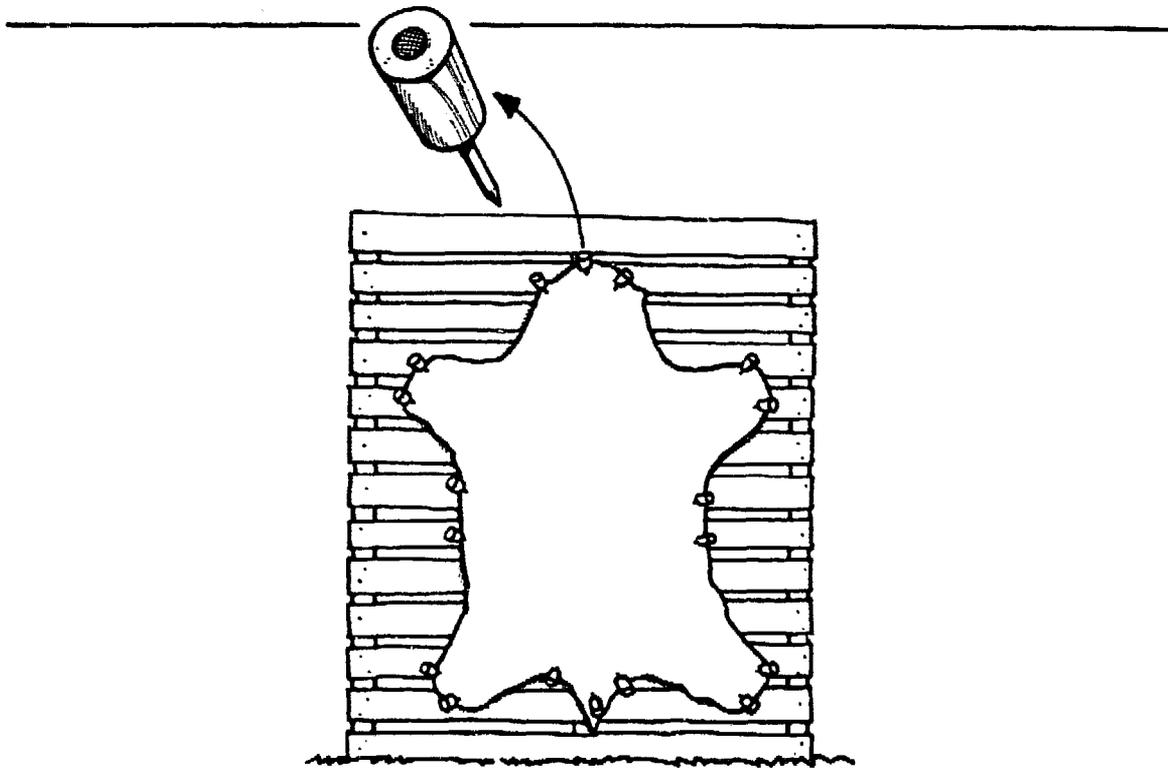


Figure 3 – Skin on a frame for drying

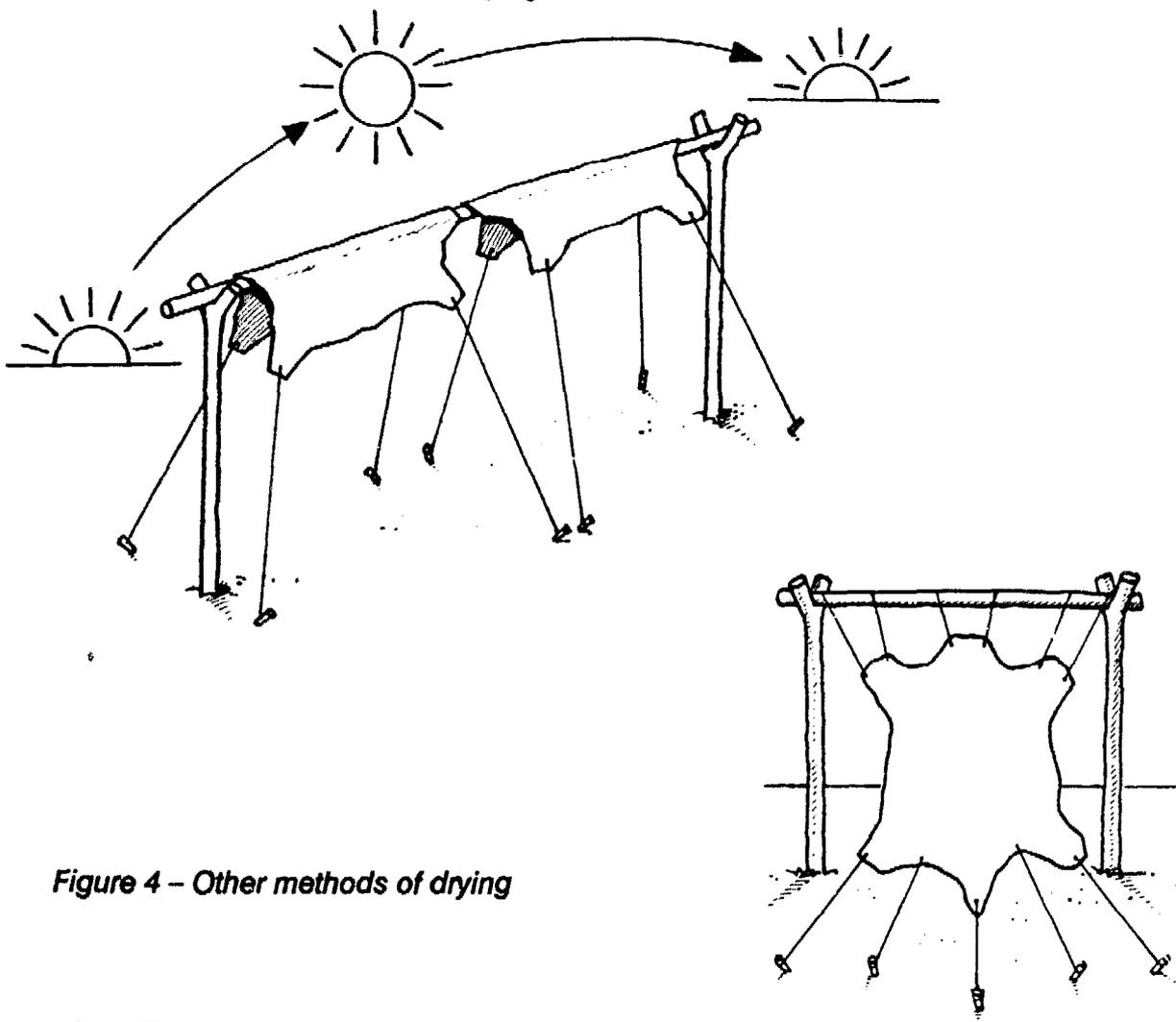


Figure 4 – Other methods of drying

often show defects caused by branding of the animal.

Parasites and diseases are another group of causes for skin defects. Gadflies lay eggs in the skin and the larvae eat their way through the skin. They are mostly recognized as round holes at the back side of the skin. Ticks also cause damages.

Some skins are worthless because of the effects of diseases like scabies or sores. They all leave their scars on the skins. Do not buy skins, if you see any of these defects. For example, lack of hair is an effect of scabies.

Never tan skins from animals that have suffered foot and mouth diseases or any other disease dangerous for people.

Defects caused during flaying

The use of a knife during flaying is always dangerous. Flaying marks are often seen along the backbone and the flanks, where the butcher has cut into the skin with a knife. These defects decrease the value of the skin a lot.

The best way of flaying a goat is by pumping air between the skin and the carcass. Therefore we make a small cut in the rear leg, where we put the pump. By pumping air between the carcass and the skin, the use of a knife to release the skin will hardly be necessary. During and after this pumping, it is good to pull the skin and to hit it with your hand or a blunt stick. In this way the skin releases easily.

The opening of the skin should always be done along right lines to get the right shape of skin (refer to figure 5). The opening should only be done after pumping. Then releasing the skin from the carcass is no more than taking off a coat.

Along the backbone you sometimes have to use your flaying knife a little bit (refer to figure 6). The flaying knife should have a rounded tip to prevent from cutting into the skin while flaying. After flaying, clean the skin from blood, manure and other dirt by washing it. If it has a lot of flesh on the inside, it is good to scrape this off.

Defects caused during preservation

You always have to dry the skins, if you are not going to tan them immediately after flaying. For drying, wind is more important than sunshine. Sunshine can damage the skin, when it heats the skin too much. The heat will change the skin substance and the skin can not be tanned properly any more. You can compare the substance of the skin with a raw egg. If the egg is cooked, it changes completely. If the skin gets too hot, it gets cooked and it changes so much, that it cannot be tanned afterwards. So you have to prevent the skin from too much sun heat.

Before storing the skins, they should be completely dry. Sometimes they look dry, but are still fresh inside. While stored, the rotting will start and damage the skin. During liming you will see this because the skin falls apart or splits. Skins which are not completely dry attract microbes and insects. Their effect can be noticed by showing loose hair, especially along the backbone, where the skin is thicker and therefore harder to dry thoroughly.

Defects caused during storing

A store should be a well ventilated, dry and cool room. The skins should be stored in a place where no dogs (or hyenas), mice or rats can reach them. Check the skins from time to time on insects and mould. Putting them in the sun for a while makes some of the insects run off and will dry the mould.

Do not store the skins directly on the floor, but put them on pallets. Never store skins over a fireplace, as the smoke (and the heat) will change the composition of the skin in such a way that it cannot be tanned any more.

Try to organise your skin store in such a way, that the first skins entered in the store, are also the first to go out (*FIFO*: first in – first out). In that way no skin will stay in the store for very long.

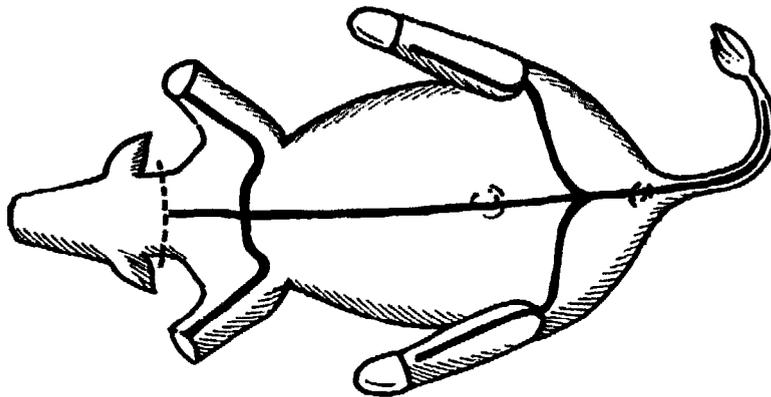


Figure 5 – Opening of the skin (thick lines)

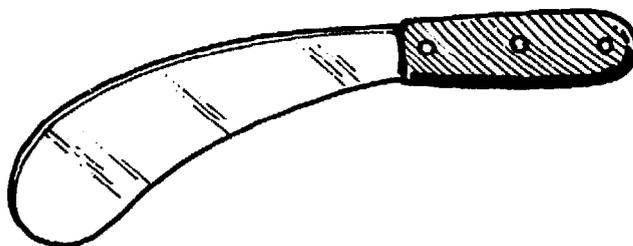


Figure 6 – Flaying knife

5 Tanning

A tannery can always be divided in two sections:

- 1 the *beam house* or *lime yard*
- 2 the *tannery* or *tan yard*

5.1 The beam house

In the beam house the skins are prepared in such a way that they can be tanned in the tan yard. As we have seen already, we only need the corium, the leather forming layer, to make leather. So the rest of the skin, the epidermis and the hypodermis and also the hairs, must be removed in the beam house (refer to figure 7).

As we have also seen the corium consists of fibres, which are kept together through a cementing substance. When the skin is in live condition, this substance lubricates the fibres and makes movements in the skin possible (refer to figure 8).

However, when the skin is dried, the substance glues the fibres together and makes the skin hard (refer to figure 9). Because we do not want our leather to be hard and stiff when dry, and soft and flexible in wet condition, this cementing substance also has to be removed. When the cementing substance is removed, the fibres in the skin are missing their interlink (refer to figure 10).

Another task of the preparations in the beam-house is the opening-up of the skin, so it will be easier for the tannin to enter the skin and to make its connections to the collagen (refer to figure 11).

5.2 The tan yard

In the tan yard, the removed cementing substance is replaced by tannin. The tannin forms the new interlink between the fibres and this turns the skin into leather (refer to figure 12). This linkage is a stable one, which also remains when the leather is put into water. So even when our shoes are wet, the leather stays leather and my shoes do not start rotting.

A tanned skin does not swell or shrink by absorption or release of water. The skin is more temperature resistant and also more resistant to putrefaction and to chemical or mechanical influences.

In the beam house also a part of the natural grease of the skins is removed. During

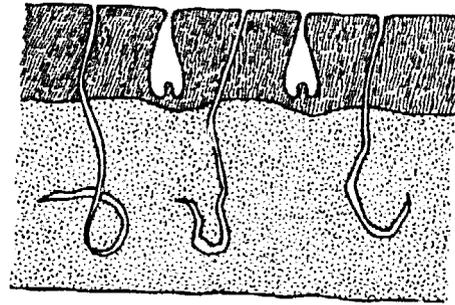
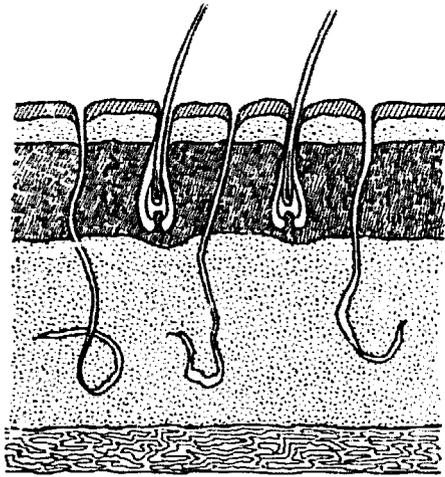


Figure 7 – Complete skin (left) and corium (right)

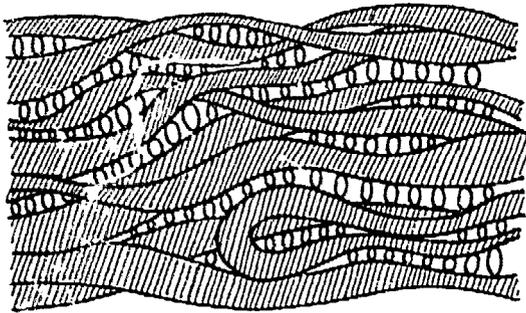


Figure 8 – Lubricating substance in the skin

Figure 9 – A dried skin

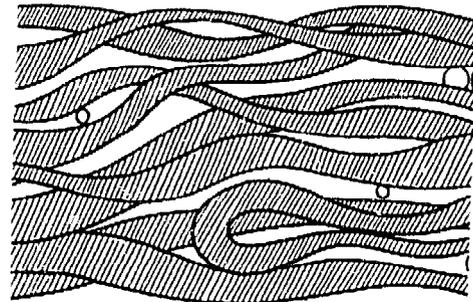
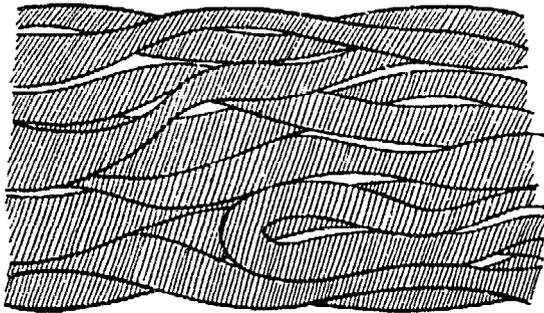


Figure 10 – A swollen limed skin

Figure 11 – A delimed and bated skin

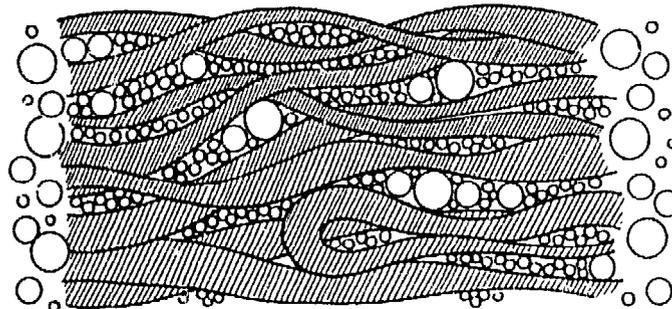


Figure 12 – Tannin: the new linkage in the skin

or after tanning we have to restore this grease level.

In the finishing process the leather is treated in several ways, to give it the desired appearance and particular handle.

The steps involved in the beam house and tan yard processes are:

Beam house

- Soaking:**
 - cleaning of the skin
 - replacing the water
- Fleshing:**
 - mechanical removal of flesh and connective tissue
- Liming:**
 - loosen the hair
 - destructing the epidermis
 - loosening up the fibre structure (removal of the cementing substance)
 - saponification of fats
 - plumping (swelling)
- Unhairing:**
 - mechanical removal of hair and epidermis
- Deliming:**
 - removing/neutralizing the lime by washing with water and chemicals
- Bating:**
 - remove the swelling
 - remove or loosen the dirt
- Scudding:**
 - mechanical removal of remnants of hairs, lime, dirt etc.

After these operations the skin, now called *pelt*, is ready for tanning.

Tan yard

- Tanning:**
 - the gradual permeation of tannin into the skin
- Retanning:**
 - stuffing of the skin with tannin
 - maturing of the leather
- Finishing:**
 - to give the leather protection against mechanical damage, moisture and dirt
 - to give the leather its desired appearance and particular handle

In the tanning process described in this book we will use the following products:

- soaking:**
 - caustic soda/wood ashes/soap
- liming:**
 - slaked lime
- deliming:**
 - lemon vinegar/other mild acids
- bating:**
 - papayotin (from papaya)
- tanning:**
 - vegetable tannin
- retanning:**
 - vegetable tannin
- finishing:**
 - palm oil/ peanut oil/ soap etc.

6 *The products we are working with*

Products we use in the beam house are mostly *alkaline*. Alkaline products are for example: soda, lime, soap and ashes from wood. Products used in the tan yard are mostly *acids*. Most important is the solution of ground bark or pods in water. Other acids are vinegar, lemon juice, battery acid etc. Acids taste sour, like lemon. These products are called chemical products and they are studied in a science called *chemistry*.

6.1 Chemistry

Chemistry is the science that studies the changing of substances. When we lighten a match, there is a reaction: the match will never turn back the way it was. The change is definite. A new product has been formed, namely ashes.

If we put certain products together under certain conditions, we may see changes that are irreversible. The products cannot be transformed back into their original form. You can never make wood out of ashes.

The making of leather is such a process. When you have made real leather, it will never transform into a skin again. In the tanning process we will see several chemical reactions. Therefore tanning has to do with what is called chemistry.

6.2 Solutions

Several products are soluble in water. Some products, when dissolved together in water, will form a new, different product. Two completely different products can form another one, which does not have the characteristics of any of both initial products.

We can divide solutions in three groups:

- Alkalines
- Acids
- Salts

The *alkaline* solutions feel slippery on our skin and they taste more or less like soap. With oil or fat they will form a kind of soap. Examples of alkalines are: lime, ashes dissolved in water, soda etc. The fact that alkalines, like soda or lime in our case, react with fats and form a kind of soluble soap, is used in tanning.

Strong alkalines are dangerous, so be careful with caustic soda. This is a very strong alkaline. Never touch it with bare hands when it is not diluted many, many times.

In chemistry people have developed products that can show if there is an alkaline in water. For this they use a product called *phenolphthalein* (figure 13). We will use this product to see if there is still lime in our skins after the deliming process.

Phenolphthalein does not have any colour; it looks like water. But if we drop a bit of it on the cut of a skin which still has some lime in it, it will turn red or pink (when there is very little lime in the skin).

To make a indicator solution dissolve 1 gramme of phenolphthalein-powder (a yellow powder) in a mix of 90 ml of pure alcohol and 10 ml of water. Add 100 ml of water and your indicator is ready.

Also pH-paper changes colour when put in an alkaline solution. Especially in the beginning you will need indicators to know if our skins are delimed or if the soaking solution is not too strong alkaline.

Acid solutions do not feel slippery on the skin. The feel is more roughish. They taste sour, like lemon or vinegar. Examples of acids are vinegar, lemon juice and battery acid. Strong acids react aggressively to nearly everything touched by them. If you spill battery acid on your cloths it will burn a hole in them.

Be careful with strong acids and in general with strong chemicals!

In our tanning process we will not use strong acids. Acids do not change the colour of phenolphthalein. They can be indicated with Ph-paper.

When we put the same quantity of acid together with the same quantity of alkaline, the solution will be neither acid nor alkaline but *neutral*. This phenomena we use in deliming when we neutralize the lime in the skins by adding vinegar to them. By doing this a soluble *salt* is formed that we can wash out of the skins. The solution will not turn phenolphthalein red and also pH-paper will not indicate the presence of acid. To indicate how acidic or how alkaline a solution is, it is given a pH-value, which indicates the degree of acidity or alkalinity. A neutral solution is given a pH value of 7. A strong alkaline solution can go up to a pH of 14 and a strong acidic solution will

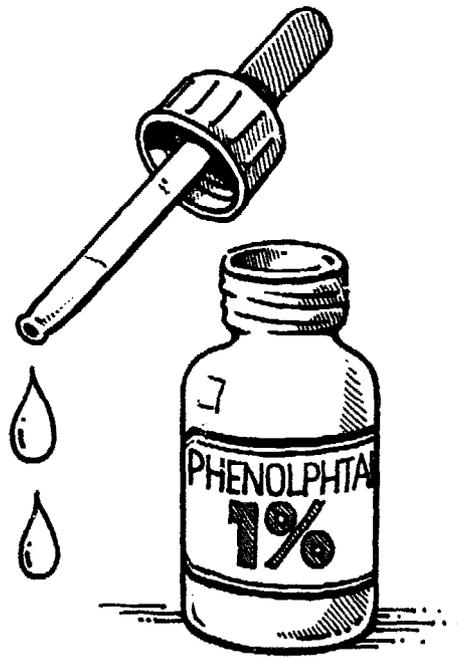


Figure 13 – Phenolphthalein

have a pH of less than 1. So the range is from 0 (very high acidity) via 7 (neutral) up to 14 (very alkaline).

Strong acids and strong alkalines are dangerous for our bodies but also for leather. So in the tanning process we will never work with solutions with a pH over 10.5 or under 3.5 (refer to figure 14).

Resume:

- Solutions in water can never be acid and alkaline at the same time. They are either acidic, neutral or alkaline.
- The first stages in tanning use alkaline solutions (pH 7 – 14) and via neutral the last stages use acidic solutions.
- pH paper indicates acids as well as alkalines.
- After some time, when you are more experienced in tanning, you will know the pH of solutions by the quantity of products added. In the beginning it is good to use the indicators frequently.

Acids, alkalines, salts are soluble in water. But not all substance used is soluble in water. An example is lime. Only about 1.5 gram of lime will dissolve in clean water. If more lime is added it will not dissolve but form a deposit at the bottom. Salt and sugar are soluble in water, but also to a certain extend. They also will form a deposit at the bottom when we put more in the water than can be dissolved.

In hot tea sugar will dissolve better than in cold tea. So we see that temperature influences the process of dissolving. If we try to make tea with cold water, the water will stay clear. Slowly it will get its brown colour. This is the same with the 'tea' we make out of ground bark or pods, for tanning.

What happens if you put some very clean sand in a cup of water? The water stays clear and the sand settles on the bottom. If you do the same with ground bark you will see something else. The ground material also settles on the bottom, but the water becomes coloured, like tea. So a part of the bark dissolves. This part contains the tannin that you will need for leather production. The water will transport the tannin from the bark to the skin. By stirring the tanning solution from time to time the skins can get into contact with more tannins.

But how do you know how much tannin is dissolved? The tannin has a certain taste and if you put a bit on your tongue you can 'taste' it (it dries your tongue). Tannin often is acidic, so the pH value should tell you something about the strength of the solution as well.

But there is a better way to find out. This is done by using a *baumé-meter* (refer to figure 15). The meter is a glass bulb with some lead at the bottom. It has a hollow corpse with a tube on top. In the tube there is a paper with numbers written on it.

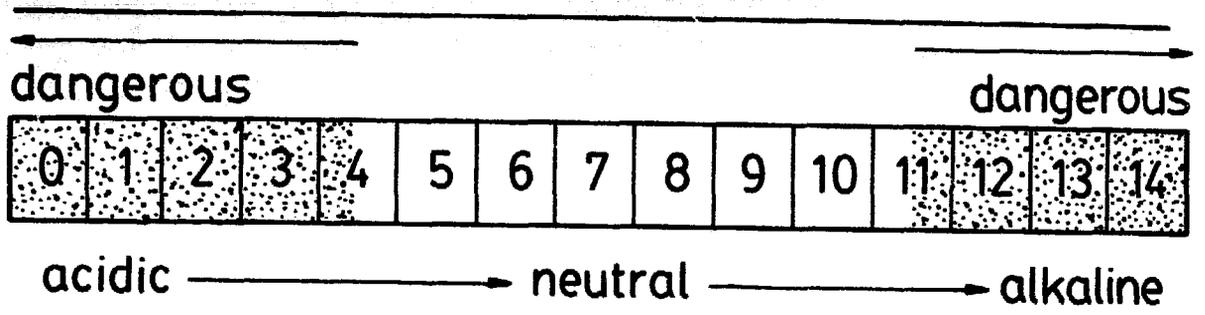


Figure 14 – A pH scale and its meaning

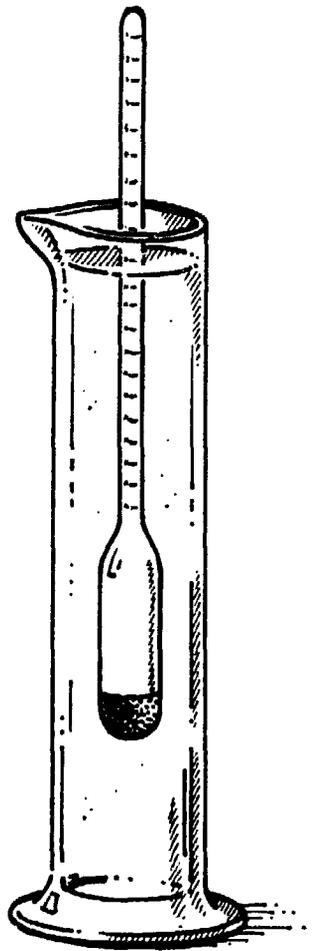


Figure 15 – Baumé meter

When more tannin is dissolved the meter will float higher and will read a higher number. When we put the meter in a filtered tanning liquor the strength of the solution can be read. Later on we will see how strong a tanning liquor should be and that it is dangerous to start using too strong solutions.

6.3 Vegetable tannin

As we noticed before, vegetable tanning means changing a skin into leather by means of a product called tannin. This tannin we extract (getting dissolved) from dried bark, pods, leaves etc. of plants. Many plants have tannin in them, but sometimes contain so little that we would need a lot of bark or pods to get a little bit of tannin. There are different kinds of tannin. Their effect on skins is also different. Some tannins give nice soft leather, others give a harder leather. Therefore we have to select our tannin and sometimes mix two or three kinds of tannin, to get the required quality of leather.

Some characteristics of tannin:

- 1 Tannins have a complex chemical structure, each different for different kind of tannins. In water tannins can be dissolved to a certain extent. The dissolved particles are of different sizes (figure 16). In solution it is weakly acidic: the pH is under 7.
- 2 Tannins react with iron and cause black stains on the leather. Therefore never use iron containers or tools in the tan yard.
- 3 Tanning solutions react with air and will become darker.
- 4 Any kind of protein added to a solution of tannin will be 'attacked' by them. The protein is being tanned. The tannin connects itself to the proteins.
- 5 Tannins react with the collagen structure of the skin and will turn the skin into leather.

In a solution of ground bark or pods there are active and non-active particles. The inactive particles, the non-tannins, also play a role in the tanning process. They play a role in giving the leather its particular feel or appearance.

When the ground material is mixed with water we do not know how much material is dissolved, neither how much of the solution consists of tannins and how much of non-tannins. The baumé-meter gives a good indication of the concentration, but it cannot tell us exactly how much tannin is in solution.

We will have to find this out by experimenting. When we know how a certain kind of tanning material reacts to the skin, we can use the baumé-meter more effectively. We will see that with some barks we can start with a baumé of 0.3 and with others it will be better to start with a baumé of 0.5.

Bigger tannin particles react more strongly with the skin than smaller ones. If we would start tanning in a very strong solution (a baumé of 3.0 or 5.0) with many big particles, the big particles in this solution would directly bind themselves to the outside of the skin (figure 17). They would tan the skin at the outside and close the openings. This will prevent tanning of the inside of the skin.

That is why tanning of the skins starts in a weak and already several times used liquor. From this solution the big particles have bound themselves to other skins, so only small particles are left, which can penetrate the skin and will not close the openings. So other tannin particles can enter and tan the skin through and through (figure 18).

In the process described in this book we will work with tannin solutions in between 0 and 2 baumé.

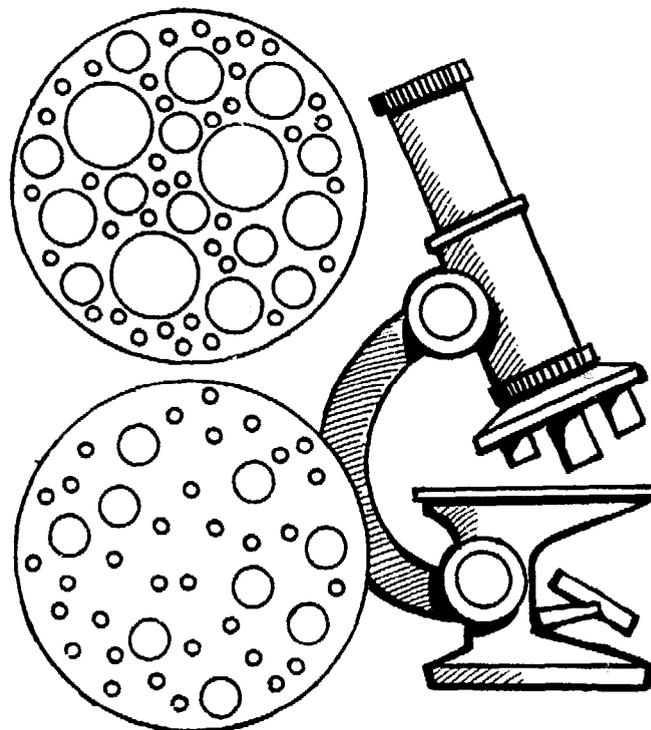


Figure 16 – Tannin as seen under a microscope

Upper view: fresh and strong solution

Lower view: used (weak) tannin solution

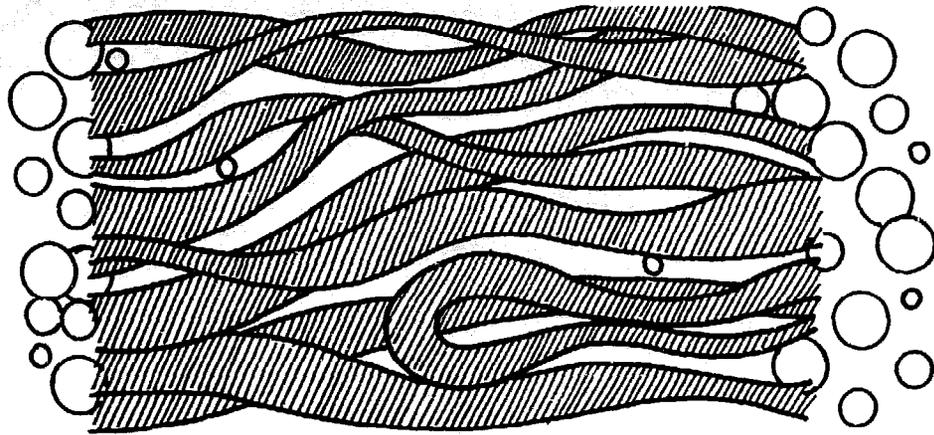


Figure 17 - Big particles block a delimed and bated skin in a strong solution

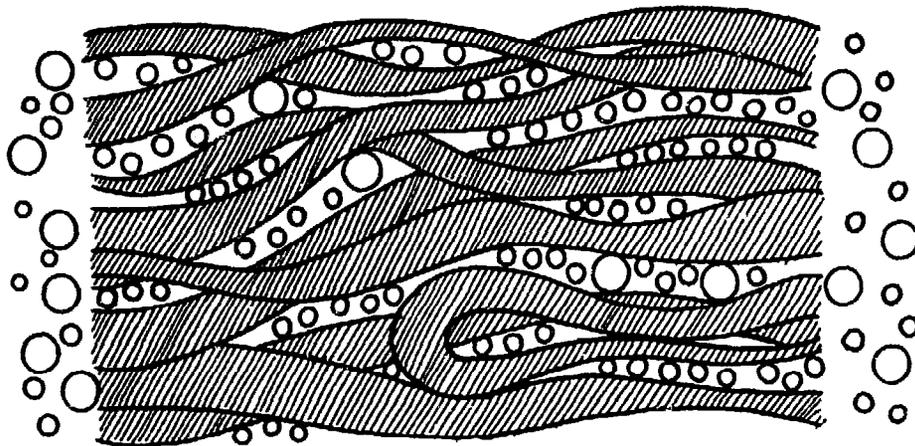


Figure 18 - Tanned skin

Tanning in practice

In the first four chapters we introduced tanning. But with the knowledge given, you are not able to start our own tannery yet. In this part, we describe the practical work, you have to do to be able to turn skins into leather in your tannery.

7 Inquiry

Your first step has to be an inquiry in your region about the demand for leather and the availability of the necessary products.

7.1 Raw materials

As we have already seen, we need the following products:

- **Water:** the water should be clean and soft (in soft water soap lathers easily) and its temperature should not exceed 25 °C. Rain water or stream water are the best.
- **Caustic soda:** this is a dangerous product. Store it in a dry and safe place.
- **Soap:** use no perfumed and/or coloured soap
- **Lime or wood-ash:** if you can get slaked lime use this. Working with wood ashes is harder to control.
- **Salt:** you need this when you want to preserve skins through salting.
- **Vinegar or lemon-juice:** these natural acids can never damage your skins, so we prefer them over strong acids like battery-acid or hydrochloric acid.
- **Tannin:** to decide which tannins you are going to work with, you will have to do some experimenting.
- **Oil:** it is preferable to use colourless oils. If vegetable oil is hard to get, it is also possible to work with animal fat or oil.
- **Skins:** watch the quality of the skins. A bad skin will never produce a nice piece of leather!

Make sure that these products are available throughout the year or the season you plan to do your tanning activities. In this way failure of supplies will not interfere with your plans.

Testing the tannin contents of a sample

Take one dried skin, soak it in water with some soap for one or two days. Scrape off the flesh, put it in a solution of 10 litres of water and $\frac{1}{2}$ kg slaked lime (which you prepared two days before). Take the skin out every day, stir the solution and put the skin back. Unhair the skin on the fourth day by scraping it in the direction of the hair with a blunt knife. Put the skin back for two more days in the lime. Wash the skin in clean water (change the water several times) and put it in a solution of 10 litres of water and $\frac{1}{4}$ litre of lemon vinegar afterwards. Leave the skin in this solution overnight and stir it from time to time.

Next day add a $\frac{1}{4}$ of a ripe mashed papaya and stir the solution frequently. Take the skin out after two hours and squeeze it out by moving a blunt knife over the skin with pressure. Now you cut the skin in pieces. With these pieces you can do your experiments. If you want to compare different tanning solutions use opposite pieces, so the right neck part with the left neck part and so on.

Make solutions with different dried and grounded barks or pods, that you found in your surrounding and of which you think that they might contain tannin. Vegetable material containing tannin will dry out your tongue when you hold the material against it. For your first experiments, use a solution of ten parts of water and one part (or half a part if one part does not fit) of grounded material. This solution will have a brownish colour. Use plastic or glass jars for your experiments. Do not use tins because iron will stain the leather. For experiments use small quantities, for example use a two litre jar, one litre of water, 100 grammes of grounded material and a piece of wet skin of 10 x 20 cm. The piece of skin will stay in this solution for five days. The first hour you stir or shake the solution continuously, after that every hour for five minutes. Twice a day you take out the skin and squeeze and stretch it. On the fifth day you take it out. You put a little bit of oil on your hands and knead the skins for a few minutes. Now you stretch the skin and dry it. When dry, you knead and stretch it and check if the skin turned into leather. If it stays hard and stiff and if it breaks instead of becoming supple, your tanning sample probably had no tannin in it.

Once you have discovered which materials contain tannin, you can do experiments by mixing two tannins or by making the solution weaker or stronger or by changing the tanning time.

7.2 Tools and equipment

You also have to inquire about the possibilities of buying or making the following tools and materials.

For the continuous processing of skins, the method described in this book, we need:

- 18 basins – 2 for soaking
- 4 for liming

- 1 for delimiting/bating

- 7 for tanning

- 2 for laying away

- 1 for bleaching

- 1 spare one

- 2 buckets
- 3 plastic containers for oil, vinegar etc.
- 1 unhairing knife/scudding
- 1 fleshing knife
- 1 knife to use on the tanning beam
- 1 knife for rounding/cutting skins
- 1 flaying knife
- 1 setter
- 1 glazer
- 1 board
- 2 beams
- 2 smooth tables
- 1 stake
- frames for drying ten skins
- steel nails with support
- 1 Baumé meter: 0 – 5 Baumé
- 1 balance
- 1 small pipette

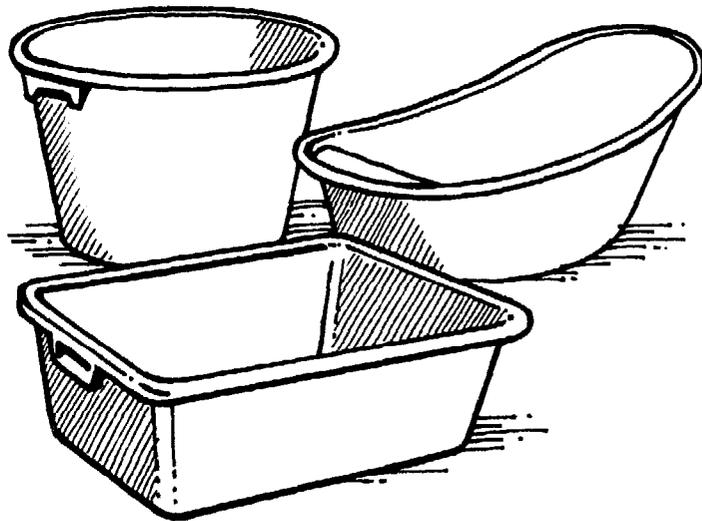


Figure 19 – Basins

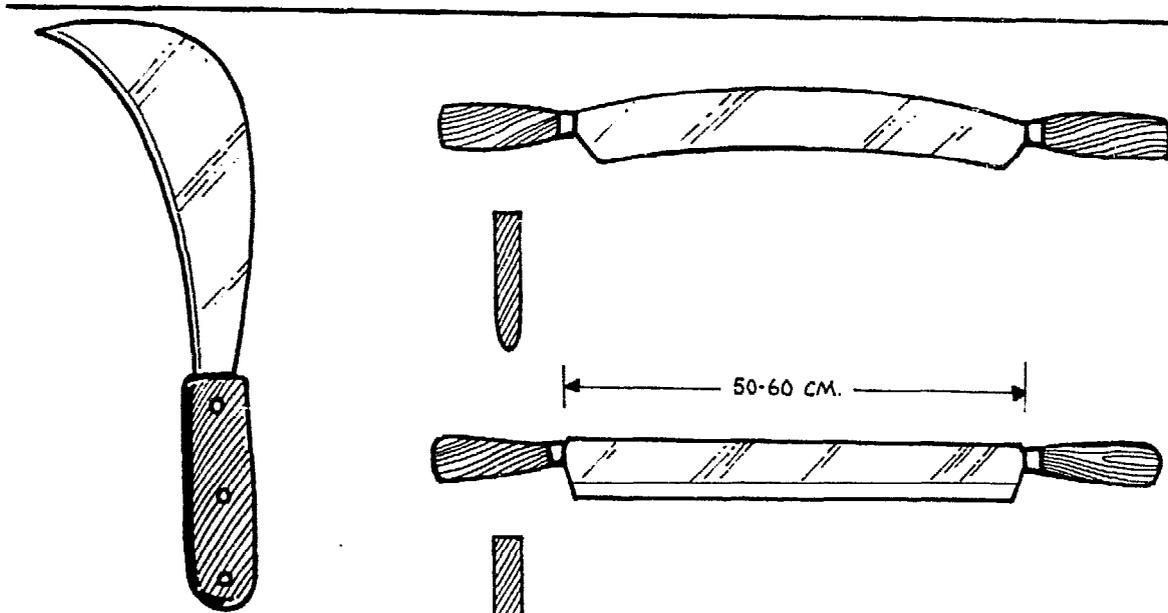


Figure 20 - Knives

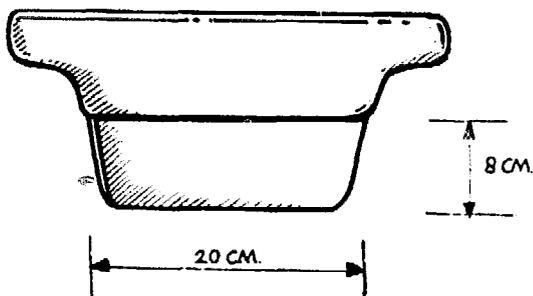


Figure 21 - Setter

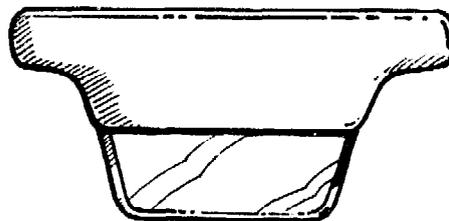


Figure 22 - Glazer

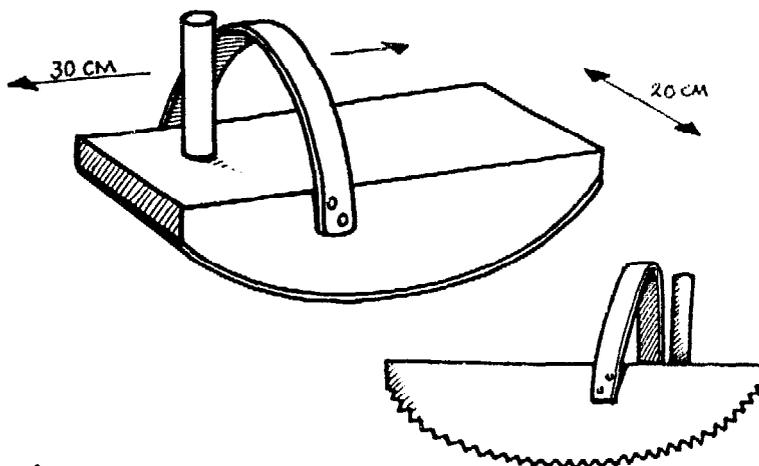


Figure 23 - Board

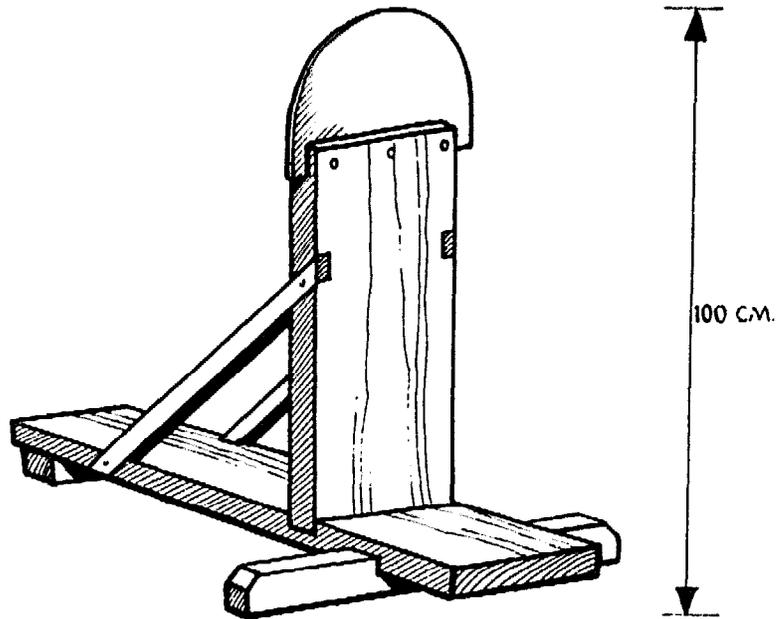
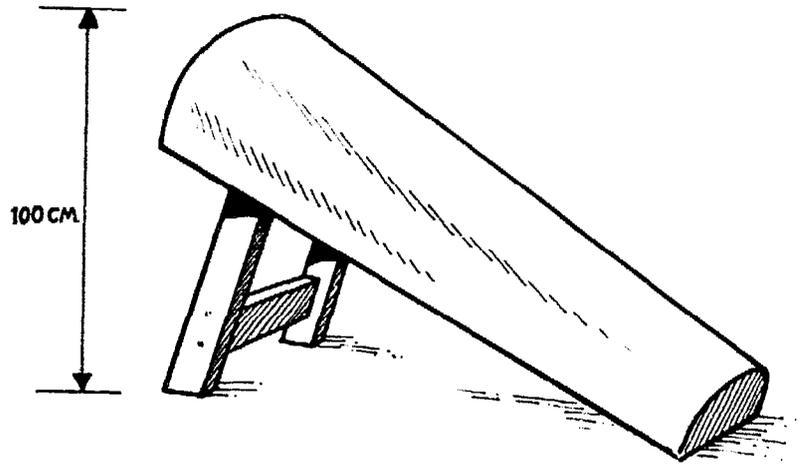


Figure 24 - Beam and stake

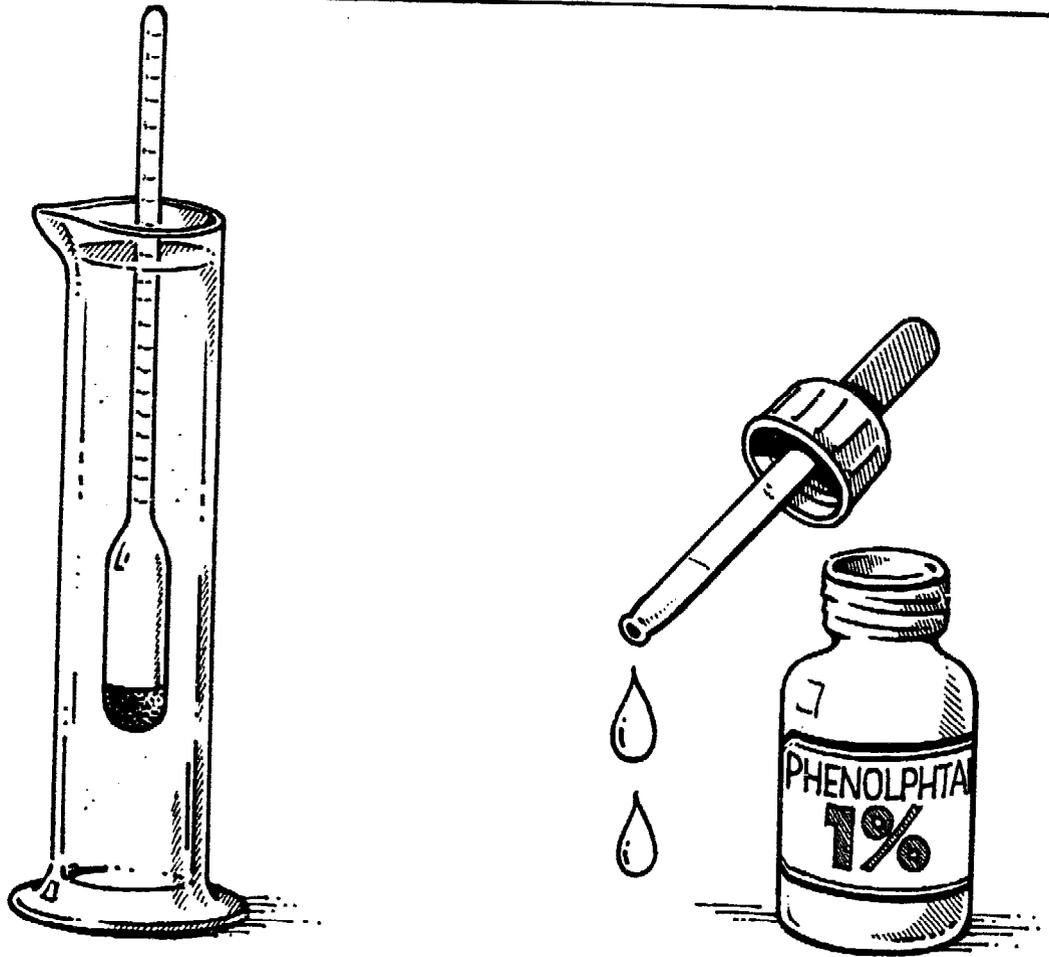


Figure 25 – Baumé meter and pipette



Figure 26 – Mortar

- 1 mortar
- 1 machete

The site

The choosing of a site for your tanning activities is very important. The availability of water is a must necessity. The site should also not be too far from your tannin resources.

Depending on how much leather you want to sell or transform into other products, how much time you can spend, how much money you want to invest and the availability of the required products, you have to decide about the size of your tanning site. It is best to start a small workshop and enlarge it when you see that your project is becoming successful.

You can estimate the requirements for the tanning of one goat skin as follows:

- water: 50 – 100 litres
- caustic soda: 10 grammes
- bark or pods: 3 kilogrammes
- lime: 50 grammes
- salt (for preservation): 250 grammes
- vinegar: 50 grammes
- oil: 25 – 50 grammes
- papaya: $\frac{1}{10}$ papaya
- time: 3 – 5 hours

7.3 The method

In this course we use a method according to which five skins per day can be tanned in a continuous process. So every day our input is five skins and our output is also five skins.

This method is meant for those who want to work in a group of three or four people. It could also be a family activity, for example a husband and his wife with one or two other family members, working together besides their farming-work.

Because of the continuous process, you are able to use the products in a very economic way. You will need more products if you tan a few skins, finish them and

start tanning another few skins.

In practice, it is now time to determine and record the costs involved for your investment, because you will need these for example for your price calculation. Refer to the chapters on *Costs and price calculations* and *What makes your project successful* to determine if your proposed project can be profitable.

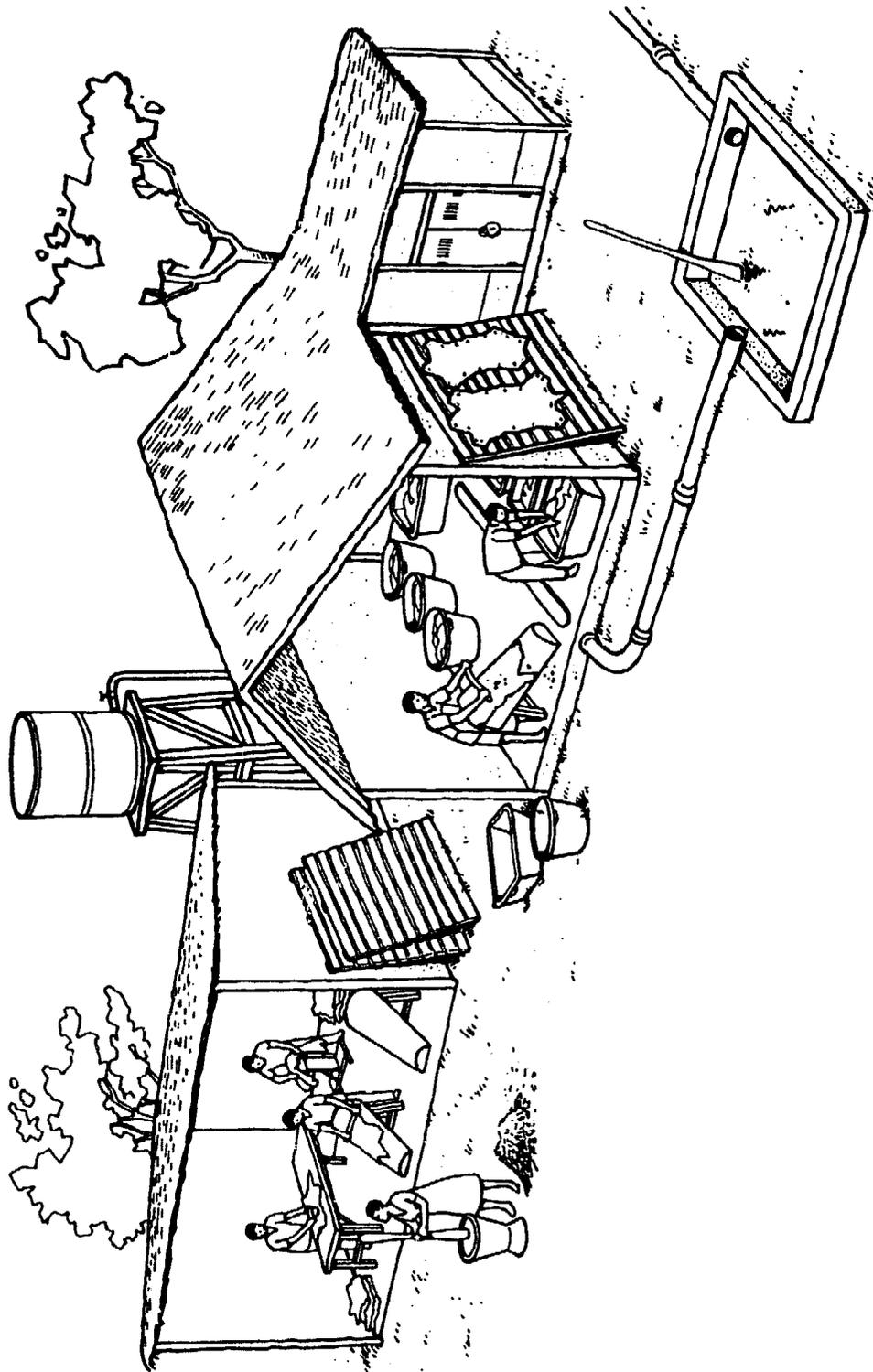


Figure 27 – Working place

8 Preparation

When you have studied your opportunities, made the inquiries and calculations, and you have come to the conclusion that it is profitable to start a tanning project, you will have to start with the preparation of your activities.

8.1 The working place

You will prepare and eventually build a work shop, and collect the required tools and equipment. Always take care that you are able to expand your activities in a later stage.

It is hard to give instructions on how you have to organise your workshop. You know that the tannery process can be divided in two sections. In your work shop it is also good to have two sections. You could start your enterprise on the veranda of your house: one side being the beam house section and the other side the tan yard. You could also build a shed with a thatched roof, all with local material. You could the shed with blocks and a concrete floor.

A concrete floor should be one of the first improvements. With a concrete floor it is a lot easier to keep the workshop clean. A gutter could divide the workshop into two sections. The waste water will flow through this gutter to a simple water cleaning system. Never lead this gutter to a public sewerage

8.2 Stocks

For some of the tanning products it will be good to have a place to store them. Pods for making tannin are only available during one season, so you must collect enough to last until the next season. Other products are cheaper in certain periods of the year, so it might be interesting to buy them when the price is low and store them. Try to maintain a minimal stock for the most important products like skins, tannin, lime, vinegar.

8.3 Preparation of lime liquor

Before you can start to tan you will have to prepare a series of lime liquors and also a

series of tan liquors. We need three lime liquors. The preparation of all three is the same. Our lime liquor will contain 50 litres of water and 2 kilogramme slaked lime. In a series of lime liquors you will usually have an old, a mellow and a fresh lime liquor. To make a series like this, you will have to do the following.

The first two groups of five skins will be limed in the first lime liquor only. The second two groups will stay three days in the first lime liquor and three days in the second. From that point the skins will stay two days in the first (old) liquor, two days in the second (mellow) liquor and two days in the third (fresh) liquor. The old liquor will gain unhairing qualities while it is getting older, because of certain chemical breakdown products from the skins that have passed already. We have to use this phenomena. The fresh lime has qualities of loosening up the fibre structure. Unhair your skins well, before they go into the mellow lime, so they do not make the liquor filthy. In that way your fresh lime stays fresh and can better loosen up the fibres.

- A lime liquor should always be prepared two days before you will use it. You need four basins to make a series of three lime liquors.
- If your old lime liquor starts stinking or smelling like ammonia you have to throw it away.
- Because every group of skins that passes will take lime out of your liquor and will also diminish the liquor level, you will have to add liquor from time to time.
- After every group of five skins that passes through the old lime liquor, you will have to add approximately 100 grammes of lime.
- After every group that passes through the mellow or the fresh lime you must add 50 grammes of lime.
- When the old lime is thrown away (has been used ten to twenty times), the mellow lime is becoming old lime, the fresh lime becomes mellow and a newly prepared lime (as described before) becomes your fresh lime liquor.
- In certain parts of the world unhairing is done by means of wood ashes. The ashes are mixed with water and the skins are put into this solution. After several days the hair should become loose.
- Old lime can be thrown on the compost heap, instead of ashes.

8.4 Preparation of tan liquor

If we would put big pieces of bark or whole pods into water, only a few of the tannin particles would go into the solution. The rest would stay in the bark or pods and be ineffective in the tanning process. Therefore you have to grind the bark to smaller

pieces, so most of the tannin particles will get the chance to go into the solution. Do not grind the bark or pods to powder, because mixing powder with water is difficult.

How to grind bark or pods?

Dried pods of *Dichrostachys Cinerea* are easily crushed by pounding in a mortar, which is also used for pounding maize or shelling rice (refer to figure 27). Only for quantities needed to tan ten skins or more per day, you would need a machine. This machine could be hand-operated or operated by animal traction or, in case we need very much to be pounded, by an engine.

So in this case, where five skins are being processed per day, the pods are simply crushed in a mortar.

In case we work with bark, which sometimes is nearly as hard as wood, pounding in a mortar is a lot harder, if not impossible. In tanneries with a production of 20 to 50 or more skins per day, you would need a hammer mill with a coarse screen to crush the bark. However in a small-scale enterprise, a hammer mill is a far too big investment. You will need some creativity to diminish the size of the pieces of bark, so the tannin can be leached out properly. A first step will always be cutting the dried bark into smaller pieces with a machete.

With the grounded bark or pods we can prepare the tanning liquors. As we have seen in the first chapters, skins coming from the beam house should enter in a weak tannin liquor and, day by day, go into a stronger one. We will work with a series of six tannin liquors. The first liquor, the weakest, will measure 0.1 – 0.3 Baumé and the liquors' strongness will increase to 1.0 – 2.0 Baumé for the last (strongest) liquor. This sequence could be: 0.1 – 0.3 – 0.5 – 0.7 – 0.9 – 1.0 or 0.3 – 0.6 – 1.0 – 1.3 – 1.7 – 2.0 or something in between. It is hard to say with how much tannin you have to prepare the strongest solution.

Some important issues:

- 1 You should have that much liquor so the skins can 'swim' in it.
- 2 The first solution is the weakest, because five groups of five skins have taken tannin out of it already.
- 3 After six groups have passed, the liquor should be used, meaning that it should not have a lot of tannin left in it. This liquor is thrown away.
- 4 Try to create a series in which you have to prepare a fresh solution every day, with such a strength that the liquor will be used after six groups of five skins have passed. When the liquor is used after 4 groups, you have to make it stronger by adding half of the original quantity to the fresh liquor. If the liquor is not yet used after six groups of five skins, diminish the quantity of tannin.
- 5 If a skin turns purple or black on the flesh side, this could be a sign that the solution does not contain tannin any more. Throw this liquor away and put the



Figure 28 – Mortar

skins in the next liquor.

- 6 Always prepare the fresh liquor one day before you have to use it. So you need seven basins for making a series of six liquors.
- 7 By using warm water to make the tan liquor, more tannin will go into solution.
- 8 Do not use any iron utensils when working with tannin.

To prepare our first series of six tannin liquors, we will perform the following steps:

- To make the liquor we will use 30 litres of warm water and mix it with a specific quantity of grounded tanning material.
- To make the strongest liquor add 1.5 – 3 kilogramme of grounded material.
- For the other liquors successively 1.25 – 2.5 kg, 1.0 – 2.0 kg, 0.75 – 1.5 kg, 0.5 – 1.0 kg and 0.25 – 0.5 kg of grounded material are being used. So the weakest liquor will be a mixture of 30 litres of water with 0.25 – 0.5 kilogramme of grounded bark or pods:
 - Solution 1 0.25 – 0.5 kg grounded bark or pods
 - Solution 2 0.50 – 1.0 kg grounded bark or pods
 - Solution 3 0.75 – 1.5 kg grounded bark or pods
 - Solution 4 1.00 – 2.0 kg grounded bark or pods
 - Solution 5 1.25 – 2.5 kg grounded bark or pods
 - Solution 6 1.50 – 3.0 kg grounded bark or pods
- In the scheme on the next page you will see when these solution have to be prepared and how the groups of five skins enter these solutions.
- So once your series is ready, throw away the oldest and weakest solution every day and in this free basin you prepare a new, strongest solution.
- Adjust the quantity of tannin in the liquors if you notice that the oldest liquor still has a lot of tannin left after six groups of skins have passed, or when you notice that the last liquors is too weak.

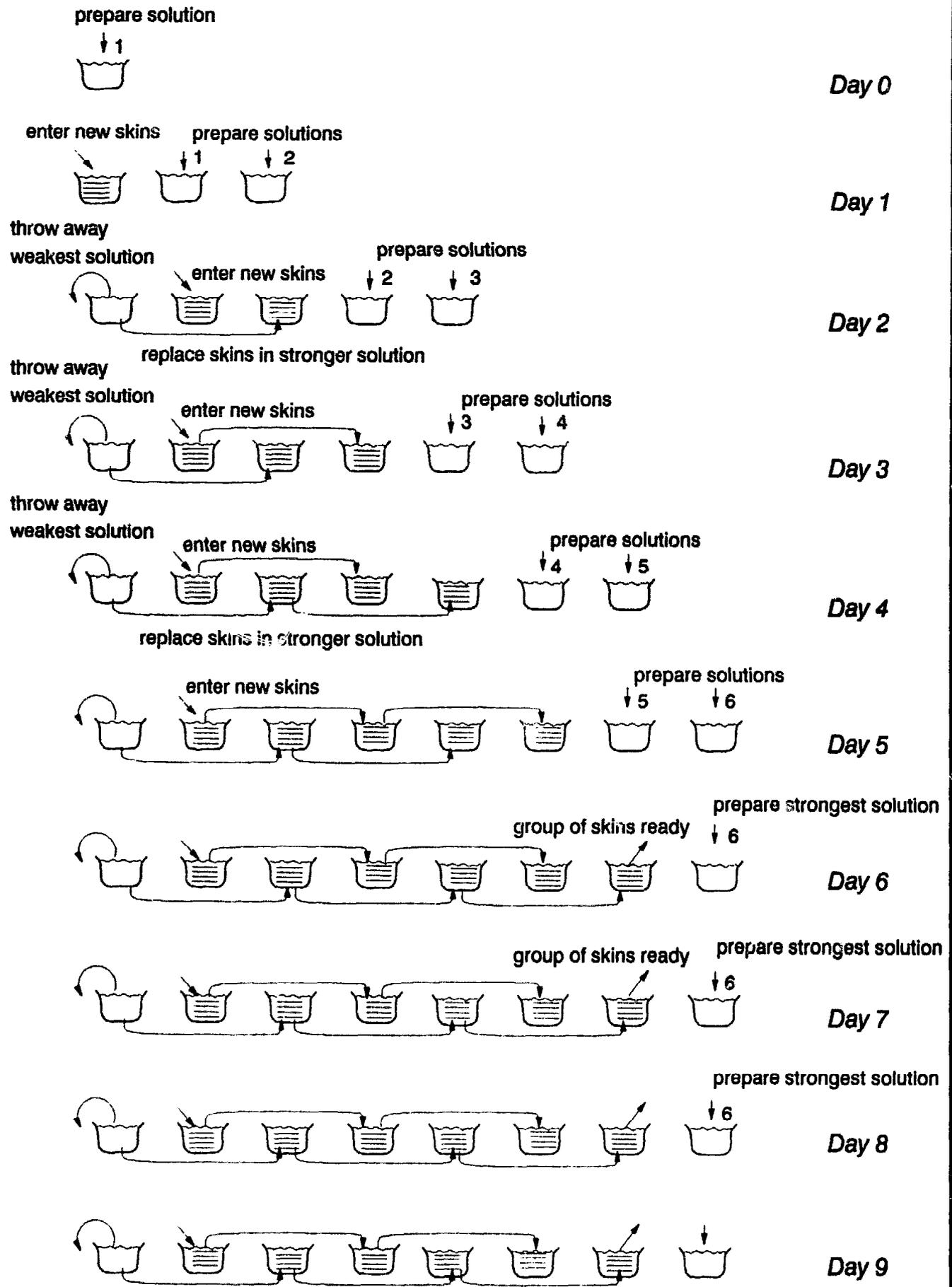


Figure 29 - Continuous tanning of groups of skins

9 *The daily work*

After all preparation have been made, the skins can be entered the tannery now.

9.1 **Beam house**

Soaking

When we work with dried skins we first have to soak them. This means that the skins are put in fresh and clean water. Soaking takes one or two days and is very important, since the skins must be completely wet. If not, the lime in the next stage will not penetrate well and therefore the quality of the leather will not be constant.

In the afternoon of the first soaking day, you throw away the water, you flesh the skins and put them in fresh water. Add some soap or caustic soda (10 litres of water + 10 grammes of soda). The pH should not be higher than 10.5. Under rural conditions, where it is hard to get soda, you might mix 200 grammes of fresh wood ash with 10 litres of water, before you put the skins in.

The soap, ash or soda will prevent from the development of microbes and helps the water to penetrate the skin. Microbes easily develop in soaking water, so therefore:

- Never use soaking water a second time.
- Never make a lime liquor with it.
- Never place the soaking basin in the sun, as the heat will stimulate the development of microbes.

When you have a fresh and fleshed skin from an animal slaughtered the same day, and you have everything ready for tanning, you can put the skin directly into the lime liquor. If you are not ready for tanning immediately, dry the skin as described before.

Fleshing

The connective tissue forms the connection between the skin and the body of the living animal. On goat skins this layer is not fixed very strongly to the corium. With a blunt fleshing knife it can be pushed off (refer to figure 30).

With a cow hide it is different. You will need a special, very sharp fleshing knife (figure 31) to cut the connective tissue apart from the corium. This fleshing has to be done very carefully and with a lot of skill, since the knife can easily damage the skin.

During the soaking the fleshing is done. Easiest is to flesh when the skins are not yet totally soaked. Therefore we suggest the afternoon of the first soaking day to do your



Figure 30 – Fleshing

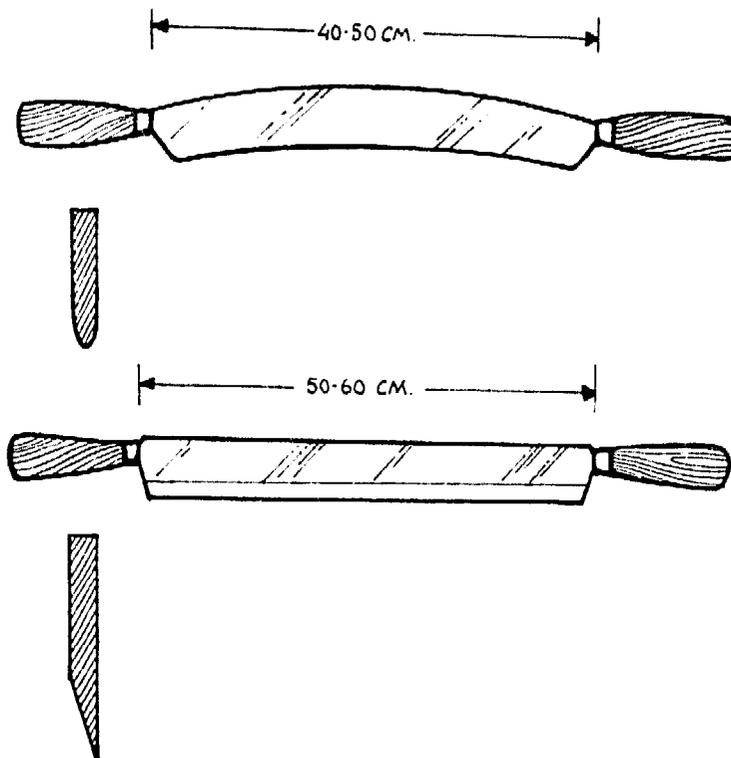


Figure 31 – Fleshing knife

fleshing.

Put the skin with its hair side down over the beam. Move the knife, with the sharper edge pointing away from you, over the skin, trying to get it between the flesh and the skin. In this way we try to push the connective tissue and the flesh off the skin.

*When a skin is rotten, you will notice that while fleshing.
Throw the skin away immediately.*

Before the skins enter the lime liquor we will flesh them for a second time.

Liming

After being soaked and fleshed the skins enter the old lime solution. In this solution they stay for two days. Twice a day haul the skins, stir the liquor and put the skins back. Watch out not to spoil too much liquor when hauling the skins!

After two days in the old lime liquor the skins are unhaired. Afterwards they enter the mellow lime, in which they will stay for two days. Again haul the skins twice a day, stir the liquor and put them back.

The next step is putting the skins for two days in the fresh lime liquor. Again you have to haul them, stir the liquor and put the skins back again.

When you haul the skins, do not leave them out of the lime liquor longer than necessary, because this can provoke stains.

Because you use only three lime liquors, but there are six groups of five skins, it is necessary to mark the skins so that you will know which skins stay for another day in a liquor and which skins move on to the next step. An easy way of marking is using a piece of rope with a number of knots in it, which you tie to the skin on a fixed spot. Another way is punching a number of holes in the skin, also on a fixed spot.

Unhairing

Unhairing is done over the beam with a blunt knife which has a rounded form that matches the beam (figure 32). Move over the skin with the sharp side of the knife pointing towards yourself, making strokes in the direction of the hair growth (refer to figure 33).

Put the neck side of the skin between your body and the beam. After unhairing this part, turn the skin, so the neck part can be done. Unhairing should be done with enough strength but also with care, because we work on the grain side, the top side of the leather.

Unhairing can only be done when the hair loosening effect of the old lime liquor has been well carried out. To check whether the hair is loose enough, try to push off hair from the skin with your thumb. If you do not succeed leave the skins in the old lime liquor for three days instead of two.

When you unhair the skins, unhair them well. In this way the mellow and fresh lime stay clean and have a better chance to enter the skin and do their work.

Deliming

When the skins come out of the fresh lime, wash them with several changes of clean cold water. In this way we wash out a big part of the lime and the breakdown products. After washing throw the skin over the beam (flesh side down) and move the unhairing knife over it to push out parts of the dirt.

Now put the skins in a solution of water with vinegar or lemon juice. Again the skins should be able to 'swim' in the solution.

For 10 litres of water add 0.1 to 0.2 litre of vinegar. The pH should be approximately 4.5. After two hours of frequently stirring the solution, we check the pH. If it went up, we will add more vinegar and try to maintain a pH of 5 to 6.

The skins stay in this solution overnight. The next morning we check the cut of the skins with a drop of phenolphthalein, to see if the skins are totally delimed. If the cut does not turn red, the skins are delimed and you can add mashed or sliced papaya to the same solution. If the cut turns red, we have to check the pH and if the pH is above 6, we will add more vinegar and continue the deliming process, until the skins are delimed.

Bating

Add some hot water to the deliming liquor (until its temperature is 35 °C) and a half unripe sliced-up papaya for every five skins. If there are no unripe papayas available, we can use ripe or overripe papaya, which we mash. Also papaya leaves can be used. After two hours of regularly stirring the liquor, check the skins. The skins which were plumped during liming, will fall during bating. This falling can be checked by gathering the skin into the form of a bag, which contains some liquor and air. The bag is squeezed. If air passes through the pores of the skin, bating is completed. When you press your thumb firmly against the grain side of the skin, the impression must remain. Bated pelts have a slippery feel.

Scudding

During bating the scud (hair roots), short hairs, dark pigment, residual epidermis, lime rests, degraded cementing substance are loosened. They can be pressed out with an unhairing knife. This action is called scudding. The scudding is done with the grain side up. The knife is pointing towards you and your strokes are in the direction of the hair. Your strikes are firm and slow. You can see how the dirt is squeezed out.

9.2 Tan yard

Tanning

We will make a strong tanning liquor every day. The skins which have been in tanning already for five days, will enter into this strong liquor. Every group of skins coming from the beam house will enter in the weakest liquor. This is the liquor that has been used already five times. After being used for six times, it is thrown away because it has no tanning capabilities any more.

The skins should be stirred or trampled frequently during the tanning process. Especially after they have entered in the first tanning liquor you have to stir or trample them continuously for the first hour. Before putting the skins into the next liquor, squeeze the skins by hand and set them out on the beam with a round and blunt knife. This setting out should be done more often, if you notice that the skins get wrinkled.

Take care that the skins are always immersed in the liquor and that parts of skins are not sticking out. Especially the first few days the skins tend to start floating. Prevent from this by putting a piece of wood on top of the liquor.

In the beginning of your tanning activities it is important to check the progress of the tanning every day. To do this you make a small cut in the thick and firm part of the skin. Watch this cut carefully. After six tanning basins $\frac{2}{3}$ of the thickness of the skin should be tanned.

Influence of the temperature

Temperatures between 25 and 35 °C are better than temperatures between 15 and 25 °C, since the higher the temperature, the faster the tanning process takes place. However, you have to take care that the not yet tanned skins do not get too hot, because their substance and their ability to be tanned then will change. In the cold season it might be worthwhile to put the basins in the sun during the morning.

Retanning

The last part of the skin will be tanned in the retanning process. But even if the skin is already 'tanned through' we will add the retanning step. Retanning we do in a *lay-away*.

A *lay-away* is a pit or a basin, where we put twice the amount of ground bark as we use everyday for making a tan liquor. The skins stay in the *lay-away* until they are completely tanned, which could take another one or two weeks. For the *lay-away* it would be nice to have a bigger pit made of bricks or concrete. This pit should be painted, to protect the liquor from any iron in the concrete, which might stain the leather.

When we consider tanning cowhides, a *lay-away-pit* will be indispensable. After tanning them for two weeks, the hides enter the *lay-away* for one to three months of retanning. We put them in with layers of ground bark in between: a hide, a layer of bark, a hide, a layer of bark and so on.

But let us return to our five goatskins. In one week we fill up one basin. For every five skins that enter the basin, add 6 litres of water and 600 grammes of grounded tanning material. Stir this solution a few times a day. The next week the skins stay in this *lay-away*. After one week you can start taking out five skins every day after checking if they are completely tanned through. If not, they stay a few more days in the *lay-away*. And if by the end of the week they are not yet tanned through, we enter them in the more recent *lay-away*.

- When all skins are out of the *lay-away* basin, squeeze out the tanning material

and use the liquor to prepare the strongest tanning liquor. In this way you can reduce the quantity of tannin material, that is normally used to make this liquor.

- An other way of laying the skins away is piling the skins on top of each other, with a thin layer of fresh grounded and soaked tannin material in between. If you have to fold the skins, also put grounded bark in the folds. Always start with a layer of grounded bark on the bottom of your basin and also cover the skins on top with a layer of bark. Add that much water so a thin layer of liquor covers the skins that are on top. Add the water at the bottom of the basin (with a hose), so no sacks of air will be left between the skins.

Bleaching

From the skins coming out of the lay-away, shake most of the tannin material and wash the skins in clean water. The non-fixed tannin is washed out in this way. Add vinegar to this water (0.05 to 0.1 litre for every 10 litres of water). This vinegar will give a better fixation of the tannin to the skins. It will also bleach the skins a little bit, so the colour will be brighter and also more even.

After the bleach of one to two hours, set the skins out on a beam or table and pile them, flesh side to flesh side.

On top cover the skins with a plastic bag or wet sacks, to prevent them from drying out.

Because the grain side is the most valuable, in a pile the first skin (the bottom one) will be flesh side down and the last skin (the top one) will be flesh side up. In this way the grain side will not easily grow filthy.

If care is being taken that the skins will not dry out or get moulded, they can stay in a pile for a few weeks. But usually you will start finishing them after one or two days.

Six rules for vegetable tanning

- 1 You need skins that have been well treated in the soaking, liming, deliming and bating stages.
- 2 Handle the skins as many times as possible by squeezing, stirring, setting out etc.
- 3 You always start tanning in weak solutions and go step by step to stronger solutions.
- 4 Check the cut of the skin regularly to see if tanning is continuing. Check the colour and also check the feel of the skin: it should feel from soft, light and slippery to fuller, harsh and heavier.

- 5 When the skins are not treated, keep them in the solutions or keep them covered.
- 6 The beam house process and the tannery process are two different processes, which should be performed at different locations. Both processes should have their own equipment and tools and these should not be used for work in the other section.

Our findings with Dichrostagys Cinerea

Trees are different under different conditions. Even the same tree can vary in size, quality of wood, quality and quantity of tannin – depending on the climate, altitude, soil and so on, where it is to be found.

The use of pods of *Dichrostagys Cinerea* is not described in any book known to us. It was found during trial and error experiments in Guine Bissau.

The tree found in Msekhocika area in Zambia looks a bit different from the one in to be found Guine Bissau. In Zambia the leaves are thicker and the pods are thinner.

The quality of the tannin also differs. The fermentation is stronger in the Zambian one, indicating that it contains more sugar. Also the strength and activeness is higher in the Zambian one.

We started with a tannin solution with a Baumé of 0.5, but it proved to be better to start tanning in a weaker solution of 0.3 Baumé. The following solutions were 0.5 and 0.7 Baumé. These solutions were cleared from the crushed pods, before they were used, by sieving the liquor through a nylon sack.

The fourth liquor had a Baumé of 1 and the fifth and sixth 1.3 and 1.7. These last three solutions still contain the crushed pods.

A solution of 1.7 Baumé was made with two buckets of hot water (25 litres) and 6 litre-cups full of crushed pods.

Dichrostachys pods give a greyish light-brown leather.

Our findings with bark of Brachystegia Spiciformis

The fact that the bark contains tannin was found in the book *Know your trees*, published by the Forest Department of Ndola, Zambia. According to this book, the bark has quite a high tannin contents. The experiments with the bark showed that it reacts mellow to the skin and tans through easily. The bark gives a warm, red-brown colour and the quality of the leather is very good, even when only the bark is used.

9.3 Dyeing of leather

Every kind of bark gives its own particular colour to the leather. We can influence the colour by mixing different kinds of barks or pods. Or by starting with one and using another type of bark or pods after a couple of days.

Besides this there are ways to dye the leather with the use of plants. In some areas people dye cloths with local products like indigo. Sometimes elderly women can tell

what they used in former times, to give different colours to handwoven cloths. For example leaves from the mango tree give a special yellow colour. Not all dyes for cloth are suitable for colouring leather and the ones that can be used, often require chemical products to prepare the skin before dyeing.

For trying out a dyeing material, we use a piece of light coloured leather. When we want a very dark colour, the initial colour can be dark as well

Dyeing leather black

If the colour of your leather is uneven or if you want black leather anyway, there is an easy way to dye it. Take some scrap iron with rust on it and put it in a tin or pan with lemon vinegar or sliced unripe lemon and put enough water on it to cover the iron and lemon. After half an hour, the colour of the water will turn grey or green-grey.

With a cloth we smear this water on the leather and after a while it turns black. Repeat to smear this mixture on the leather until the colour is deep and even.

It is best to do this dyeing before oiling the skins. The reaction of the tannin in the leather with the iron in the water, is the same reaction we tried to prevent from by not using iron utensils in the tanning process. You have to oil the skins well after this way of dyeing, otherwise the grain will become harsh and brittle.

This method of using rust and unripe lemon is used, probably for centuries, by the Mandingue people in Western Africa. In the past shoemakers in Europe also put their old nails in vinegar for the same effect. It is not known whether they learned the method independently or from each other.

10 *Finishing*

10.1 Fat liquoring

After having piled skins for 1 or 2 days, the skins can be fat liquored. To be able to apply the required quantity of oil, you have to prepare the oil in the right way. If you put oil directly on the wet leather, it would just run off in big drops. If you would put it on dry leather, it would stain the leather.

As we know, oil cannot be mixed with water easily. It will separate quickly, especially in cold water and it will form a layer on top of the water. Therefore we have to treat the oil in a special way, so it will form very small droplets in the water, small enough to enter the skin.

Large-scale tanneries use prepared oils for oiling the skins. These oils have been treated with chemicals and will form tiny droplets in the water. You will prepare your fat liquor yourself. Therefore weigh the piled skins. Take twice that weight of water. So for 2.5 kilogrammes of skins take 5 litres of water. Heat this water to 60 °C. For every kilogramme of skins take 0.07 litre of oil, that is also heated to 60 °C and mix it with the warm water (in this example: for 2.5 kg of skins take 0.175 litre of oil). Stir this mix very well and pour it into a mortar. Also place the skins in the mortar and start pounding them lightly for half an hour. Take the skins out from time to time to stretch them.

Another method of fattening the skins is by applying a fat smear.

Making a smear

Weigh the skins that have been piled. The following amounts are calculated as percentages from this weight:

- 6% of palm oil or peanut oil
- 4% of household soap
- 30% of water

For example, the skins weigh 2 kilogrammes. We have to use:

- $6/100 \times 2 = 120$ grammes of oil
- $4/100 \times 2 = 80$ grammes of soap

- $30/100 \times 2 = 0.6$ litre of water

Cut the soap into pieces and put these in the water. Heat this water and soap mixture to 60 °C. Also heat the oil to 60 °C and slowly add the oil to the warm soap mixture, stirring it all the time.

With a soft brush or a piece of cloth, apply this smear to the flesh side of the leather, which has been set out on an even and smooth table. The thinner parts of the skin get little, the thicker parts get more of this smear. You have to spread the prepared quantity of smear over the skins.

10.2 Setting out

The skins that come out of the mortar, in which they have been oiled, are set out on a clean and smooth table (figure 34). Skins that received a smear were already set out. This setting out is done with a setter, to stretch out any folds and to enlarge the surface (figure 35). Now we pile the skins again, flesh side to flesh side. We cover the skins with a wet sac or a plastic sheet.

10.3 Drying

The next day you have to dry the skins by nailing them on a frame, with the flesh side turned to the frame. Use nails that are adjusted with round pieces of wood. Because of the pieces of wood, you are able to pull the nails out by hand. The nails also can better hold the skins, because they have more grip and therefore will not tear the skins when they shrink during drying (refer to figure 36).

The drying frames are made out of soft wood so the nails can be hammered in and pulled out easily. The frames should be bigger than your biggest goatskin. Nail the skins in a way that you stretch it in the direction of the hair growth. Do not pull the belly part too much, as it will make the leather too loose.

After nailing, oil the grain side with a cloth with some pure oil. Now you can put the frames in the sun, in an upright position again. Make sure that they stay free from dust, because dust will damage the skins in the next stages. Also for drying leather, wind is more important than sunshine.

In the dry season the skins will be dry in one day. In the rainy season you may have to dry them for a second day.

For the next step, staking, it is important that the skins are still a little damp.

10.4 Staking

After drying the leather is pretty hard and needs several treatments to separate the

Figure 34 – Setting out

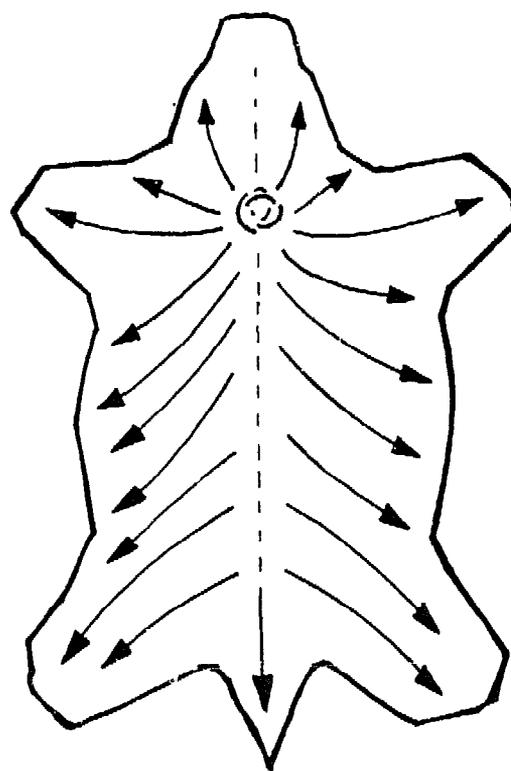
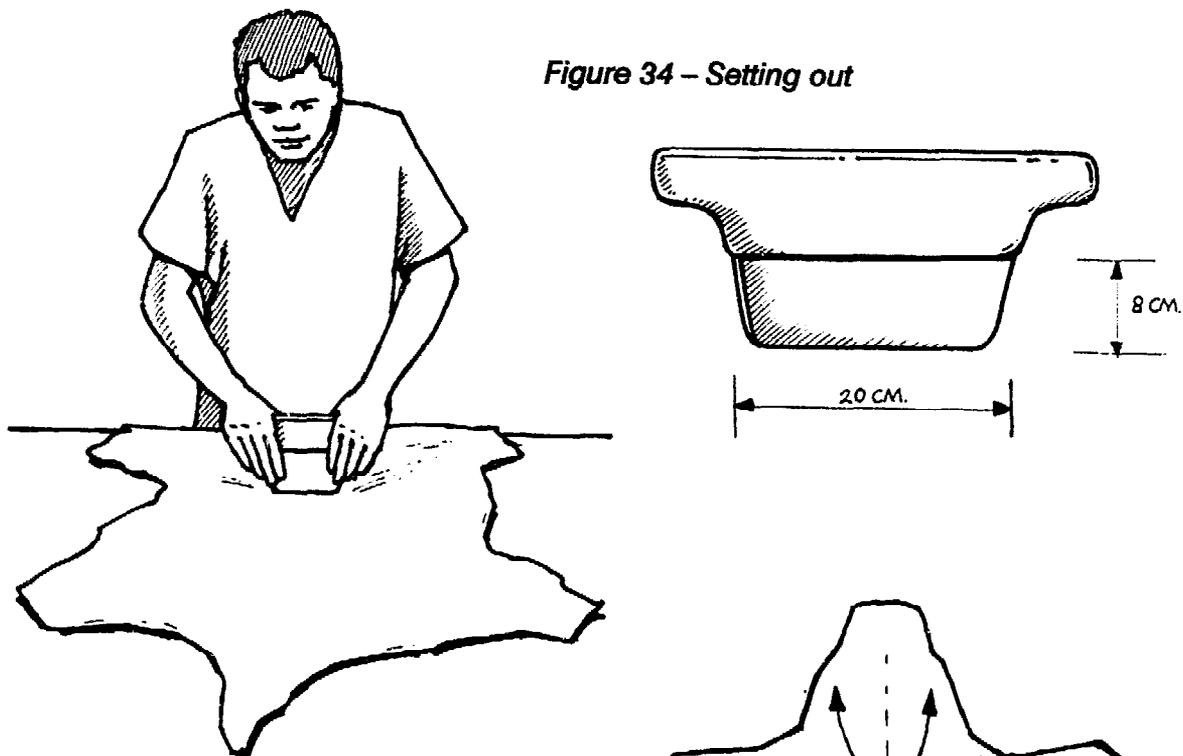


Figure 35 – Enlarging the surface

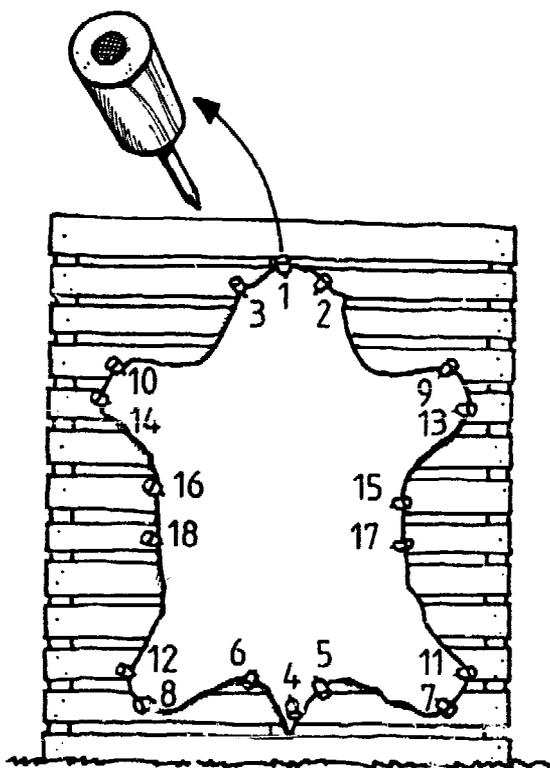


Figure 36 – Skin nailed to frame for drying

fibres and make the leather supple. The first treatment is staking. For staking you will need a stake with a blade made out of iron sheet with a thickness of 2 millimetres. This blade should be round, smooth and not too sharp, to prevent from cutting the skin.

Pull the skin over this blade (figure 37). First start with the sides of the leather. When these are done, pull the centre part of the skin over it, up and down. Use more force on the thicker parts and less in the leg-pits and flanks, otherwise these lasts will become too loose.

Always pull the flesh side over the blade (and not the grain side)!

After staking, the leather should no longer be stiff. All parts should be supple. If you want your leather to be stiff, do not stake it but sand the flesh side and glaze the grain side.

10.5 Shaving

It is possible to shave the skins, so you will have leather with an even thickness all over. Shaving by hand is very difficult and can easily damage the leather. It is better to use the thicker parts of a skin for leather work that has to be stronger and the thinner parts for finer work.

With sandpaper or a piece of pumice stone you can sand the flesh side to smooth it.

10.6 Glazing

Glazing is done to obtain a nice gloss on top of the grain of your leather. The gloss forms a protection against scratching and hits. A glazer consists of a wooden grip and a plate of glass with rounded edges (figure 38).

For glazing put the leather, flesh side down, on a smooth table. If this is the same table as the one on which you have applied the smear onto the leather, make sure the table is cleaned and dry.

With pressure of both hands and the glass in an nearly upright position pointing away from you, you have to make even strokes. Again the direction of the strokes is the direction of the hair growth. Make sure that the pressure is evenly spread over the glass. The beginning and the end of your stroke gradually have less pressure. The leather which has been finished in this way, will have a deep gloss and is still a little stiff. Depending on the thickness it could be used for wallets.

When suppleness is wanted you will have to board the leather.

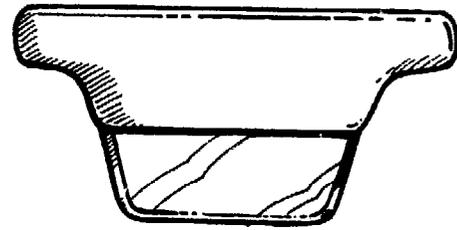
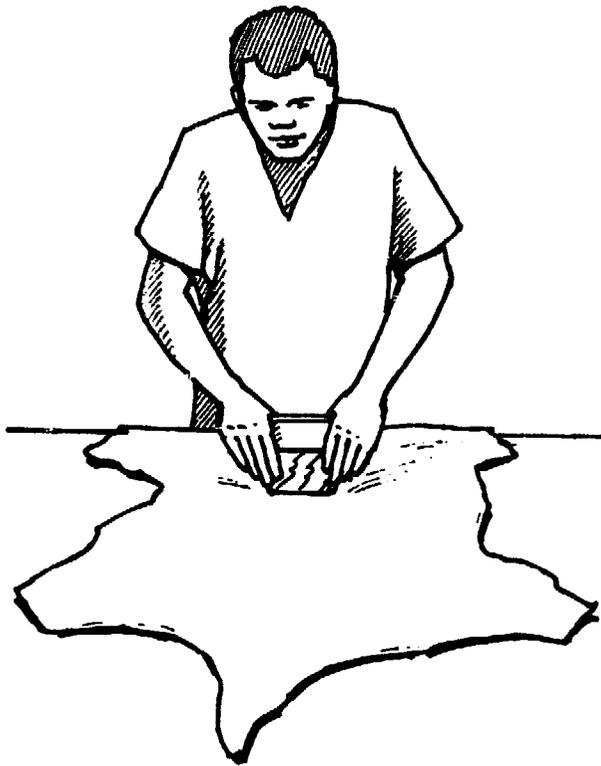


Figure 38 - Glazing



Figure 37 - Staking

10.7 Boarding

Boarding (or crippling) gives an effect, that is often mistaken for the natural grain pattern of the leather. Boarding softens the leather.

If the board does not have a cork or a rubber working surface, it is possible to make ridges in it with a saw (figure 39). The saw cuts should be 5 millimetres apart from each other and 5 millimetres deep.

Hold the handle with one hand, while the strap is laying over your underarm. Fold the leather, grain side in and roll with the board on the flesh side so the fold starts going forwards and backwards. You can fold the skins in all directions and make movements in all directions. The more directions, the finer the design on the grain side and the softer the leather. After boarding you can do a second glazing, since the boarding removes the gloss a little bit.

Keep in mind that every additional handling makes the leather more supple and soft, which is not always desired.

10.8 Rounding

As a last step in the finishing process, cut off the hard and sometimes damaged sides. The leather must lay flat on the table after rounding.

10.9 Selection

Before you store your leather you have to select it on its quality and measure it.

□ *First quality*

An equally shaped piece of leather, with no flaying marks, an even colour and gloss, with no holes or damages of the grain, even in suppleness or stiffness and no loose grain. (Loose grain means that when you bend leather with the grain side inside you will notice that the grain sets up in the bend and wrinkles).

□ *Second quality*

This leather has good properties, like suppleness or good feel, but it has a couple of minor defects, for instance a few small holes, the colour is not exactly even and so on.

□ *Third quality*

The leather has many defects, but still enough good parts to be able to sell it.

Another way of selecting leather is by its thickness. In that way you can distinguish for example:

□ **Heavy leather**

- Middle-heavy leather
- Light leather

Both quality classifications combined give: heavy leather of third quality or light leather of second quality and so on.

Measuring

You also have to measure your leather. This can be done in a very simple way by distinguishing small, middle and big skins. A more subtle way is by measuring the square feet or decimeters of a skin. If you paint horizontal and vertical lines on a table, 10 cm apart from each other, you get a grid with squares of a decimeter on your table. If you paint a spot in the centre of each square and lay a skin on top of the table, it will cover a certain amount of spots. This amount of covered spots is roughly the surface of the skin in square decimeter (figure 40).

For calculating the price of your leather, selecting and measuring are indispensable.

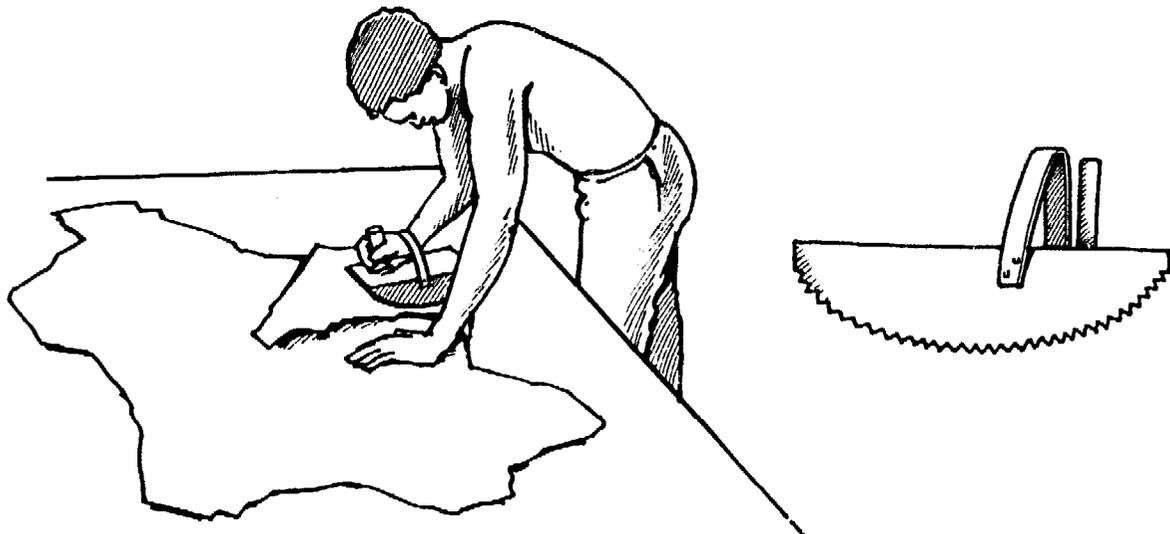


Figure 39 – Board

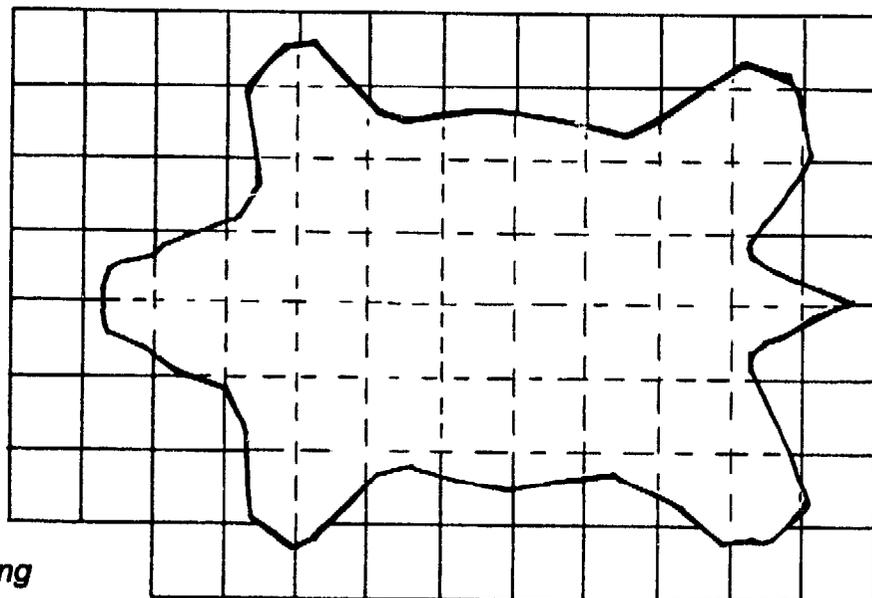


Figure 40 – Measuring

11 Jackson system

The system we will describe now is for someone – let us call him mister Jackson – who wants to tan a few skins every now and then. (As soon as you are going to prepare skins more regular, use the method described in the previous chapters.)

Mr. Jackson needs three basins, a bucket, a few plastic 5 or 10 litre containers or tanks, a mortar, a machete, a knife, a table, a setter, a stake. The setter he might make out of hard wood and for making a stake he might use the blade of a hoe. Let's say he is going to tan three skins at one time.

Mr. Jackson starts with soaking in the same way as described before. For fleshing it would be nice if he has a beam and a fleshing knife. If he has not, it should be possible to scrape the meat off with a machete for example, with the skin stretched out over an improvised beam.

The three skins are limed in a lime liquor, that mr. Jackson saved from the last time he tanned leather. After three days he tries to unhair the skins, by scraping the hair off the skins with the blunt side of a knife. He keeps the hair that comes off. After soaking, the soaking basin is used to prepare a fresh lime liquor: for every 10 litres of water he adds 400 grammes of slaked lime.

In this fresh lime liquor the skins enter after the unhairing is completed. The skins will stay in the basin for two to three days.

The lime liquor in which the skins stayed the first three days is thrown away on the compost heap. When the skins come out off the fresh lime liquor they are washed in the now empty 'old lime' basin. The kept hair is mixed with the fresh lime liquor and is put away to be stored until the next tanning activity, when it will serve as old lime liquor.

The washing is done with several changes of cold water. In this way a big part of the lime and dirt will be washed out already.

Mr. Jackson puts the skins over the beam and passes over them with a blunt knife to squeeze out part of the lime and dirt. The rest of the lime will be removed with the use of vinegar: for every 10 litres of water 0.1 to 0.2 litre of vinegar. In this solution the skins stay overnight. Next day, after checking if the skin is neutral with the use of phenolphthalein, mr. Jackson continues with bating. He adds a sliced up half papaya and he adds some hot water, to make the solution warm. He stirs this solution frequently and after two hours he squeezes out the skins again on the beam. He checks if bating is completed by checking if the skin does not pass air. If it does not, he goes on to the tanning part. If the skin still passes air, he might continue bating for one more hour.

The two basins used so far stay in the beam house and will not be used in the tannery!

For tanning mr. Jackson immerses the skins in a basin with a little bit of grounded tanning material. He has to stir the solution frequently. Every day he adds a little bit of tannin and he also checks how the progress of the entering of tannin into the skin is going. For this he makes a cut in the skin and checks if the white middle part of it is smaller than it was the day before. When the white line is disappeared, the skin is tanned thoroughly.

For 10 litres of tanning liquor mr. Jackson starts with 10 litres of clean water to which he adds 50 grammes of tannin every day. Besides stirring the liquor frequently, he also takes the skins out every day to squeeze them out over a beam. It will probably take one to two weeks, before the white line has disappeared. When disappeared, it will be good if he leaves the skins in the liquor for a few more days, so that they will be well tanned thoroughly.

As we have seen before, we usually enter the bated skins into a weak, already many times used, tanning liquor. Mr. Jackson works with fresh liquors and therefore has to handle the skins more frequently (squeezing, stretching, stirring) to help the tannin entering the skin.

After tanning mr. Jackson can sieve the liquor and store it in a dark place. If the storing time is not too long he might use the liquor again. If the storage time is too long, the quality of the tannin will change too much, so it is no longer useful.

After tanning the skins are washed in clean water. To the washing water he adds 50 to 100 millilitres of vinegar for every 10 litres of water. The oiling and finishing will be the same as described before.

12 *Trouble shooting*

Leather is hard and brittle all over

- Check if it is tanned through.
If not you might soak it in clean water and enter it again in the retanning basin.
If this happens often prolong the tanning period and use stronger liquors at the end of the tanning process.
- The skin is not well delimed.
Did you check with phenolphthalein after deliming?
- The skin might not be soaked thoroughly.

Leather is hard and brittle at certain spots

- You did not stake well enough – try again.
- The skins were not immersed well in the soaking and lime liquor.
- The soaking has not been long enough?
- You might not have used soap or caustic soda during soaking – do next time

The grain is dry and breaks easily

- You might not have used the right quantities of oil.
- You might have used a bad quality of skins.
- The skins must be scudded better after bating.

The leather has an uneven colour

- The skin has black spots.
Your tan liquor had iron in it. Check what the iron source may have been.
- The skin has dark brown stains.
Your skins might have float during the tanning process for longer periods.

- The colour is unevenly spread over the skin.
You might not have stirred the liquors with the skins in it long enough.
- You might not have set the skins out on the beam every day during tanning.
- The colour is darker because of too much fat.
Pound the skins more when fat liquoring.
- The fat liquor was not prepared at 60 °C.
- The skin was still wet during fat liquoring.
- You might not have used the right amount of oil in the liquor or smear.
- You might have smeared too much pure oil on the skins before drying.

At some spots the grain layer has come off

- Your unhairing or scudding might be damaged.
- This could be a damage caused by microbes.
Preserve the skins well.
You might have soaked the skins too long, without soda or too hot.
- The skins are bated too long.

Loose leather

- The skins have been bated too long.
- The old lime is too old so the skins start decomposing in it – throw it away.
- The skins have been soaked too long.
- Some tannins give a looser leather than others.
- The skin is badly conserved.

Uneven gloss

- You might have used too much oil.
- The skins were already dry when oiling took place.
- The skins were not scudded well.

13 Environment

The tanning of skins influences your environment on a few levels.

13.1 Animal life

We use animal skins. Leather of certain animals, like crocodile or leopard, are very wanted. To kill these animals just for the profit you will get selling their leather, would endanger these species and disturb the natural balance of the wildlife. A goat or a cow are killed to eat the meat and instead of wasting the skin we tan it. We hope you see the difference and will not be seduced by the cheap money and start to exploit endangered animals.

13.2 Vegetation

In vegetable tanning we use vegetable tannin, like bark, roots, leaves or pods. If we strip a tree off its bark, most trees will die. Therefore when you investigate different kinds of trees, to see if they can be used as a tannin source, investigate trees used at sawmills. Often at sawmills they are glad that you strip their trunks and for you it is a much easier way to get your bark.

If you use the bark of the air roots of mangrove, use the thick roots. These have a lot more bark on them. Besides, if you leave the thinner ones, the mangrove bushes will continue to grow.

Using pods or leaves is not really a problem, as long as you only use the fallen ones.

Starting a small plantation of trees which have a high tannin content, will ensure the future of your tannery and also the future of the environment. Use the tanning material with care. Only throw liquors away when they are exhausted. In that way you use all the tanning potential and therefore you will work more efficiently. The waste water will contain less tannins and is therefore cleaner for the environment.

13.3 Wastes

The tannery waste water is highly contaminated with lime, tannins and organic

wastes such as hair, pieces of skin, fleshings, fat and so on. The organic material will start rotting and stinking rapidly. The disposal of effluents therefore is an important matter. If the tannery is very small, the disposal of the effluent directly into a large river will not cause big environmental problems. Take care that the disposal is not close to where people are washing or bathing or taking their drinking water. Also never dispose waste water to a public sewage.

However, treatment of the wastes before disposal is always better. It is also possible to re-use the disposal to fertilize and water your garden. So you will benefit from treating your waste water.

Water treatment

If we would use waste water coming out of our tannery to water our garden, at one moment it would be lime water and at an other time it would contain a lot of tannins. Therefore the different kinds of waste water have to be mixed in a storage tank. In that way the acids and alkalines neutralize each other and form sludge. This sludge settles on the bottom of the tank and should be removed from time to time. This sludge can be used for compost making on the compost heap. Other tannery wastes like hairs, fleshings and trimmings, can be put on the compost heap as well, alternated with layers of grass or straw, to get a good aeration.

All the water from the tannery should be collected in one tank. If we process five skins a day, a tank of 1000 litres should be large enough. In this tank the different qualities of waste water are collected, after having passed a screen. In this tank the lime and tannin are mixed and will precipitate. When the tank is full, the overflow enters a second tank, in which the precipitate will settle as sludge. The overflow of the second tank can be used for watering the garden. Others might use this water to cultivate fish.

When you are just starting your tanning activity, these tanks can be dug-out pits. If your activity gets bigger, you could make the tanks out of bricks or concrete.

13.4 Workshop cleanness and body protection

One other aspect of environment is the environment in which you are working. Tanneries often are filthy places, but it should not be like that. When you are starting it is maybe too expensive to have the floor of the working place concreted. It will be hard to keep the place clean.

When you are having the floor concreted, have it done in such a way that the floor inclines towards an open gutter. This gutter ends in the precipitation tank. In that way, the water and dirt will automatically leave the work shop towards the water cleaning system. Consequently, the tannery should be built on a higher spot.

The gutter can also divide the tannery into the sections beam house and tan yard. In that way lime can not spoil a skin in the tanning process and tannin cannot stain a limed pelt.

The products you are going to work with, are not directly dangerous for your health. But it is good to protect your hands with rubber gloves, your body and legs with an apron and your feet with rubber boots when you are working with wet skins, lime and tannin liquors.

14 Costs and price calculation

Before you start an activity like building your own tannery, it is necessary to calculate if the activity is going to be profitable.

This is not only necessary for yourself, but also a bank or a organisation that has a credit programm wants to know if your activity is feasible, before they will lend you money. In this context however, it would go too far trying to explain how you have to start and run an enterprise.

Two things are very important when you are going to develop an economic activity:

How much money does it costs versus How much money does it bring in.

The difference of these two is your *profit* or your *loss*. Costs are not only the money that you spend in a certain month, but also a part of the investments that you made when you constructed your workshop. Every skin that you tan and sell has to pay for these investment costs. All the money that you receive in a month when you sell a lot, is not all your yield for that month.

In other words, the cash money you have at the end of a month, is not necessarily your profit for that month.

14.1 Costs

What costs do you have to make, to tan one goat skin? Or: what are the costs that you have to put in the price of one tanned goatskin?

- The costs of one skin
- The costs of the products you use for tanning:
 - soaking – soda/soap
 - liming – lime

- deliming – vinegar
 – phenolphthalein
- bating – papaya
- tanning – tannin
- bleaching – vinegar
- oiling – oil
 – soap
- The labour costs
- The costs of water, electricity and fuel
- The costs of the use of materials and tools
- The costs of the use of equipment
- The costs of the use of the workshop
- The costs of services done by others for you
- The costs of the administration
- Taxes
- The costs of permissions, licences
- The costs of special training
- Interest
- Etc.

Try to find all the costs that you make. There can be costs that you do not pay for. For example, you can use a workshop owned by someone else, without having to pay rent. In this case you are lucky, but calculate rent in the price of the leather anyway. Maybe tomorrow you will have to pay rent and it will turn out that your leather is going to be too expensive and people will go to someone else to buy leather.

If your wife or your son is working for you, calculate a price for there labour, even if you do not pay her or him a salary.

So before you start, write down all the possible costs involved in a tanning activity.

Costs can be divided in two groups:

- **Direct costs**
For example the price you pay for a skin is directly responsible for the price of the leather made out of it.
- **Indirect costs**
For example the administration costs you have to make are not responsible for the price of just one particular piece of leather.

In the list of possible costs mentioned before, the direct costs are:

- the price of one skin
- the price of the products required to tan one skin
- the labour costs (the number of hours needed per skin x the price per hour that pays for all your production labour costs)

The rest of the costs you can not directly charge to a particular piece of leather. For those costs we have to find a formula to be able to calculate these costs per piece of leather.

Ar. example: the costs of water, electricity and fuel are 200 per month. Per month we have an average production of 100 skins. The costs per skin for water, electricity and fuel are therefore $200/100 = 2$.

If the rent is 250 per month and the production is 50 skins per month, the costs of rent per skin are $250/50 = 5$.

All the costs made, have to be charge to the price of a piece of leather sold.

Some costs are fixed. For example the rent is the same every month. Whether you produce 100 skins or 500 skins this does not change the total costs for rent. In other words, per skin the costs for rent get less if you produce more. If you sell this leather for the same price, you will make a bigger profit, because it brings in the same but the costs per skin are lower.

The formula for the calculation of the indirect costs should be based on a normal (average) production.

Hopefully you will understand too, that if your production is a lot lower than normal, it will be a lot harder to make a good profit, because a low production also has to pay for all the fixed costs.

Leather has different qualities. A first quality piece of leather is worth more than a second or a third quality. But it is no rule that a third quality piece of leather has less costs than a second or first quality piece of leather. Trying to make something out of third quality leather that can be sold, might cost more.

Often it is more economic to throw a skin away after delimiting, when you see that the skin has a bad quality, although you throw something away that already cost you money. However continuing processing this bad skin would cost you much more than it is ever going to yield.

14.2 Pricing

To calculate a price you have to know three things:

- 1 the costs that you have to pay
- 2 the profit you want to make
- 3 the market price, that is the average price of leather in your neighbourhood

If your costs and the profit you want to make are a lot higher than the market price, you will most probably not sell very much, because your price is too high.

If your costs are higher than the market price, you should try to lower the costs, so you can start making a profit again or at least earn back your costs. If you do not succeed in lowering the costs it is better to stop your leather tanning enterprise.

Never sell under your cost price, maybe except in the initial period, when you might have extra starting costs.

We have mentioned a lot of important points of interest concerning costs. On the next page you will see a form which you can use to calculate how much your leather will cost.

If one of your costs changes a lot, you might have to adapt your price to this change. But do not change the price before you are sure that, if the costs are higher than calculated, it is inevitable that they are higher now. And if they are lower that they will stay lower in the future as well.

Different prices

Not every piece of leather looks the same or has the same size or quality. Therefore you can not give them all the same price. A big skin of a good quality is worth more than a small and not that beautiful skin. You will have to use different prices, depending on the size and the quality of the skin.

Direct costs	
Price per skin	=
10 gramme soda	=
3 kilogramme bark	=
50 gramme lime	=
50 gramme vinegar	=
50 gramme oil	=
1/10 papaya	=
4 hours labour	=
<hr/>	
Total direct costs	=
Indirect costs	
Water per month	=
Electricity per month	=
Fuel per month	=
Average monthly costs for water and energy	=
Rent per month	=
Indirect labour costs per month = total monthly indirect salaries (other than production salaries per month)	=
Use of material and tools per month = price of material and tools divided by the number of months they will be used	=
Use of equipment per month = price of equipment divided by the number of months it will be used	=
Use of building per month = price of the building divided by the number of months it will be used	=
Services performed by others per month = average monthly costs (for example, the monthly amount you pay for the person that grinds your bark)	=
Administration costs per month = the cost for stamps, paper, pencils, typewriter etc.	=
Tax per month = the yearly paid tax divided by 12	=
Payment for licences per month = the amount you pay yearly divided by 12	=
Training per month = total paid for training divided by the number of months you benefit from it	=
<hr/>	
Total indirect costs	=
Skins to be produced per month	=
<hr/>	
Indirect costs per skin = total indirect costs divided by the number of skins to be produced per month	=
<hr/>	
Total costs	
Direct costs per skin	=
Indirect costs per skin	=
Profit per skin	=
<hr/>	
Price per skin = total costs per skin	=

The size

In the chapter *Finishing* the measurement of skin is being discussed. Measure your skins and calculate the average size.

Average size = sum of all the sizes in dm² (square decimetres) divided by the number of skins that you measured

If the average size is 44 dm² you get the average price per dm² by dividing the calculated price per skin by 44.

Average price per dm² = the calculated price per skin divided by the average size

The quality

Now we have to differentiate the average price per dm² into a price per dm² per quality class. In this example we use factors of 1.2, 1 and 0.8:

- first quality price = 1.2 x average price per dm²
- second quality price = the average price per dm²
- third quality price = 0.8 x average price per dm²

14.3 Example

We will conclude this chapter with a worked out example.

Mr. Jackson expanded his enterprise and now has to use the form that we discussed before. He completed the form as follows:

Direct costs	
Price per skin	= 1,000
10 gramme soda	= 10
3 kilogramme bark	= 320
50 gramme lime	= 20
50 gramme vinegar	= 50
50 gramme oil	= 100
1/10 papaya	= 25
4 hours labour	= 2,000
Total direct costs	= 3,525
Indirect costs	
Water per month	=
Electricity per month	=
Fuel per month	=
Average monthly costs for water and energy	= 25,000
Rent per month	= 35,000
Indirect labour costs per month = total monthly indirect salaries (other than production salaries per month)	= 5,000
Use of material and tools per month = price of material and tools divided by the number of months they will be used	= 10,000
Use of equipment per month = price of equipment divided by the number of months it will be used	= 5,000
Use of building per month = price of the building divided by the number of months it will be used	= -
Services performed by others per month = average monthly costs (for example, the monthly amount you pay for the person that grinds your bark)	= 10,000
Administration costs per month = the cost for stamps, paper, pencils, typewriter etc.	= 20,000
Tax per month = the yearly paid tax divided by 12	= 2,500
Payment for licences per month = the amount you pay yearly divided by 12	= 2,500
Training per month = total paid for training divided by the number of months you benefit from it	= 5,000
Total indirect costs	= 120,000
Skins to be produced per month	= 100
Indirect costs per skin = total indirect costs divided by the number of skins to be produced per month	= 1,200
Total costs	
Direct costs per skin	= 3,525
Indirect costs per skin	= 1,200
Profit per skin	= 900
Price per skin = total costs per skin	= 5,625

From this data mr. Jackson is able to calculate his prices as follows:

Average size of a skin

20 skins measure:

38
44
51
60
43
33
42
42
38
46
48
49
29
60
52
47
44
53
50
31 +

900 dm²

average size: 900 : 20 = 45 dm²
average price/dm²: 5625 : 45 = 125

first quality : 125 x 1.2 = 150 / dm²
second quality: 125 x 1 = 125 / dm²
third quality : 125 x 0.8 = 100 / dm²

A first quality skin which measures 44 dm² has a price of 44 x 150 = 6600.
A third quality skin measuring 41 dm² has a price of 41 x 100 = 4100.

15 What will make your project successful

Starting and running a tannery, as a project or as a private business, is not only a question of learning some techniques. The tanning techniques as we have shown in this book are not very difficult. Besides these techniques there are other factors that are important for the success of your tanning activity.

15.1 Feasibility and viability

We have discussed this before. Feasibility means: can we sell enough leather, can we get the necessary skins and bark? Will our investments turn out to be profitable? Economic facts that have to prove that it is worthwhile to start a tannery.

In this paragraph we want to pay special attention to the role people play in a tanning enterprise. You must consider the following:

- Are the people you are planning to work with willing to put a lot of their energy and time into the work to be done?
- Do they have that time?
- Whose initiative is it to start a tannery?
- Are the initiators the ones that are going to profit from it?
- Who is responsible?
- Is the person in charge accepted by the others?
- Does the person in charge have enough management capacities to run a tannery, also when it is expanding?

Often it is seen that production projects are started in which members of the project are taught the techniques of how to produce. Maybe even a small course on bookkeeping and storekeeping is given, and that is that. The project is then supposed to run on its own.

But managing a production unit is something more than the sum of techniques,

bookkeeping and storekeeping. Therefore training is very important, especially the training of those who have to manage the business. And managing is necessary in private enterprises as well as in cooperatives or development programs.
Is the tannery that you want to start still viable?

15.2 Financing

If the tanning activity that you want to start is financed by a foreign organisation, watch out! Often these grants are more or less unconditional. The money is a gift. It could not be better, one could say.

Often the idea to start the tannery was not a local initiative. But who will not consider it a good idea to start tanning the skins which are normally thrown away – especially when the construction, the equipment, even a part of the products that are necessary for tanning as well as the salaries for the first year are paid for. Let's start a tannery!
If you are in this situation, ask yourself if the tanning activity is feasible because of the foreign money or because of economic as well as organizational viability.

Enterprising without conditions related to the external financing makes it very easy to forget economic principals. People often feel a lot more responsible when they build something up on their own blood, sweat and tears than when getting it as a present, nearly without asking for it. A lot of the failures of development projects are due to this phenomena.

So if you want to start a tannery, your first question should always be: Is the project viable? If it is possible to get a financial grant, which you do not have to pay back, you are lucky. But the project should be that viable so paying back a loan plus interest would be possible as well.

15.3 Infrastructure

A tannery, in what ever way it is organized, should fit in the local structure. Sometimes tanning is only done by particular tribes. So if you want to start a tannery, contact the already existing tanners. Not only will they be able to teach you a lot, you will need a good relation with them if you want to avoid having trouble with them in future.

Other important questions are: *with whom shall I initiate the tanning activities?* and: *how will the responsibilities be divided?*

To answer these questions it is good to know the social background of the people you want to work with. For a foreign development worker it is very hard to understand relations in a to him or her unknown society. So it should never be a development worker who is going to select a group of people or decide who is going to be responsible.

In development work there are always two parties that want to cooperate, but often have totally different goals. The people who need help, want other help than the people who can help are willing to give to them. But because their different culture and language, small and often big opinion differences are not noticed or even neglected because it is 'necessary' to cooperate.

Many so-called development projects have been very unsuccessful. It is sad to hear the low percentages on how many projects actually are successful. Many faults were made in the past, because for too long the fact that richer countries were willing to help poorer countries was enough reason not to look too critical at this cooperation. And too long the richer partner took the decisions for the poorer partner.

Let us try to do it right!

16 Miscellaneous

16.1 Vegetable tanning materials

- *Mimosa* bark
- *Quebracho* wood
- *Myrobalan* fruit
- *Oak* bark/wood
- *Camachile* bark
- *Chestnut* wood
- *Acacia catechu* bark
- *Divi-divi* pods
- *Gambir* leaves
- *Mangrove* bark
- *Sumac* leaves
- *Tara* pods
- *Valonia* acorn cups
- *Eucalyptus* bark
- *Cassia fistula* bark
- *Picea vulgaris* bark
- *Urundai* wood
- *Tizera* wood

- *Algarobilla* pods
- *Acacia arabica* bark / pods

16.2 Selected literature

- *Doing a feasibility study*, OEF International, Washington USA, 1987 (English)
- *Entrepreneur's handbook* Technonet Asia, Thailand, 1981 (English)
- *Flaying and curing of hides and skins as a rural industry*, A. Aten et al, FAO, Rome Italy, 1955 (English)
- *Der Gerber*, Josef Doberl, Bohmann Industrie- und Fachverlag, Wien Austria, 1960 (German)
- *Improve your business*, ILO, Geneva Switzerland, 1986 (English)
- *Méthodes artisanales de tannage*, M.I. Mann, FAO, Rome Italia, 1962 (French and English versions available)
- *Small-scale horn processing*, ILO, Geneva Switzerland, 1988 (English)
- *Tanning of hides and skins*, ILO, Geneva Switzerland, 1981 (English)

These publications (except *Der Gerber*) are available from:

TOOL Bookshop
 Sarphatistraat 650
 1018 AV Amsterdam
 The Netherlands

16.3 Useful addresses

This list is not intended to be complete. Addresses of manufacturers of tool, equipment and other products usually can be obtained from local Chambers of Commerce or the Ministry for Economic Development. For more information on NGO's and institutions involved in technical assistance refer to ILO or Satis (addresses of ILO and Satis to be found in the following list).

Central Leather Research Institute

Adayar
Madras 600 020
India

Centro de Investigacion de Tecnologia del Cuero

Technical institute with tanning experience
Avenida 52 entre 121 y 122
La Plata
Buenos Aires
Argentina

Clasen Nicolai

Tanning tools and equipment
Grosse Brunnenstrasse 63
200 Hamburg – Altona
Germany

Himeca – Hidromecanica de Vettori

Tanning tools and equipment
Avenue Mal. Masc de Moraes
4989 Reclife
Brazil

International Labour Office

CH-1211 Geneva 22
Switzerland

Indonesia Leather Institute

Technical institute with tanning experience
Djl. Diponegoro No. 10
Djakarta
Indonesia

Institute National du Cuire et du Textile

Technical institute with tanning experience
Boit Postale 1725
Fes
Morocco

Leather Research Group

Technical institute with tanning experience
343 Royal Parade
Parkville
Victoria
Australia

Leather Research Institute
Technical institute with tanning experience
PO Box 1052
Zaria
Nigeria

S & G International BV
Tanning tools and equipment
Grotestraat 97
Waalwijk
The Netherlands

Feamehough W. Ltd.
Tanning tools and equipment
Riverside Works
Bakewell
Derbyshire SK14 5RN
United Kingdom

Satis
Global union of NGO's involved in technologies for sustainable development
PO Box 2664
Dakar
Senegal

TOOL Foundation
Reference Centre and Consultancy Services for technical assistance and support of
local development organisations and small enterprises
Sarphatistraat 650
1018 AV Amsterdam
The Netherlands