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WET BLUE CHROME LEATHER FOR EXPORT[1/]

by

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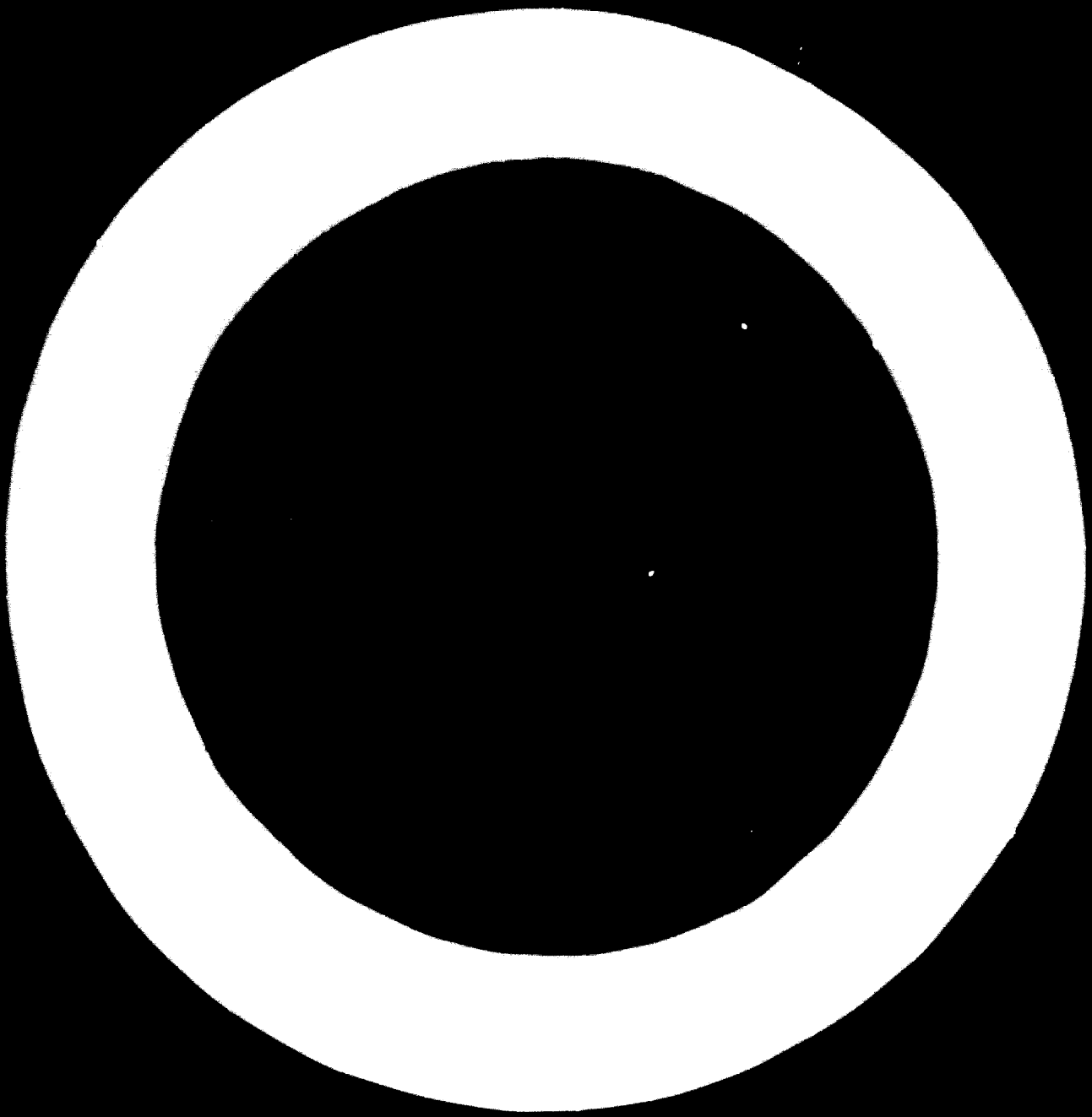
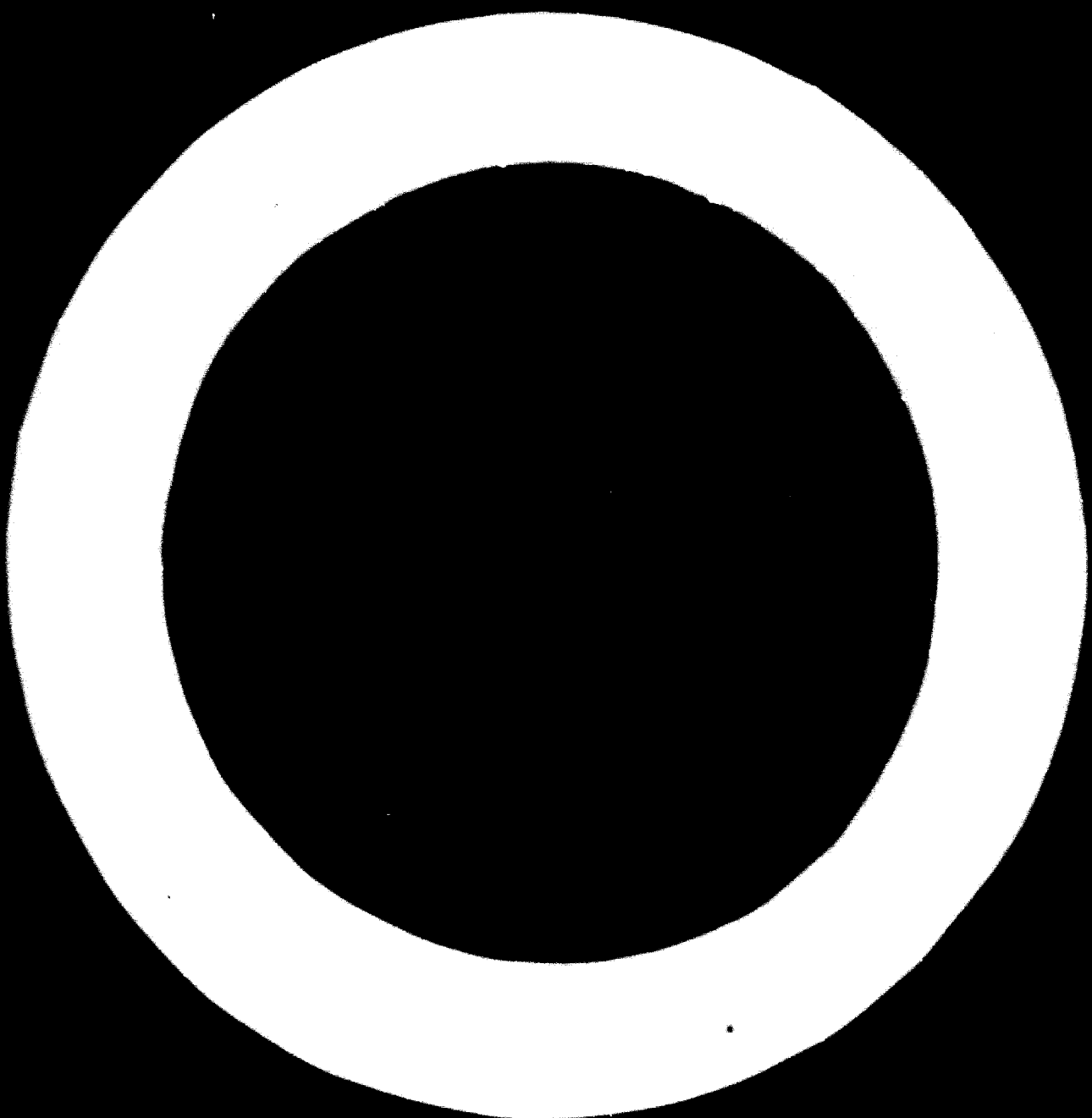
1/ The views and opinions expressed in this paper are those of the author and do not necessarily reflect the views of the Secretariat of UNIDO.



PREFACE

This study was prepared by Y. Nayudamma, Director, Central Leather Research Institute (CLRI), Madras, India, as a working paper for the Seminar on the Development of the Leather and Leather Products Industries in Developing Countries (Regional Project for Africa) organized by the United Nations Industrial Development Organization (UNIDO) and held at Vienna, from 22 February to 5 March 1971.

Today, India is probably the world's largest single exporter of wet blue chrome leathers, and the CLRI has accumulated a great deal of knowledge and experience in the field. Many of the observations contained in this study reflect the intimate association of the author with the Institute and with the Indian leather industry in general. He also shows an understanding of the plans, programmes and progress of the leather industry in several developing countries of Africa, Asia and the Middle East.



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I. THE IMPORTANCE OF LEATHER

Leather has always been a symbol of durability, breathability, elasticity, fashion, and prestige. Of late, however, there has been a growing threat to leather from substitutes, and though imitation flatters the original, the rapid advances being made by the chemical manufacturers towards producing synthetic and poromeric materials to replace leather cannot be ignored. At the present time, man-made products substitute for 50 per cent of leather goods and industrial leathers, 60-80 per cent of sole leather, and 2-15 per cent of upper leather in footwear.

So far, these substitutes have remained mainly as supplements. The real threat to leather may come from the possibility of using raw hides and skins for purposes other than leather-making. However, research conducted so far has not made much progress in this direction.

Generally speaking, the demand for leather in the world is rising. The inherent superiority of leather, when compared to substitutes, the footwear needs of growing populations with higher incomes, new uses for the material, rapid changes in fashion, and the greater use of resources in developing countries - all contribute to this rising demand.

Leather is made from raw hides and skins - by-products of the meat industry. World meat demand in 1975 is expected to increase by 40 per cent over that during 1961-1963.[1/] The supply of raw hides and sheep skins will, therefore, increase, though goat-skin production may remain static. Thus, the increased demand for leather is likely to be met by this supply of raw hides and skins, and further supplemented, rather than substituted, by the poromerics.

Leather contributes to the economy of many countries: it is a valuable foreign exchange earner, and it gives gainful employment to many. It is amenable for development both as a labour-intensive and as a capital-intensive industry.

The total value of the world's leather and allied industries is estimated to be over $2,000 million. International trade is reported to be worth $1,000 million.[2/] The industry provides employment to over 1.5 million workers.

Leather becomes even more important when it is realised that the ever-increasing gap between the developed and the developing countries is best combated by the developing countries exploiting their natural resources to increase the volume and value of exports.

1/ Food and Agriculture Organization of the United Nations, Commodity Review (Rome, 1968) p. 208.

2/ Ibid., p. 190.

Difference in the rate of production is not the sole distinguishing feature between developed and developing countries: advanced countries are equipped to convert waste into wealth, whereas developing countries are marked by poor animal care, low kill rates, badly organized slaughter, and negligible use of by-products. The developing countries raise 60 per cent of the world's cattle, but account for only 40 per cent of its annual hide output.

Better herd management would bring greater returns. However, the developing countries' scope for improvement is also limited by such factors as religious taboos, lack of proper collection and slaughter facilities and a shortage of the appropriate tools and materials. Until these countries are able to establish medium or large tanneries and factories for the manufacture of leather and leather products, the trade will remain the preserve of the developed countries.

Another factor that explains the lack of progress of the industry in the developing countries is the fact that the tanning and footwear industries are essentially in the decentralized cottage sector and mainly craft based. In the last few years, however, there has been a marked trend towards the fusion of small, uneconomic holdings into fully or partly mechanized medium-sized production units with a corresponding increase in exports.

This increase, however, has also been subject to certain structural changes. A preference is shown for processed, rather than raw, products. New markets have been entered, and barter deals and joint ventures have contributed to the establishment of modern tanneries and footwear factories.

The upsurge has been greatly assisted by the substantial reductions on import duties, afforded by the Kennedy round of negotiations, while the scarcity and high cost of labour in advanced countries, compounded by the reluctance of their workers to carry out wet tanning operations, have forced these countries to turn to the developing countries for increased quantities of leather in place of raw.

There is every indication that the developing countries will become the future suppliers of finished leather and leather products to the world at large, provided their production possibilities are properly exploited and complemented by good organization.

II. THE CASE FOR LEATHER EXPORTS

Problems and prospects

The growth in world population and a general improvement in the standard of living has resulted in an unprecedented demand for footwear and other leather products. Many developing countries have large resources of the raw materials needed for leather production, an abundance of cheap labour, and age-old experience and skills in the trade. Some of these countries also have a large number of small and medium sized tanneries; some even have large mechanized and semi-mechanised tanneries and footwear factories. Thus, these countries are well poised for a major breakthrough in the development of their leather and allied industries.

The developing countries, however, also suffer from certain disadvantages: their leather industry is plagued by traditional and social attitudes; the abundant, cheap labour is often unproductive, levels of technology, organisation, management, and productivity are low, while price fluctuations and capital requirements are high; and markets, with their quick changing fashions, trade and tariff barriers and quota restrictions, are usually too distant.

The newly independent countries are very keen to realise maximum utilisation of their natural resources, in order to fetch higher financial returns on them, to provide gainful employment to a larger number of people, and to promote their exports.

At present, many of these countries earn valuable foreign exchange by exporting mainly raw hides and skins. If this raw material could be converted into finished leather and leather goods, and then exported, its value might be doubled or even trebled; it also would provide additional employment and encourage the setting up of ancillary industries.

The leather industry, in this regard, deserves the serious attention of planners and policy makers. The leather and footwear industries are amenable to development in the small-, medium-, and large-scale sectors as both labour- and capital-intensive industries. Thus, there is a positive case for developing countries to modernize their existing industry and/or to set up new, modern industries.

However, there are problems attached to setting up modern leather plants in developing countries:

(a) It is necessary to organise animal management and slaughter, and the collection, preservation, transport and supply of quality raw hides and skins;

(b) The foreign currency needed to buy machinery, materials and technology is not always easily available;

(c) Training facilities are not always available;

(d) No single industry can grow without the concurrent growth of related industries;

(e) Market surveys have to be carried out.

It is true that growing populations and rising living standards do lead to an increasing domestic demand for leather, which the industry can supply. Competition in international markets, however, is difficult because of resistance from established industries in advanced countries.

The advanced countries could help developing countries by importing finished leathers and leather goods; but these countries have trade barriers to protect their own established industries. They would prefer to import raw hides and skins and, perhaps, pickled skins. They quote an old saying that "leather is made in the lime yard", which means that they would like to start from the raw. Many firms in the advanced countries depend mainly on imports of raw hides and skins from developing countries. They have the experience and know-how to handle, mix, tan, finish and tailor these materials to meet the vagaries of fashion and the changing demands and needs of their own and other advanced countries. They import the raw with a view to exporting the finished. Thus, it would not be in their own interest to encourage the developing countries to set up factories.

Nevertheless, times are changing and there is a growing realization all round that every country would like to utilize its own resources to the best extent and that it may not be possible to continue demanding only primary raw materials. Furthermore, in the advanced countries, labour is not only costly but becoming increasingly difficult to get for the unpleasant work of the beam house. Treatment and disposal of effluents have also proved to be a constantly nagging and costly problem. Technology is now geared to the use of less water, less effluent and less labour. In order to avoid these problems, many factories in the advanced countries are now importing tanned leather in place of raw hides and skins.

Changed outlook in trade

This development has brought changes in the international trade of hides, skins and leather. Instead of importing raw material, the advanced countries are now showing a growing interest in, and are demanding, partly processed hides and skins. Importing semi-processed materials allows the importer to buy leather in which he can see the surface defects and thus make a better selection.

On the other hand, for the developing countries, the export of finished leather would mean that for the same unit of export, they would earn more foreign

exchange and employ more labour. They would gain additional economic returns by processing the by-products recovered, which requires only the minimum amount of skills, technology, imported machinery and materials.

Several countries have the capacity to produce finished leathers, but at the present time, their ability to produce material of sufficiently high quality for the world market is limited.

Therefore, the ideal interim solution is to increase exports of partly processed leather and to reduce exports of raw material.

What to export

The following partly processed leathers are in demand: pickled, vegetable tanned, chrome tanned, and chrome crust.

Pickled skins

In pickling, the raw hides and skins are soaked, de-haired, fleshed, and pickled or preserved in acid and salt. This is the simplest form of processing for export. Australia, New Zealand, Turkey and Iran export large quantities of pickled sheepskins. The export of these skins has certain disadvantages, however:

(a) The pickled pelt is essentially a raw material and cannot be stored for long;

(b) Packing and freight costs are high;

(c) Selection is better than in the raw but can still be difficult;

(d) Additional value earned per unit exported is minimal, including only additional labour and the availability of some by-products.

Vegetable tanned leather

Vegetable tanning is probably one of the oldest processing techniques known to man. Mimosa and, to an extent, quebracho and chestnut are popular international tanning materials, though most countries have their own, indigenous tanstuffs. In the advanced countries, the volume of vegetable tanning is decreasing as leathers tanned in this manner (used for shoe soles, upholstery, luggage, etc.) are to a large extent being replaced by synthetics. In the developing countries, however, vegetable tanned leathers are in great demand for domestic consumption and export, as imported synthetics and chemicals are expensive.

For over two centuries, India has been exporting vegetable tanned leathers. Exports of these leathers, known as East India tanned, were at about $US 70 million in 1969. Nigeria, also, exports a large amount. The United Kingdom of Great Britain and Northern Ireland is the main importer of these leathers. France, the Federal Republic of Germany, Italy and the United States of America are other important buyers.

The vegetable tanned leathers thus exported are known as "semi-tanned". Semi-tanned means that, although the leather is completely tanned, the degree of tannage is low. This process involves the removal of hair and flesh and treatment with infusions of vegetable tanstuffs in a pit or a pot, followed by light oiling and drying. It is a long process, but modern methods - using paddles, drums, syntans and powdered vegetable tan extracts - have sharply reduced the time involved. Importers of these leathers first strip off the loosely held tan and then re-tan them with chrome or other agents before final processing into finished leather.

In most countries, vegetable tanning is a traditional craft, usually practised in the cottage and small-scale sectors of industry. This form of tanning covers many surface defects and lends weight, substance, and area. Leather so treated can be stored for long periods, though the colour may darken. It is readily wetted back for re-tanning and finishing and may be used for a wide variety of end-products such as soles, insoles, slippers, straps and belts and for ornamental purposes such as carving and printing. There is always a market for it; even the rejects can be sold.

From the importers' point of view, however, vegetable tanned leather is costly to prepare and to finish. Also, the variety of finished leathers that can be made from it is limited and it is difficult to get pastel shades or rich bright colours to meet fashion requirements.

Chrome tanned leathers

Pickled pelt, if treated with chrome tanning agents, results in a pale blue coloured leather, which is much in demand in international trade. Chrome tanning, though relatively new, is now used extensively for the production of a wide range of leathers. Chrome tanned leather dyes brightly and the colour remains fast against light and washing. This is particularly important, in view of the current demand for aniline and similar types of finished leathers where obliteration of the grain with pigments is reduced to the minimum. Chrome tanned has better storage qualities and strength, particularly in tropical and sub-tropical conditions, than many other leathers.

The process is very short and lends itself to nearly all types of raw materials. Chrome tanned has high hydrothermal stability and is cheaper to produce than vegetable tanned leather.

However, chrome tanning also has its defects. The leather is thin, does not take print well, has a tendency to stretch, and the area yield is comparatively small. Selection is strict, as defects show up more prominently. Chrome tanning

so requires a better understanding of technology, process controls, machinery, c. Most developing countries have to import the tanning agents necessary.

Although, nowadays, most leathers are chrome tanned, and although further ocessing is a continuous, easy operation, most importing countries still prefer getable tanned leather. The main reason for this is that chrome tanned leather s a major drawback: once dried, it is difficult to wet back for further pro- ssing. Furthermore, as chrome tanning is sensitive to several factors good ocess control is necessary, and this is not readily found in many developing ntries. Thus, exports of vegetable tanned were encouraged mainly by the United gdom of Great Britain and Northern Ireland and some other countries in Western ope. These countries developed their own techniques for re-tanning and finishing. wever, when several buyers from Western Europe, who were not experienced in finish- vegetable tanned leathers, entered the international trade they required either or pickled stock. Later, they found it easy to switch over to buying chrome ned leathers.

To overcome the problem of wetting back, chrome tanned leather is now being orted in the wet condition - merely drained after the tanning. This has come be known as "wet blue chrome" leather and there is a rapidly growing demand for today.

ome crust

This is yet another stage in exporting chrome leather. The 45-60 per cent sture content of wet blue chrome leather results in higher packaging and trans- tation costs. There is also the possibility of grain wrinkling and patchy dry- during transport, and measuring is difficult. To overcome these drawbacks, empts are being made to introduce dry "chrome crust" leather. These fall into main categories: (a) ready-to-wet and (b) ready-to-finish. In the first, ing, mordanting or other agents are introduced in the wet blue and dried: a crust leather wets back readily. In the second, the wet blue leather is her treated with re-tanning, dyeing and fat-liquoring agents.

Chrome crust leather is sent out in ready-to-apply-top-finish form, to suit fashion trends. Even machine operations such as shaving, splitting, buffing staking are carried out. However, at the moment, the markets for these leathers limited.

Wet blue for export

ntages

There are several arguments in favour of the export of chrome tanned her.

For the importer, chrome tanned leather, when compared to vegetable tanned, is cheaper to buy, cheaper to finish per unit area, and fits better into his own tannery practice; selection is more rigorous as defects show up prominently; further processing is continuous and easier; special knowledge and experience for finishing are not needed.

For a developing country, chrome tanning may mean a healthy departure from traditional processes and markets. It may high-light the need for scientific control, technicians, modern methods, materials and machinery. This awakening may require the introduction of modern methods of organization, management, productivity, cost accounting, etc. Rejects usually pose a serious problem in the export of chrome tanned leathers, but, paradoxically, they may prove an advantage as, in order to utilize them, the tanner will be forced to process them further. And this necessitates the setting up of a finishing unit. Thus, a leather exporter becomes a finisher who can meet the domestic demand for finished leathers and leather products, thereby reducing imports into his country. In due time, he may also become an exporter of finished leather and leather products.

Developing countries, if they are to meet the growing domestic requirements for footwear in the domestic and export markets, must consider the installation of chrome tanning facilities. This installation does not have to be at the expense of vegetable tanning. As discussed earlier, vegetable tanning has its own advantages and leathers so processed have sustaining and steady markets. Many developing countries have rich vegetable tanning resources and experience; but, introducing chrome tanning concurrently offers certain advantages.

A wise tanner in a developing country would produce three leathers for export; pickled, vegetable tanned and wet blue chromed. Practically the same equipment is required for all of these lines and additional investments are not large, but the exporter has the advantage of greater facility and flexibility in the diversification of his exports. Depending on demand and price, he can adjust the volume of production in any one line, without reducing the total output. Also, he has the advantage of being able to select the skins at different stages; this, in turn, reduces the percentage of rejects.

The same tanner would eventually turn to preparing chrome crust leather for export. Today, the demand is for wet blue chrome, but dry chrome crust is slowly gaining acceptance and the tanner must be alive to this situation.

Once a tanner is exporting chrome crust ready-to-finish leather, it is but a short step to the production of finished leathers, both for internal and export markets.

Disadvantages

There are also a number of disadvantages attached to chrome tanning, for example, the value added, per skin or per square foot, using this process is less than that obtained for vegetable tanning. Therefore, the total foreign exchange earned is less for the same unit volume of export. The tanner/exporter with a quicker turnover may earn more profits by exporting chrome leather, but the country loses to an extent in the total earnings.

Another disadvantage is that whereas even low grades of vegetable tanned leather can be sold at a price, it is difficult to dispose of wet blue chrome rejects. Also, chrome tanned yields less area and lower prices than vegetable tanned leather.

If a country has an established leather and footwear industry, the export of wet blue leather in large quantities could be highly detrimental to it as all the best quality hides and skins will be exported. This could cause a shortage of good quality finished leather in the local market, with adverse effects on the export of footwear and leather goods. Thus, a country like India, which has an established footwear export market, can ill afford to export large quantities of wet blue chrome.

Between November 1968 and March 1969, unprecedentedly high exports of wet blue chrome leather from Argentina and Uruguay resulted in an alarming increase in the prices of raw hides and skins, which badly hurt the local tanning industry. To correct this situation, Uruguay had to take the drastic step of controlling, and even banning, the export of wet blue chrome.

The local industry was paralysed in Argentina too, but the situation appears to have improved since then[3/]. It is forecast that, by 1974, of 13 million raw hides available annually, only 2-4 million will be exported raw (i.e. 15-20 per cent); 8-10 million will be tanned in the country (as against 5 million in 1968 and 6 million in 1969). As, of the 8-10 million tanned, only 3-4 million will be absorbed by the domestic market, the remainder may be exported in the tanned blue state.

The cases of Uruguay and Argentina show the future trends for trading in wet blue chrome leather. The export of chrome leather is recommended provided it is not at the expense of existing exports of vegetable tanned leathers and leather products or at the expense of the growth of the local industry. It is recommended only that it replace exports of raw hides and skins and pickled pelt.

3/ Anon., Cuerecon, vol. 2, No. 8 (1969) p. 22.

History and growth of wet blue chrome leather exports

In India, as early as 1958, it was suggested that, in addition to vegetable tanned leather, the export of chrome tanned be considered. The possibility of exporting of goat skins in the wet blue rather than the raw state was explored.4/ Samples were sent in 1959 to some East and West European buyers, and it was pointed out that further processing would be easier than with vegetable tanned leather, but no business resulted. This was probably due to the natural human resistance to change. Then the Union of Soviet Socialist Republics, followed by other countries in Eastern Europe, began to purchase wet blue chrome leathers prepared specially to their specifications and for their process methods. The USSR entered this market in 1959 because of the quota restrictions imposed by India on the export of raw goat skin and because of the USSR's reluctance to buy traditional vegetable tanned leather, as it had no previous experience in finishing such leathers.

Once the resistance was broken, there was a phenomenal increase in international demand for wet blue chrome leathers. The trend may be seen in the export figures from India given in table 1. The data show that between 1965 and 1969 the value of exports increased 50 fold.

Table 1. Wet blue chrome exports from India, 1965-1969
(Millions of dollars)

	1965-1966	1966-1967	1967-1968	1968-1969
Goat skins	0.48	17.70	16.90	23.20
Sheep skins	-	-	0.65	0.89
Buff calf	-	-	0.54	0.52
Cow calf	-	-	0.04	0.03
Buffalo hides	-	-	-	0.07
Cattle	0.10	0.14	0.06	1.19
Total	0.58	17.84	18.19	25.90

Source: Monthly Statistics of the Foreign Trade of India.

Exports of wet blue chrome leather from Pakistan and Thailand have also shown a remarkable increase in the past five years. Similarly, over the past two years, Kenya has rapidly increased its wet blue exports. Uruguay was the first country in Latin America to enter the market; Argentina joined later and exported large quantities of wet blue chrome hides in 1969.

The demand for wet blue chrome, which started with goat skins, has now extended to all other types of hide and to widespread markets.

4/ Minutes of the 1st Seminar on Leather Footwear and Leather Goods Industry, Ministry of Commerce and Industry (New Delhi, 1958) p. 12.

III. WET BLUE CHROME TANNING TECHNIQUES

Wet blue chrome tanned leather should reach its destination in a fully wet state (50-65 per cent moisture) without partial or patchy drying of any part. It should be ready for immediate re-tanning and finishing by customary methods. During transit, the leather should not dry; it should show no stains, moulds or formation of salt crystals; the grain should be smooth, tight with required strength and of a light, uniform colour. The importer/finisher may offer his own recipes and requirements for the production, sorting and packing of the leathers he wishes to buy. Otherwise he should be assured of the quality and consistency of the product offered by the exporter.

General principles

Raw materials

The tanner should know the origin, season of collection and breed of the animal whose hide he is working on. He should also have accumulated information through experience, on special characteristics, quality, grades, yields, etc. This enables him to fix the price and to decide whether "lots" from one region could be judicially mixed with those from another.

Raw cow and buffalo hides are sorted for substance and weight and generally purchased by weight. It is best to form lots of similar substance and size.

Goat and sheep skins are sorted for cure, size, substance, shape, grain and seasonal defects. For wet blue, sizes 24" - 44" are in demand. There is limited demand for skins outside of these limits. Skins with a square pattern-yielding substance of 0.8-1.0 mm in the blue, and 0.5-0.8 mm after finishing, obtain premium prices.

Rejects in the raw sorting usually amount to 5-10 per cent.

Soaking

This consists of soaking the raw material in water. It appears a simple operation; but improper soaking can cause many problems throughout the subsequent operations. The object is to fully and uniformly re-hydrate the cured raw hide or skin to its original, flaccid, freshly flayed condition. Soaking efficiency depends upon the nature of the cure, temperature, time, soaking agents used, and whether the soaking is carried out in a pit, paddle or drum.

For wet salted stock, a total soaking for 3-5 hours is generally recommended. A preliminary soaking in 300 per cent water (i.e. three times weight of stock) for an hour, followed by 3-5 fresh changes of water over 3-4 hours is suggested.

In winter, and for dry salted and dried hides and skins, a longer soaking period is needed. For dry salted stock, an overnight soaking in water, followed by washing with 4-5 changes of water, may do. In such cases it is necessary to add some antiseptic, such as sodium pentachlorophenate or simple bleaching powder, to the water. For air or flint dried material, however, greater attention is needed. A static soaking for 24 hours is given, to soften up before the mechanical treatment. Drumming with 5 per cent salt and 400 per cent water prior to regular soaking helps. Several soaking aids, e.g. wetting agents, salts with polyvalent anions like citrate, polysulphide, sodium sulphide and enzymes in small quantities, are often added with the salt to wet back, to help disperse the coagulated proteins and to facilitate complete re-hydration.

Fatty or dried skins are often beamed on the flesh side to aid soaking, or machine green fleshed or dry drummed to open up the structure.

Soaking may be done in a pit, paddle or drum. Soaking in a paddle or drum with running water accelerates the process.

The well soaked material is then washed, drained and weighed (soaked weight).

Liming

Liming is a de-hairing process. Factors to be considered in liming are: time, temperature, concentration of materials, method of agitation, addition of sharpeners, and whether hair is to be saved or not. For good break, temper and tight grain, short liming is recommended. Uniformity in the procedure and concentration of materials used is essential.

Hair from hides is seldom saved, but hair and wool from skins usually are. Goat hair (used in making druggets, carpets etc.) fetches less than sheep hair and much less than sheep wool. Hairy sheep, however, and particularly red hairy sheep, have better skin than wool sheep. White hair or wool is more valuable than coloured. As hair and wool that have been contaminated by lime and sodium sulphide deteriorate, particularly in storage, they are carefully cleaned with acid, washed and dried. For goat and sheep hair, however, treatment with lime is demanded by importing countries as a safeguard against its carrying disease and pests.

Hair-saving

This involves painting the flesh side with a paste composed of 5-10 per cent hydrated lime, 2-3 per cent sodium sulphide or a mixture of sodium sulphide and

sodium sulphhydrate, and 30 per cent water. Instead of lime, an inert material such as chalk may be used, which will result in a firm but tight leather. Painting may be done by machine or by hand, using a brush or swab. The hides and skins so treated are piled flesh to flesh for 3-6 hours.

Where hair need not be saved, the liming can be done in paddles or drums using a mixture of 5-10 per cent slaked lime; 2-3 per cent sodium sulphide, and 150-300 per cent water, for a period of 4-6 hours.

The flooding method may also be used for liming. After applying the lime-sulphide paste, the hides or skins are piled flesh to flesh in a pit which is then flooded with water. The stock is left fully immersed for 3-5 days, then taken out for de-hairing.

De-hairing. After the appropriate period, the limed material is de-haired, either by hand or by machine. In the case of wool sheep, hand-pulled wool yields a higher price.

Re-liming. To obtain the desired degree of plumping, the de-haired pelt is put in a vat, paddle or drum and treated with an alkaline solution containing any one of the following: lime; lime with sodium carbonate; lime with sodium sulphide; sodium sulphide; once-used lime liquor with fresh lime; sodium hydroxide with dimethylamine, etc. The re-liming may take from 12 hours to 4 days, depending on the concentration of materials, the method of agitation used, etc.

The swelling of pelts during liming gives drawn grain, whereas flat pelts give loose grain. It is suggested that pelts be kept for from 10 to 12 hours in a pit containing sharpened, used-once lime liquor, fleshed and then drummed for another 10-12 hours. Drumming is done for 2-3 minutes in every hour in the beginning and then continuously in the last 2-3 hours. Lime-free de-hairing methods avoid sludge, give a uniform and bright dyeing, and produce a tight grain.5/

Fleshing. The limed, re-limed hides may be cut into sides. The pelt is then fleshed by hand or by machine, washed and weighed (fleshed limed weight).

Soudding. At this point, the pelt is washed and soudded. If required, a second soudding may be given and the hides re-washed.

Lime sorting. If selection is made for chrome, 5-10 per cent should be allowed for rejections. The soaking, liming and re-liming processes may be carried out in the same drum and can be completed in 24 hours, if hair is not to be saved.

De-liming

Excess lime and alkali are removed or neutralized by treating the pelt with mild acids or acidic salts. De-liming is generally only partial up to about

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5/ G. Toth, Leather Science, vol. 15 (1968) p. 272.

75 per cent of the hide's thickness. Full de-liming results in soft leather and loose grain whereas light de-liming may give a hard leather. De-liming with strong acids, like sulphuric acid, may cause grain crack. If the lot contains pelts with varying thickness, great care should be taken in de-liming. De-liming may also be done in paddles, drums or pits. The time and procedure vary according to season, water and the stock.

Prior to chemical de-liming, it is usual to wash several times with water to remove loose lime and thereby reduce the quantity of chemicals required.

De-liming is better when a short float is used containing 0.5-1.0 per cent of either ammonium chloride, ammonium sulphate, sodium bisulphite, or weak acids such as lactic acid, which gives a silky grain.

Bating

Bating helps to remove the inter-fibrillary matter and cleanses the pelt. (In the case of bad quality hides with poor substance, and where climates are hot, however, bating should be avoided.) The process consists of treating the de-limed pelt with a bate - a mixture of enzymes and de-liming salt. Ordinarily, the enzyme used is proteolytic; but, sometimes a mixture of proteolytic and lipolytic enzymes is used to facilitate removal of fat. Most enzymes work well in a neutral, slightly alkaline medium, but enzymes are also available that work in acid media. Several commercial bates are available.

The de-liming bath may be used for bating, or a separate one, using 0.5-1.5 per cent bate for 1-6 hours at a pH 8-8.5, in paddle or drum at 30°-40°C. Completion of bating is indicated by the pelt retaining the thumb impression and by its degree of flaccidity.

The bated pelt is scudded by hand or by machine and thoroughly washed. If it is wished to eliminate machine scudding, a small quantity of non-ionic detergent may be added along with the bate. This process is further aided by dry drumming of the bated pelt with a detergent, followed by thorough washing. Washing with an organic acid will improve the cleanliness of the pelt. Good washing is important as otherwise stains and patches may occur on the leather.

Pickling

The bated stock is pickled with acid and salt in a paddle or drum. One method employs rapid pickling for about 30 minutes, followed by chrome tanning in the same bath. Another method - leaving it overnight in a drum, so as to equalize the pH to 2.5-2.8 - gives an equilibrium pickle. The composition of the liquor in a pickling drum may be 6-12 per cent salt; 1-1.5 per cent commercial sulphuric acid, and

100-150 per cent water. Part of the sulphuric acid may be substituted by a weak acid, such as formic acid, or by 2-3 per cent alum or aluminium sulphate.

The bated stock is usually drummed or paddled first with salt solution. This is followed by the addition of diluted acid in 2-3 instalments, running for 1-2 hours, and being left to stand overnight.

Pickle sort. The pickled pelt is now sorted for three different product lines: for export as such; for chrome tanning; and for vegetable tanning. Pelts with very good grain characteristics go for wet blue chrome tanning; those with visible blemishes on the grain or flesh - e.g. pock, tick, thorn or stain marks - or which are of poor substance go for vegetable tanning. These may also go for dyed chrome crust, for later use as lining leathers. As 15-20 per cent of the pickled pelt may go for vegetable tanning, this material has first to be de-pickled.

De-liming, bating, pickling and tanning operations are sometimes carried out in the same drum. Rate of water flow and float ratio are considered very important in such operations.6/

De-greasing

For fatty skins, particularly sheep skins, de-greasing is necessary. This is done by treating the pickled, sammed pelt in a drum with chlorinated paraffinic solvents, or kerosene with a suitable detergent (5 per cent kerosene, 1 per cent detergent). The de-greased pelt is washed 2 or 3 times with brine.

Re-pickling

This process is reserved for de-greased pelts. The pelt is re-pickled with 3-4 per cent salt, 0.25-0.50 per cent concentrated sulphuric acid and 80 per cent water, in a drum running for 30 minutes to pH 2.5-2.8.

Chrome tanning

The white, pickled pelt is treated with a basic chromium sulphate solution [$Cr(OH)SO_4$], which results in light-blue coloured chrome leather with high hydrothermal stability. The temperature at which it shrinks in water (T_s) will be above 100°C (up to 150°C). The T_s of the original pickled pelt would be only around 60°C. The completion of chrome tanning is indicated by success in the "boil test": a small piece placed in boiling water for 2-3 minutes should neither curl nor shrink.

Chrome tanning is carried out at pH 2.5-2.8; this is later basified to pH 3.5-3.8. Tanning in a drum requires 3 hours. Usually, 2-3 per cent Cr_2O_3 is fixed in the leather. After chrome tanning, the leathers are horsed up for 1-2 days.

6/ Muller, "Report of the Symposium on Quality Control, 1967", Journal of the American Leather Chemists Association, Supplement No. 14 (1969) p. 50.

The fixation of chrome by the pelt will be governed by the following: pH; basicity of chrome liquor; concentration, time; temperature; mode of agitation; presence of salts of organic and inorganic (weak and strong) acids; previous treatment of the pelt; and ageing of the chrome liquor. Therefore, careful control in the preparation of chrome liquors and in the tanning procedures is extremely important.

Preparation of chrome salts

Several standard chrome salts are sold by international chemical firms. They come in crystal or powder form. All are readily soluble in hot water, some even in cold. Salts with special compositions and characteristics are available for the processing of different types of chrome leather with certain property requirements. "Masked", "self-basifying" and "unbasified" chrome tanning agents are such products. The powdered chrome extracts contain about 25-33 per cent Cr_2O_3.

A number of developing countries have to import these chrome salts. However, if dichromate is available it should not be difficult for the tanner to prepare his own liquor. It is important that material concentration and procedure be kept strictly uniform. Every batch should be analysed for chrome content and basicity.

There are a number of methods for making chrome liquors. The following is an example: Using a lead-lined stirrer, 100-150 litres of hot water are stirred into a lead-lined tank or tub containing 100 kg commercial sodium dichromate. To this solution 90-95 kg commercial sulphuric acid (Sp.gr. 1.84 or 66° Bé) are added, slowly and carefully. Then 25-30 kg glucose syrup or 35 kg molasses are added slowly, over a period of 1½-2 hours, with constant stirring, till a light-blue coloured liquor is obtained.

There are three tests for complete reduction:

(a) A few drops of the chrome liquor are poured into a white basin containing cold water. The reaction is incomplete if the mixture turns yellowish;

(b) A few cubic centimetres of chrome liquor are diluted with water. Ammonium hydroxide and ammonium chloride are added, the mixture heated to boiling, and filtered. The filtrate should not be yellow.

(c) To a few drops of chrome liquor diluted hydrochloric acid is added and the mixture heated in a test tube. A blue or bluish-grey colour on a starch-iodide paper dipped into it indicates the presence of un-reduced dichromate.

Finally, add 3-5 kg of sodium sulphite or sodium bisulphite. The reduced liquor is made to a volume of 400 litres and stored for a week before use. Its strength is around 12 per cent Cr_2O_3 wt/vol, and its basicity 30-33 per cent.

Some observations

(a) Excess sugar in the chrome liquor should be avoided as leather tanned with it tends to develop red pigmentation on storage.

(b) The chrome liquors, as prepared, should be boiled and left standing for at least 5-7 days to allow the chrome liquor to stabilize.

(c) Once the optimum conditions for the preparation of these liquors are set, they should be strictly adhered to.

(d) Unless the customer is informed of it, or specifically asks for it, the addition of masking agents (formates etc.) to the chrome liquor is not advisable in the preparation of wet blue for export as it may interfere with the finishing.

(e) Sulphur-dioxide reduced liquor is the best to use, though sugar-reduced liquors give fuller leathers, cost less, and the reducing agents are easier to handle.

Conventional methods of chrome tanning

Two-bath tannage

Tannage is done in two separate baths. In the first, the pickled pelt is treated with chromic acid for 2-4 hours, horsed up, and struck out. Later, in the second bath, the pelt is treated with sodium thiosulphate solution to reduce hexavalent chrome to trivalent basic chromium salt *in situ*. The advantages of this process are: the elimination of over-tanned grain; uniform fixation of chrome; and the precipitation of colloidal sulphur within the fibres, which gives strength and a fine smooth grain with good feel. Two-bath tannage involves a great deal of work, however, and uneconomic utilization of materials. This method is now being largely displaced by single-bath tannage.

Single-bath tannage

Conventional tanning is carried out, using basic chromium salts in a separate bath after pickling. The pickled pelt is treated with 80-100 per cent water and 2-5 per cent common salt for a few minutes and then the chrome salt (equivalent to 2-3 per cent Cr_2O_3) is added and drummed for 3 hours. At the end of this period, the complete penetration of chrome is insured, even in the thicker neck areas. Then 0.75-1.0 per cent sodium or ammonium bicarbonate, dissolved in water, is added in instalments in order to increase the basicity of the liquor and to raise the pH to 3.5-3.8.

However, tannage in a salt-rich system does not permit the substance of the leather to build up; it rapidly exhausts the supply of chrome liquor; and it leads to wrinkles in the neck region, particularly during basification.

Combination single- and double-bath tannage

The chrome tanning is done in the pickle bath with a portion (0.5-1.0 per cent Cr_2O_3) of basic chrome liquor (as in single bath), together with sodium dichromate solution (equivalent to 1.5-2.0 per cent Cr_2O_3). Sodium thiosulphate (5-10 per cent),

and/or bisulphite and acid are added to the same drum till the pelt obtains a bluish tinge. Such a combination is claimed to give a better and smoother grain.

Modern trends in chrome tanning

Pre-basified liquors

The tannage is started with low basic chrome liquors (25-30 per cent basicity) followed by pre-basified highly basic liquors (40-50 per cent). This minimizes the quantity of alkali required for basification and mitigates the wrinkle problem.

Salt free tannage

The pickled pelt is treated with one third of the total chrome liquor (0.75 per cent Cr_2O_3) in the pickle bath at pH 3.0. The grain is set; the T_s is around 85°C. The leathers are kept overnight in a pile. The next day they are drummed in a short float (15-20 per cent water) with the balance of chrome liquor (1.75 per cent Cr_2O_3) probasified to 40-50 per cent. The drum is run for 2 hours and the leather checked for complete penetration. This procedure produces full leathers that are fairly free from back-bone wrinkles.

Hot bath

After tanning in a short float, the bath is flooded with water at 80°C and the leather drummed for about an hour. The chrome salt hydrolyses, resulting in a higher basic salt fixation without basifying with alkali.

Floatless tannage

Floatless, or powder, tannage involves the tanning of pickled pelt directly with the chrome powder, without the addition of water. The chrome compound should be readily wettable and anionic in nature in that concentrated form. It penetrate readily and, in contact with the water contained in the pelt, it hydrolyses into a basic cationic chrome compound and reacts with the pelt. This system requires the use of fewer effluents and gives fullness and smoothness to the leather; however, wear and tear in the drum can be very high.

Self-basifying tannage

The pickled pelt is treated with powdered chrome salt containing dolomite or calcium sulphite - slow-acting alkalis that result in gradual basification and tanning.

Short float tannage

The tendency today is to use short floats, from liming to re-tanning. The advantages of short-float processing in a drum are: water and effluent volume are less; tanning time is shorter; there is better penetration, distribution and take up of material; and the leather has better handle and tighter grain.

Masked chrome tannage

The addition of certain salts to chrome liquors - prior to, during, or after, tanning - in order to achieve co-ordinated chrome complexes that are more resistant to the effect of pH, hydrolysis and precipitation (masking action) is now a well-established practice. Salts of organic acids (formic, adipic, phthalic, lactic, sulphophthalic) and inorganic salts (sodium sulphite, syntans etc.) are added to the basic chrome sulphate, in small concentrations, with advantage.

Unbasified tannage

This system is ideal for village chrome tanning. A special chrome liquor is prepared by adding a suitable quantity of salts of hydroxy acids (e.g. lactic acid) to the basic chromium sulphate solution and adjusting it to pH 4.5-5.0. A fully de-limed pelt, at pH 5.0 without pickling, may be tanned with such a chrome salt without any further basification. The leather obtained is soft and tight. However, as this tannage is partly anionic in nature, finishing techniques such as dyeing and fat-liquoring may have to be modified.

For all these modern techniques, strict process control is essential. Time, temperature, float, concentration, pH, mode of agitation, etc. have to be strictly controlled.

Boil test

After basification, a small leather piece is cut and plunged into boiling water for 2-3 minutes. It should neither curl nor shrink, and on drying it should have a mellow handle. Resistance to this test shows the effectiveness of the tannage.

Some wet blue importers demand leathers with low chrome content These leathers need not stand the boil test, as the importers themselves will re-tan them with an additional amount of chrome.

Paddles versus drums

Until recently it was the general practice to use paddles for all processes, from soaking to bating, with the exception of pickling and tanning, which were done

in drums. Today, however, drums are being used exclusively. In a paddle, the float to pelt ratio is at least 3:1, whereas in drums, it is 1:1 or more; therefore greater volume of effluent and less exhaustion of materials is achieved with paddles. Also, drums give a heavy beating to the pelt, which results in wrinkles etc.; paddle action is milder. However, with proper control, chemical and mechanical adjustments, appropriate design and rotation speed etc., good results can be obtained using drums throughout the process. The speed of the paddle or drum will vary, depending upon the operation. In a paddle, soaking may be done at 12 rpm; liming and re-liming at 8 rpm, and de-liming and bating at 16 rpm. With drums, pickling is done at 12 rpm and chrome tanning at 8 rpm. The drum may only have shelves for pickling, but for tanning it should have both pegs and shelves.

Machines

The machines required for wet blue manufacture are relatively few and simple. Apart from paddles and drums, the tanner needs only machines for fleshing, de-hairi scudding and setting. Purchase of a scudding machine may be avoided by drum batin and scudding. If necessary, machines may be dispensed with altogether, but hand operations are lengthy and somewhat unpleasant.

Washing

For wet blue export, after basification, the tan drum is flooded with water, run a few minutes and drained. The leather is washed again with fresh water or cleared with a weak, diluted acid (0.25 per cent acetic acid) and washed further. The water squeezed from the pieces should be practically colourless, indicating that there is no free chrome liquor. Some importers prefer it if the goods are not washed to any great extent.

Treatment with preservatives

The leather, when washed free of loosely held chrome, is floated in a drum containing 100 per cent water and a small amount (0.25 per cent) of preservative like sodium pentachlorophenate, and run for 15-30 minutes. It is then taken out and piled for 2-3 days.

Striking out

The goods are lightly set out. Some tanners samm the leathers before setting in order to reduce the moisture content to minimum level.

Sorting

The wet blue chrome leather is now sorted. Rejects may amount to 5 per cent.

Area measurements

The leather is sold by area. This poses a problem, as it is difficult to measure the area of wet, rubbery leather; there is no suitable equipment available. The generally accepted method is the following: The wet blue leather is dipped in water for 2 hours, left overnight to drain, lightly set, slicked flat, put on a wooden board, and the area measured by a planimeter or pinwheel measuring machine.

Alternatively, for normal transactions length and width are measured and area is obtained by reference to tables.

Packing

The goods should reach their destination in wet condition; there should be no drying in any part of the pack. As a rule, the wet blue leather is packed in polythene sheets, then wrapped with burlap (gunny cloth) and placed in a wooden box.

Manufacture of wet blue chrome from wet salted goat skins

Raw materials

The raw materials are wet salted goat skins, 24"-40" in width (24"-28" is considered very small; 28"-31", small; 32"-36", medium; 37" and above, large). The skins may be cut open if they are in the form of a bag.

Soaking

Three or four changes of fresh water are given in a paddle over a period of 3 hours. The skins are then drained and weighed (soaked weight).

Beaming

The skins are beamed on the flesh side, particularly the back bone and neck portions, and piled for 1-2 hours.

Liming/de-hairing when hair is valuable and should be saved

Painting. The paint composition is 7-10 parts slaked lime, 1.5-2.5 parts sodium sulphide, and about 15 parts water. This gives a creamy consistency. The paint, which is prepared several hours before use, is applied by machine, by jute bag or by brush to the flesh side. The skins are piled flesh to flesh and left overnight, well covered. Next morning they are de-haired.

Plumping

The de-haired skins are limed in a pit containing 200 per cent once-used lime liquor, 200 per cent fresh water and 5 per cent fresh slaked lime, and left for two days, being handled once a day. The skins are then scudded and re-limed with 400 per cent water and 5 per cent slaked lime and kept for another two days, being handled once every day. The skins are then machine fleshed and scudded.

Plumping, alternative method

The de-haired skins are run for 15 minutes in a paddle containing 300 per cent water and 1.25 per cent sodium sulphide. Thereafter, the paddle is run for 5 minutes every 3 hours. The skins are left in the paddle overnight. Next morning they are put in water containing a little slaked lime. They are then fleshed, scudded and weighed. The skins are washed in the paddle for 30 minutes before de-liming.

Liming/de-hairing when hair is not to be saved

Liming. After soaking and beaming, the skins are run for 1½ hours in a paddle containing 300 per cent water, 5-6 per cent sodium sulphide and 5-10 per cent lime. The paddle is then run for 5 minutes every 3 hours and the skins left in it overnight. It may take 24-36 hours before the skins are ready to be de-haired.

When the skins are de-haired they are returned to the paddle, run for 15 minutes, and kept in the paddle for another 12 hours. (Total period, 24-40 hours). The skins are then fleshed, scudded, weighed and washed in running water for 30 minutes.

The fleshed weight is very important. All the material concentrations in the operations that follow are based on this weight.

De-liming and bating

The scudded, washed pelt is de-limed in a paddle containing 300 per cent water at 38°C, 0.5 per cent ammonium sulphate and 0.3 per cent sodium bisulphite, and run for 30 minutes. Then 1 per cent bate is added and the paddle run for another 30 minutes. Next, 0.1 per cent detergent is added and the paddle run for an hour. Bating is tested for completeness. The bated pelt is then scudded and washed for 30 minutes.

De-liming and bating, alternative method

The scudded pelt is placed in a drum containing 200 per cent water and 0.5 per cent ammonium sulphate and run for 30 minutes. The pelt is two thirds de-limed.

Half of the liquor in the drum is removed, the temperature of the bath is raised to 38°C, 1.0-1.25 per cent bate is added, and the drum run for 1½ hours. The pelt is taken out, scudded, dry drummed for 15 minutes with 0.25 per cent non-ionic wetting agent (though this is not essential) and washed thoroughly with fresh water.

Pickling

The pelt is pickled in a drum containing 80 per cent water and 6 per cent salt and run for 10 minutes. A solution of 1.25 per cent commercial sulphuric acid diluted with 10 per cent water is added to the drum in 2-3 instalments at intervals of 5 minutes and the drum run for 1½ hours. The skins are left in the bath overnight. Next morning the pH is checked: it should be around 2.5-2.8. The drum, with a preservative added, is run for 30 minutes. The skins are taken out and the pickle liquor drained off.

Sorting

The pickled goods are sorted for: export as such; blue chrome; and vegetable tanning. The better grain selections go for chrome tanning.

Chrome tanning

Method A:

The pickled skins are drummed for 5 minutes with 60 per cent water and 2 per cent salt. One third of the total chrome liquor (of $33^1/3$ basicity) is added and the drum run for 30 minutes. Then another third of chrome liquor (previously adjusted to 40 per cent basicity) is added and the drum run for a further 30 minutes. Finally, the remainder of the chrome liquor (of basicity 50 per cent) is added and the drum again run for 1½ - 2 hours. The total quantity of chrome is 2.5 per cent Cr_2O_3. Sodium bicarbonate (0.5 per cent), previously dissolved in water, is added slowly to basify; the pH is raised to 3.5-3.7. A piece is checked for boil test. The leathers are then horsed for a day.

Method B (Pickling and tanning in the same bath):

The bated stock is pickled as described above in a drum containing 80 per cent water, 8 per cent salt and 1 per cent sulphuric acid. This is run for 30 minutes. To the same bath, chrome liquor, containing 0.8 per cent Cr_2O_3 (basicity $33^1/3$ per cent) is added and the drum run for another hour. The skins are kept overnight in the bath. Next day, the drum is run for 30 minutes, a second portion of chrome liquor (0.8 per cent Cr_2O_3 - basicity 40 per cent) added, and the drum run for 30 minutes. Finally, a third treatment of chrome liquor (0.9 per cent Cr_2O_3 - basicity 50 per cent) is given and the drum run for 1½ - 2 hours.

The bath is further basified with 0.5-0.75 per cent sodium bicarbonate or a mixture of bisulphite and bicarbonate, added in instalments to attain pH 3.5-3.7. The drum is run for 30 minutes. After the boil test, the skins are removed from the bath and piled flat for a day.

Method C (Single and double bath tannage):

Pickling is done in a drum, as described in method B.

To the same bath, $33^1/3$ per cent basic chrome liquor (0.75 per cent equivalent Cr_2O_3) is added in 2-3 instalments and the drum run for 3 hours. The stock is left overnight in the bath. Next morning it is checked for complete penetration, 3.5 per cent sodium dichromate in 50 per cent water is added, and the drum run for another hour. Then 6-8 per cent sodium bisulphite or sodium thiosulphate, or a mixture of both dissolved in a small amount of water, is added in 2 instalments and the drum again run for 2 hours. The liquor is basified with 0.75 per cent sodium bicarbonate, raising the pH to 3.7, and the goods taken out and piled.

Treatment with preservative

The tanned, piled skins are returned to the drum, washed thoroughly with wate for 15-30 minutes, and drained. They are then floated in a bath containing 50 per cent water and 0.5 per cent sodium pentachlorophenate (or 0.2 per cent sodium trichlorophenate) and run for 30 minutes. The skins are then taken out and piled for 1-2 days.

Striking out

The skins are struck out on the grain or flesh side and piled grain to grain. If the moisture content is to be reduced, the skins are samed and then struck out.

Sorting

The wet blue stock is sorted and graded according to size, colour, grain pattern, tightness, fullness, blemishes etc. The leather area is measured.

Packing

The skins are packed - either flat or in rolls - in polythene sheets and placed in wooden boxes. Some naphthalene is sprinkled over them. Usually, there are 10 skins to a pack and thirty packs to a box. The size of box corresponds to the size of the skins. They are properly marked. The box is nailed and sealed.

The processing methods described above may also be applied to hairy sheep skins, but for fatty sheep skins, de-greasing is necessary.

Manufacture of wet blue chrome from dry salted goat skins

Only the soaking procedure is different.

Raw material

Dry salted goat skins.

Soaking

The skins are left overnight in a pit containing 500 per cent water, 1.0 per cent wetting agent and 0.1 per cent bleaching powder. Next day they are drummed for one hour and then again for two hours with 200 per cent water.

After draining, 200 per cent fresh water, wetting agent and bleaching powder are added. The drum is run for half an hour and the skins left overnight. Next day, the drum is run for 5 minutes; the stock is drained; it is run again for 15 minutes, with fresh water, and again drained.

Manufacture of wet blue chrome from sheep skins

Raw materials

Three varieties of sheep skins are marketed: hairy; woollen; and de-wooled. Hairy sheep skins may be given the same processing as goat skins (see previous section) but woolly sheep skins need de-greasing when pickled.

De-greasing

The pickled pelt is drummed with 5 per cent kerosine and 1 per cent detergent for one hour and washed three times with saturated brine.

Re-pickling

The de-greased skins are re-pickled in a drum containing 80 per cent water, 3 per cent salt and 0.25-0.50 per cent sulphuric acid, run for an hour, and left overnight. Next morning, the pH is about 2.5-2.8.

Chrome tanning and subsequent operations. As in goat skins processing.

Manufacture of wet blue from cow hides

Raw material

Wet salted cow hides of medium size and weight.

Soaking

The salt is shaken off and the hides placed in a drum containing 200 per cent water for one hour. The drum is next run for 30 minutes. After washing in 2-3 changes of water, the stock is drained.

Liming

Method A:

A paint is prepared with 100 parts slaked lime, 100 parts sodium sulphide lumps, 50 parts common salt and sufficient water to give 12°- 15° Bé consistency.

The well-drained hides are dipped in, or swabbed with, this solution, piled flat, grain to grain, covered with a wet gunny cloth, and left overnight. Next morning, the hides are put in a paddle or drum containing water, run for half an hour, taken out and de-haired.

Plumping. The hides are re-limed with 3 per cent slaked lime and 1-2 per cent salt, run in the drum for 10-12 minutes, and left overnight. Next day, the goods are fleshed, trimmed, scudded and washed 2 or 3 times. The fleshed weight is noted.

Method B:

The soaked hides are kept for one day in a pit containing 400 per cent water, 3 per cent slaked lime, and 4 per cent solid sodium sulphide. The next day, the hides are de-haired and placed in water containing a small amount of slaked lime. They are left overnight. The third day, the hides are fleshed, scudded, washed, trimmed and the fleshed weight noted.

De-liming

The fleshed pelt is placed in a drum containing 200 per cent water and 1 per cent ammonium sulphate, until two thirds of the cut section of the thick part of the butt are de-limed. Sometimes 0.25 per cent formic or acetic or 0.5 per cent lactic acids are used in addition to the ammonium sulphate. The de-limed pelt is scudded and washed thoroughly.

Bating

If a clear pelt is required, bating may be done in the drum containing 125 per cent water at 38°C and 0.25 per cent bate for 30 minutes. The bated stock may be dry-drummed with a non-ionic wetting agent and then washed thoroughly.

Pickling and tanning

Method A (in the same drum bath):

The bated stock is placed in a drum containing 80 per cent water and 8 per cent salt. The drum is run for 10 minutes. Then 1 per cent hydrochloric acid, diluted with water, is added in two instalments, at intervals of 15 minutes.

After 2 per cent iron-free aluminium sulphate and two thirds of the basic chrome liquor (0.75 per cent Cr_2O_3) have been added the drum is run for 2 hours. The rest of the chrome liquor (1.75 per cent Cr_2O_3 - 40 per cent basicity) is added in three equal instalments at intervals of 30 minutes. Along with the last instalment, 0.5-0.75 per cent sodium formate is added and the drum run for 1½ hours. Sodium bicarbonate (0.5-1.0 per cent) is added in two instalments for basification, and the drum run for one hour to pH 3.8. The shrinkage temperature is tested and the stock horsed up overnight.

Method B (in separate drums):

Pickling. The de-limed pelt is pickled with 60 per cent water and 6 per cent salt. The drum is run for 10 minutes. Sulphuric acid (1.25 per cent) is added in 3 measures over a period one half hour. The drum is run for a further 1½ hours. The pelt is left overnight in the bath. Next day the drum is run for 30 minutes and the hides removed.

Tanning. Tanning is done in a separate drum. The pickled stock is placed in a drum containing 2 per cent salt and 60 per cent water. One third of the basic chrome liquor (0.8 per cent Cr_2O_3) is added and the drum run for 45 minutes. The second measure of chrome liquor (0.8 per cent Cr_2O_3 at 40 per cent basicity) is added and the drum run for another 45 minutes. The final third of the chrome liquor (0.9 per cent Cr_2O_3 at 50 per cent basicity) is then added and the drum run for 1½ hours.

When penetration is complete, the bath is basified with 0.5-0.75 per cent sodium bicarbonate to a pH 3.6-3.7. The boil test is applied. A final drum run of 30 minutes is given, and the stock horsed overnight.

Treatment with a preservative

The chrome tanned stock is washed well and run for 30 minutes in a drum containing a preservative (0.25-0.5 per cent) and 100 per cent water. The treated material is piled to drain for one to two days.

Setting and sorting

The goods are lightly set out, measured and packed in polythene paper.

Packing

The wet blue leathers are stacked in a wooden box lined with gunny cloth or a mat made of date leaves.

Manufacture of wet blue from cow hides: alternative process

Raw materials

Wet salted cow hides weighing 10-12 kg each.

Soaking

After they have been drained, the hides are washed in plain water in a paddle for 30-45 minutes. They are soaked then in 500 per cent water, 0.1 per cent preservative and 0.1 per cent wetting agent (on the raw weight), run for 10-15 minutes, and left overnight. Next day the soaked weight is noted.

Liming

The washed skins are limed in a paddle containing 3 per cent sodium sulphide, 3 per cent lime and 300 per cent water on soaked weight. They are run three times a day, for 20 minutes each time, and left in the paddle overnight. The hides are then de-haired, fleshed and washed. Pelt weight is noted.

De-liming and bating

The hides are next de-limed in a drum containing 200 per cent water and 1 per cent ammonium sulphate (on pelt weight) and run for 30 minutes. Then 0.2 per cent bate is added to the bath and the drum run for a further 30 minutes. The hides are washed in running water for 20 minutes before draining.

Pickling

The goods are pickled in a drum containing 50 per cent water, 6 per cent salt and 1.7 per cent sulphuric acid (on pelt weight) of Sp.gr.1.74. The acid is diluted with 10 volumes of water, and added in three 20-minute intervals. The drum is run for 1½ hours and the hides left in the bath overnight. Next day, they are given a further run of one hour and the pH of the pelt adjusted to 2.8-3.1, ready for chrome tanning.

Chrome tanning (in pickle bath)

A 10 per cent measure of chrome powder (containing 2.5 per cent Cr_2O_3 - $33^1/3$ per cent basic) is added directly to the pickle bath and the drum run for 1½ hours. Then 1 per cent sodium bicarbonate (dissolved in water) is added within

one hour at four equal intervals, and the drum run for another two hours. The pH of the pelt is adjusted to 3.7. The boil test is given and the hides piled up for two days.

Preservative treatment

The goods are washed in running water for 10 minutes and then some of the water drained off to leave about 150-200 per cent. To this, 0.3 per cent sodium pentachlorophenate is added and the drum is run for 20 minutes. The hides are piled up overnight. Next day, they are ready for selection and packing.

The above processes may be applied to buffalo hides and buffalo calves.

Manufacture of wet blue chrome from buffalo calf

Raw material

Wet salted buffalo calf hides weighing 5-8 kg per piece.

Soaking

The material is soaked for 2-4 hours in a pit containing 300 per cent water. Three to four changes of water are given. The goods are green fleshed, washed again with fresh water, drained and weighed (soaked weight).

De-hairing

A paint is prepared with 2.25 per cent sodium sulphide flakes, 5 per cent China clay and 25 per cent water on soaked weight. The hides are dipped one by one in the paint, piled and covered with burlap. Next morning they are de-haired.

Plumping

The goods are left for 2 days in a pit containing 1.5 per cent sodium sulphide flakes and 300 per cent water. Handling is twice a day.

Fleshing

On the third day, the pelts are machine fleshed, washed, scudded and weighed (fleshed pelt weight).

De-liming

The pelts are drummed for 30 minutes in a de-liming bath consisting of 150 per cent water and 0.5 per cent sodium bisulphite.

Sulphuric acid (0.25 per cent, diluted with water) is then added to the drum in 3 instalments at 10 minute intervals. The pelts are drummed for another hour

and left in the bath overnight. Next day the drum is again run for one hour and the pelts tested for complete de-liming, using phenolphthalein. They are then washed in water.

Bating

The pelts are bated for 30 minutes in a drum containing 125 per cent water of 38°C and 0.25 per cent bate. The drum is then drained.

Dry drumming

The drum is run for 5 minutes. A non-ionic wetting agent is added and the pelts dry drummed for 30 minutes.

Acid wash

The pelt is washed for 15 minutes in 0.25 per cent acetic acid and 125 per cent water. The drum is then drained.

Pickling

The pelt is drummed for 5 minutes with 80 per cent water and 8 per cent salt; then 1 per cent sulphuric acid (in 20 per cent water) is added in 2 instalments and the drumming continued for an hour. The stock is left overnight in the bath. In the morning, the pH of the bath should be 2.5.

Chrome tanning

Half the pickle bath is drained and the drum started. The chrome liquor (33 per cent basic) is fed into the drum in the following proportions: an amount of liquor equivalent to 0.8 per cent Cr_2O_3 (drummed for 15 minutes); 1 per cent Cataliz Gs (Sandoz) (drummed for 30 minutes); an amount of liquor equivalent to 0.8 per cent Cr_2O_3 to which 1 per cent sodium formate has been added previously (drummed for one hour); and an amount of liquor equivalent to 0.8 per cent Cr_2O_3 to which formate is added (drummed for one hour).

Basification

A solution of 0.5 per cent sodium bicarbonate and 10 per cent water is added in two feeds at 10 minute intervals and drummed for 45 minutes. The pH of the bath should be 3.5-3.7. The boil test is applied. The goods are flooded with 50 per cent water and run for 15 minutes. Another 50 per cent water is added and the drum run for another 15 minutes. A further 100 per cent water is added and the drum again run for 15 minutes. The drum is then drained.

Acid wash

The goods are washed for 15 minutes with 0.25 per cent acetic acid and 200 per cent water. They are further washed with plain water for 15 minutes. On pressing, the run-off should be practically colourless, indicating absence of free chrome liquor.

Preservative

The skins are floated in a bath containing 100 per cent water to which 0.5 per cent sodium trichlorophenate (dissolved in water) is slowly added to the running drum over 15 minutes. The leather is taken out and piled to drain for 2 to 3 days.

Sorting

The goods are sorted, measured and packed.

[illegible]

Raw material

Wet salted buff calf (6 to 8 kg average).

Soaking

After the skins have been washed for half an hour in a paddle containing plain water, they are drained. Then they are soaked in fresh water containing 500 per cent water, 0.25 per cent sodium sulphide, 0.5 per cent lime, 0.1 per cent preservative and 0.1 per cent wetting agent (on raw weight), run for 10-15 minutes, and left overnight. Next day, the skins are green fleshed and soaked. The weight is noted.

Paste liming

A paste composed of 2.5 per cent sodium sulphide, 8 per cent lime and 12-15 per cent water (on soaked weight) is applied on both sides of the skins, which are then piled and left overnight.

Paddle liming

The pasted skins are then transferred to a paddle containing 300 per cent water and 5 per cent lime and left for two days. The paddle is run three times a day for 10 minutes each time. Next day, the skins are de-haired and put back into the same liquor, with a further 5 per cent lime and 0.5 per cent soda ash added, and left for two more days. The paddle is run twice a day for 10 minutes each time. Then the skins are fleshed and scudded, and the fleshed weight noted. Finally, they are washed in two changes of water, for 15 minutes each time.

De-liming

The washed skins are de-limed in a drum containing 1.5 per cent ammonium sulphate, 200 per cent water on the pelt weight. The drum is run until de-liming is complete.

Bating

Bating takes one hour in a drum containing 200 per cent water (37°-39°C) and 0.75 per cent bate (on pelt weight). The goods are then drained.

Basting

The goods are dry drummed for 15-20 minutes, then 0.4 per cent wetting agent is added and they are given a further run of 30 minutes. Finally, they are washed in running water for 30 minutes and drained.

Pickling

The skins are now pickled with 60 per cent water, 6 per cent salt and 1.25 per cent sulphuric acid (on pelt weight). The acid is diluted in 10 times its volume of water and added in three equal instalments at intervals of 15 minutes. They are run for a further 1½ hours and left in the drum overnight. Next day the goods are run for another hour.

Chrome tanning

Chrome powder containing 2.5 per cent Cr_2O_3 (33 1/3 per cent basic) is added to the pickle bath and run for 1½ to 2 hours. Then 1 per cent soda ash, dissolved in 10 times water, is added slowly over 1½ hours and the drum run for a further 6-8 hours. The skins are given the boiling test, checked for pH 3.7, and piled up.

Preservative treatment

The goods are washed in running water for 10 minutes, treated with preservative, piled and graded.

Chrome tanning for cottage and small tanners

A cottage tannery may be defined as an individual family tannery that uses only hand tools. A small-scale tannery may be a family unit or it may engage others, but it is equipped with some machinery.

Cottage tanners

In many developing countries, tanning is a traditional industry scattered throughout a number of cottage units and employing age-old experience and skills,

mostly related to vegetable tanning. Can these skills and the existing facilities be diverted to chrome tanning? Is it possible to bring the fruits of modern science and technology to these people? Is it economically worth while?

If only to utilise this skill and labour, the introduction of chrome tanning at the cottage level is worth considering.

At present, the village collector of raw hides and skins either uses them indiscriminately or ruins them by improper preservation. However, if he were to de-hair, pickle and chrome tan at source, and then supply the wet blue chrome leather to an established tanner/exporter, he would realise more value for his labour.

Alternatively, a group of tanners could form a co-operative, and a common service facility centre could be set up with the supervision and technology required to process the individual tanners' raw material as contract work. Such a co-operative unit could become a feeder to an established tanner.

In India, CLRI has been conducting extensive investigations into the introduction of alkali-stable chrome complex compounds which could be used by the cottage tanner without much control (with or without prior pickling) and without the aid of heavy machinery. These were described earlier as unbasified chrome compounds. If they were available, the cottage tanner could proceed with his usual method of de-hairing (using enzymes, or by liming and de-liming) and drenching, but instead of vegetable tanning he would use the ready-made masked chrome liquor. The wet blue leather so prepared could be transported to large, organised tanneries within the country or direct to the exporter.

Favourable results have been obtained by applying strongly masked anionic chrome sulphate solution to bated pelts (without pickling).1/ Such chrome liquors have high stability towards alkali and penetrate into the slightly alkaline pelts. By tanning with less than 1 per cent Cr_2O_3 (on bated weight), together with a suitable preservative, for one hour, then washing and striking out, a material with about 55 per cent hide substance and 40 per cent moisture content is obtained. This can be stored for a long time, shipped abroad and further processed by any kind of tanning.

The Central Leather Research Institute has extended this thinking to attempts to develop chrome compounds that not only tan but neutralise, fill, fat-liquor and colour the leather.

1/ E. Gergely, Fuller and Better Utilisation of Hides and Skins (1964), p. 287.

All this work is still at the experimental stage, however. More intensive study in the laboratory and an extensive dissemination of the know-how to the cottage sector would be needed before the over-all results could be assessed.

The vital question remains: Will the villager, who cannot even preserve a hide properly, be able to supply a properly tanned chrome leather? The answer may be a matter of incentives. Today, the cottage tanner has no incentive to produce a well-flayed, cured hide. The production of wet blue, however, could mean higher returns and more employment for him. If foolproof materials and methods were offered to suit his level of operation, and if his products could be readily sold, the cottage tanner might have sufficient incentive to switch over to chrome tanning.

Small-scale tanners

Some developing countries have several small-scale tanning units. These units have the minimum machinery necessary to produce chrome upper leathers, but their levels of technology, capital, etc. are low. They could be fully utilised to make wet blue chrome leather, however, provided they were given practical demonstrations of the latest know-how and help in obtaining the additional equipment and capital required. These tanners should be encouraged to take up wet blue chrome leather production for export. Similarly, the present exporters of pickled pelts easily switch over to chrome tanning. Serious attention should be paid to these possibilities as the existing, reportedly uneconomic, units could be switched over to a more profitable field of activity.

Cottage chrome tanning

When complete "cottage chrome tanning" has been achieved, it is expected that the cottage tanner will process his skins to the de-haired, well-limed state (using the process most appropriate to his circumstances) and then proceed as follows:

De-liming and cold bating

The limed pelt is kept in a pit containing 300 per cent water, 0.5 per cent bate, and 1 per cent ammonium sulphate. It is trampled and left overnight. Next morning, if required, another 0.5 per cent bate is added. It is left standing for a further 4-5 hours, with occasional handling, then scudded and washed thoroughly. Finally, the pelt is treated with 1 per cent formic acid added in several feeds or in a fermented infusion of wheat or other materials capable of producing a drenching effect.

The pH should be around 5.0. No pickling is necessary but de-liming should be complete.

Tanning (pit)

The fully de-limed pelt, at pH 5.0, is treated with specially prepared chrome compounds (pH 4.5-5.0). The total chrome content given is only 2.0 per cent Cr_2O_3. A quarter of the chrome liquor (equivalent to 0.5 per cent Cr_2O_3) is applied and the pelt handled and trampled. The other three instalments are added at four-hour intervals. In the last instalment, 0.25 per cent preservative is added. The pelt is then left overnight. Next morning it is handled again.

The tanned stock is checked for shrinkage temperature. It may be 90°-100°C. No basification is needed. The material is horsed for a day. The stock is then washed thoroughly and drained for a day.

It should be noted that the chrome composition contains greater amounts of anionic complexes than the regular chrome compounds. It may be necessary for the importer to re-tan with cationic chrome compounds. For this reason, the chrome content given to wet blue is only 2.0 per cent, in contrast to 2.5 per cent Cr_2O_3 given in the other procedures.

Finally, it is emphasised that this work is still experimental and has not yet been introduced in commercial practice.

IV. PROCESS DEFECTS AND REMEDIES

Once optimal conditions have been determined for the processing of raw material into wet blue chrome leather, they have to be closely adhered to. In spite of strict controls, however, variations do occur occasionally from batch to batch and even from skin to skin in the same batch. These variations are inherent in raw skin, and may be due to age, sex, feed, breed, region, season, etc. Therefore, regular attention should be paid to each batch during each stage of the process. Apart from variations in the skins, defects may also be caused by incorrect processing.

Some of the common process defects observed in wet blue chrome leather production, and methods to correct them are detailed below.

Empty substance

Empty feel in goat skins may be due to improper plumping or the use of excess salt during tanning. It may be remedied by longer re-liming or the addition of soda ash to the re-liming liquor. It may also be adjusted in pickling by a suitable change in the acid/salt ratio.

Lack of cleanness and whiteness in bated pelt

Lack of cleanness and whiteness in bated pelt is mainly due to non-removal of scud and may be rectified by:

(a) Bating with warm water;

(b) Scudding the bated goods well and then washing them thoroughly;

(c) Adding a detergent to the bate bath;

(d) Dry drumming the bated pelt with a detergent and then washing it thoroughly;

(e) Using a small quantity of organic acid, e.g. acetic acid, in the pelt wash.

Good liming, prior to de-liming, is essential for ensuring a clean, white pelt.

Dark or green colour in wet blue chrome leather

Usually, the dark colour results from basification with sodium carbonate or bicarbonate. Neutralizing with sodium sulphite may make the goods green. Lighter colour may be obtained by using sodium thiosulphate as a neutralizing agent. Light colour may also be obtained by adding 1 per cent alum at the commencement of chrome tanning.

Stains along the backbone, particularly in goat skins

Stains along the backbone may be due to drying up of the area along the backbone in the salted raw state. Sometimes painted skins are folded and piled instead of being piled flesh to flesh. The stains show up along the backgone, particularly in the region of the neck, because of the pressure developed in the pile. Hot weather helps backbone stain to dry up rapidly.

Other stains[8/]

Various other stains may be caused by:

(a) Overloading of paddles in the liming, de-liming and bating operations;

(b) Improper positioning of the paddle;

(c) Water/goods ratio in the paddle not being the required 1:3;

(d) Improper washing of bated goods after scudding;

(e) Too much pressure, or uneven pressure, in fleshing;

(f) Dirty fleshing rollers (flesh, fat etc. adhere to the roller and are transferred back to the skin);

(g) Incomplete removal of lime (resulting in green spots);

(h) Non-removal of short hair;

(i) Use of alkaline water or hard water. (This is more pronounced in hot weather);

(j) Contact with iron and chrome (Processing and packing should be carried out in such a way that it is impossible for the leather to come into direct contact with iron or any other metal);

(k) Bating burns (due to localised heat).

Green chrome patches

Green patches may result from chrome precipitation while basifying with soda ash. It is better to use a 50:50 mixture of sodium bicarbonate and sodium sulphite. These patches may also occur if the goods are kept in the drum overnight, without running immediately after basifying. If patches are due to chrome precipitation,[9/] the affected goods should be drummed with a solution of acid and salt until the green colour turns to blue. This is followed by washing and re-tanning with an amount of basic chrome liquor equivalent to 0.5-1.0 per cent Cr_2O_3.

8/ Central Leather Research Institute Team, Leather Science, vol. 16 (1969) p. 253.

9/ P. S. Venkatachalam, Leather Science, vol. 16 (19[illegible]

Red pigmentation

Red pigmentation is caused by a mould of the Penicillia group (Penicillin rubrum Stoll).[10], [11], [12] This occurs mainly where the chrome liquor contains excess glucose or sucrose. If this excess cannot be avoided, the chrome tanned leathers should be treated with a suitable preservative (e.g. 0.05 per cent w/v partanitrophenol or sodium pentachlorophenate).

Drawn grain

Proper adjustments are needed in liming and pickling as well as in setting. Swelling of pelts during liming gives drawn grain whereas flat pelts give loose grain. Too much drumming or drumming at too rapid a rate may also result in drawn grain. Tanning should be around pH 2.5-3.0. Chrome tanning at high pH (4.0) can give drawn grain and wrinkles.

Wrinkles and veins

Wrinkle formation on the grain is a major problem, particularly with the hides of buffalo calf.

Basification with strong alkalis during chrome tanning can cause wrinkles; so can tanning at high pH (4.0), unless it is properly masked. This could be obviated by avoiding basification with chemicals, using instead the hot bath method or pre-basified chrome liquors or self-basifying tanning agents.

Wrinkles may also be due to heavy beating in the drums, to the drum construction, and to the revolutions per minute. The drum should have both shelves and pegs and the speed should be about 8 rpm.

Wrinkles occurring in piling, packing and transporting can be avoided by piling the hides flat, one over the other.

Veins may appear when a lime-free de-hairing method is used.

Area shrinkage

It is generally felt that chrome tanning leads to a decrease in area. Compared to the area obtained in vegetable tanning, chrome tanned leather does give less area. Vegetable tanning gives 10-15 per cent more in area and increased substance - up to 30-40 per cent.

10/ S. N. Sen, Y. Nayudamma and P. Ramakrishnan, Leather Science, vol. 12 (1965) p. 357.

11/ S. N. Sen, Nature, vol. 199 (1963) p. 71.

12/ S. N. Sen, Leather Science, vol. 10 (1963) p. 388.

A distinction should be made between chrome tanned skin in the blue and leather in the dry crust form. In the wet blue stage, the area shrinkage is negligible, compared to raw skin. When it is dried and finished, however, the area loss is of the order of 10 per cent. With vegetable tanned leather, this loss is negligible. It is drying that shrinks the chrome leather, and staking does not fully restore it. The following figures are reported for area yields.

	Percentage
Vegetable tanned leather	100
Vegetable chrome (semi-chrome)	97-98
Chrome re-tan (Cr-veg)	94-95
Chrome mordanted	92-93
Full chrome	90

When compared to the area of a well-soaked skin, the area loss in chrome tanning is nil or negligible.

It is interesting to study the area changes at every stage of the process. Some results show that after pickling the area is increased by 3-5 per cent over the area of the soaked skin. After chrome tanning to pH 3.5, the loss is about 3-5 per cent; therefore the net result is no loss in area.

There is also the possibility of area loss while trimming the pickled pelt. Area shrinkage can also occur if the final pH of the tanning is either very low or very high (it should be 3.5-3.7). If the pH and chrome content are low, the leather tends to swell on storage. If the pH is high, the highly basic tannage obtained causes wrinkles and shrinkage of area. Where there is adequate chrome content, little or no shrinkage should occur. (Italian tanners, however, prefer light chrome tannage, as it is said to give greater area.) Area shrinkage may also result from stretching in the raw skins; selection must therefore be carefully made in the raw.

Packing folds

The moisture content of the leather should not be too low, otherwise, it is difficult to remove packing folds. Also, low moisture content may permit the skins to dry up in places during transport. Dyeing these dried-up areas is difficult.

Non-uniform tannage

Non-uniform tannage is often due to improper soaking.

Weak grain

In pickling, if the salt concentration is too low, the skins are tanned in a slightly swollen condition, which results in a weak grain and too elastic and rubbery a leather. On the other hand, salt-rich tannage yields poor substance and often loose leather.

V. QUALITY CONTROL, STANDARDS AND GENERAL MARKET REQUIREMENTS

Quality control

Quality control in the leather industry is best exercised in production. It should start with the raw hide and skin and continue right through the various processes, including packing, storage, and transport. Testing of a final product is no substitute for process control. While final testing of a product is useful as a language in which to communicate with the customer, process control prevents the occurrence of faults and permits improvements to be made, etc.[13]

Standards

The function of standardization is to lay down requirements for raw materials, production processes, testing, performance etc. in order to reduce costs, cut waste and increase productivity, interchangeability and trust.

With the exception of certain methods of testing evolved by the International Union of Leather Chemists Societies, the leather trade has no international standards. Since 1966, however, a technical committee of the International Organisation for Standardisation (ISO) has been formulating international recommendations, which may serve as a guide for shaping national standards. These recommendations may also serve as a basis for international trade contracts.[14]

In the meantime, the leather trade adheres to certain accepted practices. Approved samples and prototypes are often used as the basis for international trade. There is also a code for grading, which, though it is often arbitrary and variable, does form an agreement between the buyer and seller.

Contracts are made on an accepted contract form.

Contract forms

For the international trade in raw hides and skins, an internationally agreed standard contract form has been drawn up by the International Council of Hides and Skins Sellers' Association, London.[15] For leathers, the Leather Importers, Factors and Merchants Association, London, has a special contract form for trading in vegetable tanned and wet blue chrome or chrome crust leathers.

13/ Y. Nayudamma and N. R. Srinivasan, A Review of Standards for the Indian Leather Industry (1969).

14/ R. L. Sykes, Leather, vol. 171 (1969)

15/ United Nations Conference on Trade and Development/General Agreement on Tariffs and Trade, Major Markets for Hides, Skins and Leathers (1968).

General market requirements

Wet blue chrome

Wet blue chrome leather, which must be tanned throughout the thickness, should be of regular pattern, well trimmed, graded and packed properly. The leather should show no stains, wrinkles or folds. The grain should be smooth, tight, free of veins, damage or short hairs. The flesh side should not show cuts, pitting or gouges. Packing should be such that there is no drying.

The wet blue hides and skins should be sorted in grades acceptable to both buyer and seller: e.g. in India, skins are sorted into as many as six grades and hides into four grades. The leathers should be measured and marked.

While there is general agreement on the physical standards for wet blue, the chemical requiremen s vary.

The moisture content may vary between 45 and 65 per cent. The chrome content may vary from 2 to 5 per cent Cr_2O_3 on the weight of leather (14 per cent moisture basis) or 3-7 per cent on hide substance basis. Some importers prefer low chrome content, which allows them to re-tan. Tanners in the United Kingdom of Great Britain and Northern Ireland require leathers as lightly tanned as possible, with shelf life stability, and with a chrome content not exceeding 3 per cent. The Continental tanners require 5-6 per cent Cr_2O_3 on hide substance basis. Generally speaking, tanning with straight unmasked basic chrome liquors is recommended, but there are demands for formate masked chrome liquor tannage. The pH of water solubles should not be lower than 3.0. On the other hand, in the United Kingdom, tanning with highly basic chrome liquors is discouraged as it is difficult to modify by further processing.

Area measurement is a current cause of complaint among importers. Each skin should be clearly marked or, alternatively, skins of the same size bundled separately and the bundles marked. Some shippers do not mark either skins or bundles but simply state that there are so many skins totalling so many feet in a given case. This makes it virtually impossible to check. Measurement also varies wildly - as much as 30 per cent over-measured to 5 per cent under-measured. The double measurement tables currently used in India seem to work out reasonably well, provided the skins are laid out flat before measuring.

Crust leathers

The ready-to-finish leathers should be full, soft, and have a tight grain with an even colour and moderate abs rbing power. The pH of the grain should be 4-5. The surface of the leather should be free of fat, talcum powder, titanium dioxide or any such substance that might interfere with the finishing operation.

It is most important that the shippers of wet blue and crust leathers inform the customers of the type of tannage used and any changes made in processing.

Need for well-defined standards

In view of the growing international trade in wet blue, the need for quality control and standard specifications is great. As the raw material varies from country to country, each country should ascertain, and then offer, the quality that it can maintain.

Table 2 shows the combined data yielded by a detailed analysis carried out by CLRI on a number of wet blue goat skins from different regions of India and a private, preliminary study on wet blue cow hides and cow and buffalo calf skins.[16/]

From the data given it can be seen that, as compared to goat skins in wet blue, the wet blue chrome cow and buffalo calf skins and hide intended for export contain less water, chrome and hide substance.

Table 2. Analysis of wet blue goat skins, cow hides, cow calf skins, and buffalo calf skins

	Goat	Cow hide	Cow calf	Buffalo calf
Chemical				
pH of water solubles	2.8-3.6	2.7	2.8-3.2	2.9-3.0
		(Per cent by weight)		
Moisture	50-60	47	40-51	58-61
		(On 14 per cent moisture basis)		
Water solubles	1.0-6.2	5.7	4.5-5.2	5-11
Petroleum ether solubles	0.8-2.5	2.5	2.6-2.8	0.5-2.6
Hide substance	68-73	53.7	60-62	60-63
Cr_2O_3 content	3.4-5.6	2.7	2.0-2.4	2.8-4.9
Cr_2O_3 content on hide substance basis	5.8-7.0	-	-	-
Physical				
Shrinkage Temperature (Ts °C)	-	-	90-113	108-115
Tensile strength (kg/sq. cm)	196-291	216-349	-	228-347
Tongue tear strength (kg/sq. cm thickness)	10-19	44-57	-	16-23
Thickness (mm)	-	3.8	2.3-3.0	Min. 2

16/ Y. Nayudamma, K. Venkatabhoopathy and S. Bangaruswamy, Leather Science, vol. 16 (1969) p. 279.

The Indian Standards Institution, in co-operation with the Central Leather Research Institute (CLRI) has drawn up an Indian Standard for wet blue chrome goat skins - IS:5034-1968 Chromed goat skin in wet blue condition.

Usually, the buyer states his requirements for size, grade, fungicide, moisture, chrome and fat contents in the wet blue state. Even the method of manufacture may be prescribed by the buyer and kept secret by the manufacturer. There would be no difficulty in a tanner/exporter directly supplying the material to the finisher/importer, provided each knew the other's requirements.

As the importer may wish to re-tan with a further amount of chrome or other re-tanning agents, it is advisable to have a chrome content around 2-3 per cent Cr_2O_3 on weight basis, or 3-5 per cent on hide substance basis. Leather with low chrome content is said to swell and shrink in transit, but there are some conflicting opinions about this. Heavily chromed and unwashed skins may contain loosely held chrome and account for higher chrome content on 14 per cent moisture basis. The leathers may not contain much oil or masking agents, as they may interfere in further processing. Excess water solubles may indicate the presence of jaggery, molasses, etc. that give rise to mould growth. The minimum pH of water solubles is 3.0. A lower pH denotes free mineral acid which on storage could give rise to acid rotting. The shrinkage temperature is usually above 100°C. Leathers with a low chrome content are sometimes demanded for further tanning with additional chrome at the finisher's end. The leathers should be properly set and should contain not more than 60-65 per cent moisture and not less than 45 per cent.

The variability of the data prove the necessity of a prior understanding between tanner and buyer in regard to specifications.

Wet blue chrome leather grading

Information on the practices followed by Indian tanners in sorting out wet blue leathers is included here as it is felt that such information is useful for establishing guidelines.

Before packing, the skins are sorted into six grades. The selection is based on: (a) origin of skin, (b) substance, (c) size, (d) fineness and smoothness of grain, (e) fullness and tightness, (f) uniformity of tanning and moisture and chrome contents, (g) colour (should be light bluish), (h) skin pattern (should be square) and (i) freedom from wrinkles, surface scratches, blemishes, etc. The selection criteria vary from buyer to buyer, country to country and upon whether the leather is cow, buffalo, goat or sheep skin.

Generally speaking, countries in Western Europe have stricter grading requirements than those in Eastern Europe.

Sale is on the basis of total surface area. Certain countries buy on a "lot" basis, a lot containing a 'mix' of oversized and undersized skins, in addition to regular grades. Here again, what constitutes a 'mix', 'run' or 'lot' parcel varies from country to country. Tighter quality control and a clearer definition of these practices are necessary so that any country wishing to buy on the market can be assured of set international standards.

Grading of goat skins

Goat skins are classified in India as follows:

Size: Sizes below 24" length and 16" width or above 44" and 32" width are rejected. The sizes are: large 36" and above; medium 32-36"; small 28-32"; and undersmall 24-28". For each size, again, there are 6 grades.

Grade I - 1stg: The skin should have a good, smooth grain, full flanks with a good square pattern having not more than two small defects, which could be healed, or small blemishes, scratches or similar surface pitting, which could be covered easily. (Selection: about 5 per cent.)

Grade II - 2ndg: The skins should be the same as the 1sts but with up to four defects, which may be more visible. However, there should be no defects such as deep cuts, drawn grain, pipiness, stripping of the grain, etc. (Selection: about 15 per cent.)

Grade III - 3rdg: Skins should have a good grain, but may have up to six defects. The skins should be free of veins, loose and thin flanks. (Selection: 25 per cent.)

Grade IV - 4thg: These are similar to the 3rds but small butcher cuts on the edges, pock and other marks are accepted. There should be a usable area of not less than 60 per cent in the butt portion, however. (Selection: 25 per cent.)

Grade V - 5thg: These have poor grain character, raised and pitted defects, scratches, pock and tick marks, butcher cuts. The usable area should be not less than 40 per cent in the butt portion. (Selection: 25 per cent.)

Grade VI - 6thg: Similar to the 5ths, but with a usable area of not less than 30 per cent in the butt portion. (Selection: 5 per cent.)

'Lot' or 'Mix': For each size, the skins are graded as above. The following is a suggested pattern for mixing them:

Size	Length (inches)	Width (inches)	Percentage of the grades I	II	III	IV	V	VI
Extra large	40 up	24 up						
Large	36-40	22-24	5	15	25	25	25	5
Medium	32-36	20-22	10	20	25	25	15	5
Small	28-32	18-20	5	20	25	25	20	5
Very small	24-28	15-18	5	20	25	25	20	5

Grading of cow and buffalo hides

The hides are graded into three or four categories as follows:

Grade I - 1st: The hides should have good grain, well-filled flanks, and not more than two small defects. They should be completely free of flay cuts and drawn grain. (Selection: 25 per cent.)

Grade II - 2nd: The hides should have good grain, filled flanks, and not more than four defects. Healed scratches and 25 per cent drawn grain are tolerated. (Selection: 40 per cent.)

Grade III - 3rd: The hides should have a good grain, but with up to six defects. Drawn grain and loose substance should not be more than 50 per cent. (Selection: 30 per cent.)

Grade IV: The remaining 5 per cent.

Specifications for packaging

The tanned skins or hides should be packed in solid wooden cases disinfected against pests and disease. The leather should be well covered with polythene sheets and there should be no possibility of its drying. For goat skin export, the following sizes are prescribed for the boxes:

Size of skin	Size of the box (inches) Length	Width	Height
Large	40	22	18
Medium	36	20	17
Small	32	18	16
Very small	30	17	15

Each case contains 300 pieces of wet blue chrome goat or sheep skins, or 50 pieces of cow or buff calf, or 25 pieces of hides. The box should be banded with steel

baling plates, 15-20 mm wide, and sealed by the buyers' representative with at least two seals.

Sorting

The following data present the experience of the Indian tanners in the preparation and export of wet blue. The material is sorted at four different points of processing, namely, raw, limed pelt, pickled and chrome tanned stock.

Goat skins

The demands of the West European market are for: 32"-44" size; 0.8-1.0 mm thickness; fullness; tightness; fine smooth grain; square pattern; freedom from wrinkles; bluish colour. The skin's origin (location, area) also counts. The East European market demands are: minimum length, 28"; maximum length, 44"; minimum width, 16"; maximum width, 32".

The skins are selected in the raw. If they come from a slaughter house and are in proper season, about 80-90 per cent are selected for wet blue; the rest go for vegetable tanning. If the stock is from the villages, only 70-85 per cent will go for chrome and the rest for vegetable tanning. In the rainy season a smaller percentage goes for chrome tanning.

The second and third sorting take place when the skins are in the limed and pickled condition. About 8-10 per cent may be rejected and processed by vegetable tanning.

The final sorting comes in the wet blue stage. Rejects usually only run about 1-5 per cent

In the case of the markets in Western Europe, the sorting is not so strict. Once the raw skins or limed pelts are selected, there is little further rejection. This is also due to the fact that grades I-VI are accepted in a mix, whereas for the markets in Western Europe, grades I-IV only are accepted.

Sheep.

Both wool and hair sheep skins are in demand. France, Spain, Japan, the United Kingdom, Yugoslavia and Czechoslovakia are the major buyers today.

Sizes 28"-44" (area up to 8 sq. ft.) are in demand, but only up to 3rd and 4th grades are accepted by many countries.

The following observations are based solely on the experience of the Indian leather industry:

Raw selection: Rejections may be many in the case of sheep skins. Hair or wool sheep are difficult to grade. Only up to 5 per cent may be rejected in the raw. If the goods are already hair-pulled skins, up to 25 per cent in the raw may be rejected.

Lime sort: At this point, an additional 15-20 per cent may be rejected for chrome tanning. In the rainy season, the selection may be 50-70 per cent. Black wooled pelt is difficult to judge even at this point, however.

Pickle sort: At this point, another 5-10 per cent may be rejected.

Chrome blue: If the above selections are made properly, the rejections need not be more than 5 per cent. Thus, for 100 raw skins a maximum of 60-75 in the blue are obtained.

It is worth noting that there has been heavy demand recently for rejected wet blue chrome goat and sheep skins. These fetch a reasonably good price, particularly from Spain. In general, Western Europe accepts 50-75 per cent of the wet blue chrome skins offered, but the countries in Eastern Europe accept 80-90 per cent

Cow hides and cow calf

There is a large demand for wet blue chrome cow hides from Italy, one of the largest buyers, and from the United Kingdom, France, Hong Kong, Hungary and Sweden.

Specifications: Area 11-13 sq. ft.; thickness 1.5-1.7 mm in blue; no splitting; softer leather with masked chrome tannage. Thirds and fourths are in demand in Sweden.

Raw sort: Up to 10 per cent cow hides rejected.

Liming sort: Up to 30 per cent rejected.

Pickle: Up to 10 per cent rejected.

Thus, 10-40 per cent of the raw hides are rejected prior to chrome tanning.

Buff calf

The demand for buffalo hide and buff calf is ever increasing. Italy, the United Kingdom, Australia and the United States of America are the largest buyers.

The requirements for buffalo calf are: area 5-8 sq. ft. (sometimes 11-14 sq. ft.); full hide (not sides); light colour; light tannage; uniformity in tanning, drying and chrome fixation; smooth grain with few pronounced wrinkles in the neck area. Selections for the United States are: 50 per cent 1st; 50 per cent 2nd. This is a difficult demand to meet.

Sort: Raw rejects up to 20 per cent (in bad seasons up to 40 per cent); liming rejects up to 30-40 per cent; and pickling rejects up to 10-15 per cent.

This means that 40-50 per cent may be rejected prior to chrome tanning. Very thick necks and very loose bellies account for these rejections. In the case of cow and buffalo hides, the leathers exported in the blue are not split. Many advanced countries prefer unsplit hides because they cannot rely upon the accuracy of splitting in the developing countries. This has to be looked into closely, however, as exporting without splitting means more weight, more water, more freight, etc. Also, if split at source, the splits could be profitably utilised for cheap leathers by the developing countries.

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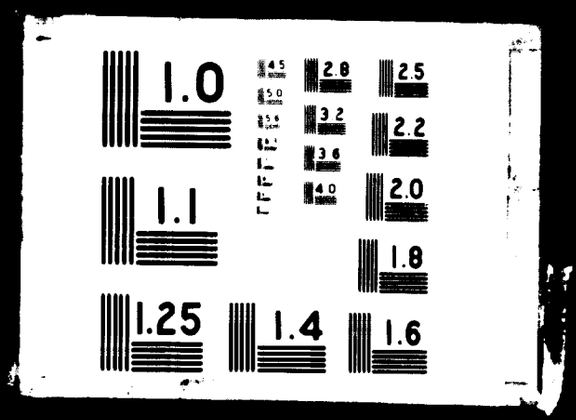

VI. FEASIBILITY STUDIES

Before setting up a tannery, a feasibility study should be carried out. In certain developing countries, tradition, religion and customs have an impact on the leather industry; these should all be taken into consideration. Many other factors covered by the study will vary from country to country. In most of the developing countries, raw materials and labour are available in abundance; but the costs and skills of labour vary widely. Similarly, transport is often a major problem.

Keeping such limitations in mind, an exercise is made here to indicate the guidelines for a feasibility study.

Survey

Data relating to the existing market conditions; local resources, skills and production capacity; imports, exports, internal and external demands; and the future prospects for the industry in the country are collected and analysed

Capacity

The capacity of the tannery to be built is determined, based largely upon the nearness and size of the markets and on the availability of funds. A minimum economic unit is worked out for each line of production. For wet blue chrome skins, a minimum economic unit may involve production of 2,500 pieces a day. (Discussion in this and the next chapter is based on a unit of production of 10,000-12,000 pieces a day.) Initially, production may be started with half the daily capacity and stepped up to full capacity over a year. There must always be room for expansion of production.

Location

The location of the tannery depends upon several factors:

(a) Nearness to slaughter houses;

(b) Steady supply of raw material at a reasonable price;

(c) Nearness to rail, road and shipping lines; quick and cheap transport;

(d) Plentiful supply of good water;

(e) Possibility of disposing of tannery effluents into a nearby sewerage system;

(f) Adequate power supply;

(g) Availability of labour, skilled and unskilled;

(h) Land at reasonable price;

(i) Proper environment - housing, health and educational facilities for staff;

(j) Proximity to markets.

No single location can enjoy all these condition, but first priority is given to a site with an assured supply of water and easy disposal of effluents. Nearness to the raw skin market and an assured supply without resorting to long storage are also advantages. Raw material and transport costs are other important considerations.

Technology

Requirements of machines, skills, labour, etc. vary, depending upon the type of technology to be used, or the process to be followed. The technology should be appropriate to the conditions obtaining the raw materials, and the end products to be made. Though the tannery will concentrate on the production of wet blue chrome for export, consideration should also be given to the manufacture of vegetable tanned and chrome crust leathers. The possibility of adding a finishing unit at a later date should also be thought of.

Choice of plant and equipment

Drums versus paddles

In the manufacture of chrome leathers, wet operations from soaking to tanning are done in drums and/or in paddles. Some tanners prefer to use only paddles for soaking, liming, de-liming and bating; they use drums for pickling and tanning. De-liming and bating are also often done in a drum, however. The paddle operation is thought to give better grain and milder treatment to the pelt; also power requirements and costs are slightly lower for paddles than for drums. The modern trend is to use only drums from soak to tan. Drums take up less space, need less float, and give less effluent than paddles. There is also a saving in time and better exhaustion of materials. There is also a trend to combine two or more operations in the same drum. Drums can be advantageously fitted with automatic process control equipment. Such equipment is costly, however, and lack of spare parts and service facilities make it more difficult to use in developing countries.

Drums

Even in the case of simple wooden drums, there are many factors to be considered:[17/] (a) length/height ratio, (b) pegs or shelves - their size, shape,

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17/ R. L. Sykes, Leather, vol. 171 (1969) p. 29.

quantity, (c) feed at one end or both, (d) the optimum lifting system for goods of a particular area and/or thickness, if any, (e) relationship between liquor/goods ratio and the lifting system, if any, (f) desirability for drums to be reversible, (g) need for varying the speed during tanning, (h) the ideal loading for a given drum, and (i) the real purpose of drumming - mixing, flexing to aid diffusion, or generating heat. Great attention should therefore be exercised in choosing the right type, size and number of drums. The capacity of a 10' x 10' drum is calculated as follows:

(a) For practical purposes the working capacity, inclusive of float, is taken to be two fifths of total capacity, i.e. $\frac{22}{7} \times 5 \times 5 \times 10 \times 27 \times \frac{2}{5} = 8,500$ P.

(b) For liming, the goods to float ratio is 1:2 or even 1:1. A 10' x 10' drum can therefore take a 2,800 kg load of skins. For liming 2.5 tons of skins (10,000 pieces), four drums are needed.

(c) For chrome tanning, the float ratio is 1:1 and that for pickled pelt only 0.6 kg, as against the raw weight of skin at 1 kg. Therefore, three drums will be sufficient to treat the 10,000 pieces. Pickling and chrome tanning operations take only 3-4 hours per batch however, and with three drums working in two shifts (8-10 hours), it is possible to process 20,000 pieces in one day.

To process 10,000 skins a day, the drums requirements would be the following:

Soaking, liming, de-liming and bating (4-day process)		4x4 = 16	
Painted skins (3-day process)	3x4 = 12		
Pickling	3	3	
Tanning	3	3	
Spare	2	2	
Total	20	or 24	

If pickling and tanning are done in the same drum, three drums should suffice for 10,000 pieces. If sorting is to be done after pickling, or if an equilibrium pickle is to be given before tanning, the drums for pickling should be separate from the drums for tanning. The capacity of the drum will also vary with the amount of water used as a float.

For hides, only a 2-day process is given from soak to bate, and this requires only 2 x 4 = 8 drums.

The speed of the drums in soaking, liming, etc. is about 2 rpm, but in pickling and tanning it may be 6-8 rpm.

The normal drum consists of a wooden body, iron fittings, and driving unit. The body is made of planks held together by hoops. In several developing countries the drums are imported, but it should be possible to make them indigenously, utilizing local materials and skill. If necessary, the door and other metallic fittings could be imported.

Paddles

A paddle consists of a stationary, shallow, wooden or cement concrete trough with wooden blades to mix the solution and move the pelt. The construction is simple but it is necessary to know the correct sizes of the vat and the wooden paddle. The paddle should be fixed off-centre with more space in the front and less at the back wall, otherwise the skins will either tend to sink to the bottom or get tangled around the blade.

In selecting the type and number of paddles, the size of the paddle and the loading capacity have to be determined, as in the case of drum. In the paddle, the ratio of goods to float would be 1:3. A paddle 7'3" in length, 6' in breadth, and 2'9" in depth would have a loading capacity of 600 kg skins, i.e. 400-600 pieces. A 5' x 6' x 3' paddle would carry a load of 550 kg.

The capacity of the paddle can also be obtained from measurements of the trough. The following formula is used:

$$F \times b = (\tfrac{2}{7}) \frac{r^2}{2} + 2r\,(t-r-0.08) \times b$$

where F = cross sectional area of the total, b = breadth in metres, t = depth in metres and r = radius in metres; 0.08 is factor for the vat filled up to 8 cm below the top edge of the paddle.

The speed of the paddle varies from 8 to 16 rpm, according to the operation.

Pits

To a large extent, pits have given way to paddles and drums, but they are still used where power is scarce or costly and in the small-scale sector. The pits are constructed of concrete. They are usually above ground level, with an opening at the bottom to drain off the waste or used liquors. In hot and tropical conditions, however, they are constructed underground (sunk-in pits) which helps with temperature control. A rocking system is used to agitate the hides.

Machines

Tanning machines are manufactured in different widths to match various sizes of hides and skins. A machine intended for hides cannot be equally effective for skins. For each operation, there are different models: for moderate output, fast output, continuous line feeding, etc. In choosing the machine, thought must also be given to its weight, power requirements, etc. Both hydraulic and mechanical machines are in use; hydraulic machines are very costly, though the output and quality are high. For certain machines, e.g. fleshing machines, a hydraulic system is not needed. Pneumatic bolsters are considered advantageous.

In choosing machines, developing countries also have to consider the availability of: (a) foreign exchange, (b) spare parts and tools, (c) proper service for setting up, maintenance and repair, (d) properly trained operatives and (e) cheap labour.

Apart from paddles and drums, the important machines required for wet blue chrome leather making are fleshing, scudding, and setting machines.

Other equipment: In addition to tanning machinery, the tannery needs a boiler, transformer, workshop equipment, laboratory equipment, instrumentation, process control equipment, etc.

Layout

The layout of the machinery should allow either gravity or pipe-line flow. Where land is available, a pipe-line flow system is prefered.

Where land is difficult to get, the only recourse is to construct a multi-storeyed building. Here the gravity flow system can be used. The raw material, after wet operations on the ground floor, is taken to the top floor. It is then fed from the drum on the top floor directly into a drum on the floor below for the next operation. The finished leathers arrive finally on the ground floor.

It is very important to plan for future expansion. Shed type constructions are advantageous in this regard as they can be added as and when needed without disturbing the existing set up and location of machinery.

Design and construction

Floors must slope towards the sewerage system (channels for the outflow) to a allow proper cleaning. Floors should also be non-slippery, preferably made of cement. Acid/alkali resistant tiles and cement may be used in some sections. The inside walls should be of cement construction to resist the high humidity and the action of chemicals, salt, etc. Equipment should not be attached to the walls.

The buildings should be positioned in such a way that odours emanating from the tannery will not disturb the nearby community.

Requirements of hot and cold water, steam and electricity have also to be calculated. Distribution points for these must also be determined. For all motors, an earthing system is important. In wet departments, special precautions have to be taken. Safety arrangements against fire, and for machinery are needed.

Proper lighting arrangements have also to be made. As selection of skins is important at every stage of processing, provision should be made to let enough north light into the production yards by means of conveniently fixed sky lights.

Land, water, power and sewerage

Land requirement

Five acres of land should be allotted for a tannery processing 10,000-12,000 skins into wet blue chrome leather a day. The covered area should include the production unit and auxiliary units such as stores for raw hides, chemicals, finished leathers etc., workshop, office, laboratory, separate boiler and transformer houses.

Water requirement

Sufficient water should be available for (a) the processing of skins, (b) personnel utilities @ 100 gallon/person/day, (c) the boiler and (d) gardening.

It is generally estimated that, for processing one pound of raw skin or hide, to the pickle stage, 5 gallons of water are required, and 6 gallons to arrive at wet blue chrome leather. For processing 10,000 skins, 60,000 litres, or 600 cubic metres of water are needed per day. An additional 100 cubic metres, for various other purposes, should be allowed. Storage capacity should be one third of the consumption. The water supply should be obtained partly from the tannery's own wells and partly (particularly potable water) from the municipality.

Sewerage system

The volume and nature of the effluent, and the proximity of a sewerage system will decide the system for treating and disposing of effluents.

In the case of wet blue chrome leather, the effluent contains acids, salts, lime, sulphide, and chrome liquors. By judicious adjustment, it is possible to precipitate mutually lime and chrome and neutralise the acids, but it is difficult to remove salt. The general principle is to run the waste liquors from each operation into settling tanks where mutual precipitation of lime and chrome takes place. The supernatant liquid is further adjusted to pH 5.0 and passed through a filter bed. The liquor, so treated, is aerated before it is discharged into the nearby sewerage line.

Power

The power requirement should be calculated on the basis of general lighting, motors connected with the machinery, paddles and drums, heating, air conditioning, ventilation, exhaust fans, street lights, requirements for workshop etc. The wiring diagrams have to be prepared early so that as the construction proceeds, the electrical services can be provided concurrently.

Personnel requirements

A tannery needs administration and accounts staff; chemists; a technologist/technician; a works manager and a general manager; foremen/supervisors; skilled, semi-skilled and unskilled workers; and a maintenance force.

The personnel requirements for a tannery processing eight tons of cattle hides for chrome upper leathers daily, using modern equipment and situated in a country with a good labour supply, have been estimated as follows: 18/, 19/

Category of work force	Number
Management and supervisory personnel:	
General manager	1
Plant manager	1
Chemist	1
Book-keeper (accounts)	1
Foreman	1
Maintenance	1
Stationery manager	1
	7
Non-production workers:	
Secretary	1
Office clerk	1
Utility delivery personnel	4
	6
Direct labour:	
Hide house	5
Beam house	12
Tannery and finishing	17
	34
Total	47

It is interesting to note that the number of management and supervisory personnel (7) is high in relation to the number of production workers (34).

For wet blue chrome leather production, the total number of employees could be reduced. In finishing and machine shop yards the direct labour could be reduced from 17 to 10. Direct labour would then be only 27 and the total work force only 40. The ratio of management to production workers would be 1:4 (7 to 27). The ratio of management and administration would be 1:3.

18/ P. R. Kelly, Estimation of Managerial and Technical Personnel Requirements in the Field of Leather and Shoe Manufacturing Industry, document UN/CID/VI, Background Paper No. 17.

19/ ILO Report No. II (1969) p. 29.

As contrasted to the above estimate, the distribution of the work forces in two tanneries in India processing 10,000 pieces of wet salted goat skins a day, is given below.

		Tannery A	Tannery B
1.	General manager	1	1
	Works manager	1	1
	Technicians	3	1
	Chemist	-	1
	Supervisors	12	3
	Maintenance	8	10
	Workshop	10	-
	Engineer	1	-
		36	17
2.	Office manager	1	1
	Clerks	2	3
	Cashier	1	1
	Store keeper	1	2
	Watch and ward	4	5
	Delivery personnel	-	6
		9	18
3.	Skilled workers	55	20
	Unskilled workers	45	50
		100	70
		145	105

In Tannery A the management/production labour ratio is 1:4; with management and administration put together the ratio is 1:3:2. In Tannery B the ratios are 1:6 and 1:3 respectively.

Thus, in a modern tannery producing blue chrome leather, the ratio between management-administration staff and production labour is 1:3.

It is also possible to arrive at the following factor: for processing 10,000 skins 70 to 100 direct labour personnel are needed; this means that for every 100-150 pieces processed, one worker is needed. The general safe estimate is for every 100 skins processed one worker is needed.

Investment

Capital outlay

To arrive at total investments, both non-recurring and recurring expenditure have to be accounted for. The non-recurring expenditure covers the cost of land, building, plant and equipment, auxiliary services like water, power, steam sewerage

and laboratory. The working capital requirements are based on the stock of raw hides and skin, finished stock, chemical and other stores, outstanding sales bills, credits etc., expenses on labour, management, power, water charges etc. Usually 25 per cent of the annual total recurring expenditure (i.e. for 3 months) is reckoned as working-capital in the tanning industry. However, as wet blue chrome leather manufacture takes only 7 days, compared to one month for producing finished leather, it may be enough to take the expenditure for one month, i.e. one twelfth of the total.

In addition to the above, provision has to be made for contingencies.

Capital outlay is the sum total of the working capital and the non-recurring expenditure.

Phasing of funds

Once the capital outlay is known, it should be phased out. The total amount is not required in the beginning. A schedule should be worked out as to when exactly funds would be needed for the purchase of land and machinery, construction of buildings, etc. Production should start about one year after the beginning of construction.

Possible future expansion, and other lines of production that may be taken up, should also be taken into account.

Sources of funds

Funds may be raised by equity capital, long- and short-term borrowings with deferred payment, or easy loans, where possible. The interest rates vary from country to country but 8-10 per cent may be taken as average.

Profit and loss account

The feasibility study should clearly show the profitability of the investments. For this, the manufacturing costs have to be worked out. The cost structure and pricing must also be worked out and compared to the norms in order to find out where economy could be effected.

For the manufacture of wet blue chrome leather, the following rough figures could be used for purposes of calculation: on the cost of the raw material, the cost of chemicals may be around 5-6 per cent, labour and supervision 6-8 per cent, and overheads about 6-10 per cent. At today's ruling prices, the manufacturing costs per piece of skin (average 4 sq. ft.) would be about 4-5 United States cents/sq. ft. and for the hides 5-6 cents/sq. ft.

Sales and profits

The total sales revenues are then calculated, gross profits determined and taxes deducted to give net profits. During the first year or two, when the production programme is not in full swing, there may be no profits. Therefore, figures should be reckoned for the first five years. The assets and liabilities should also be indicated over a five-year period, as well as the cash in-flow and out-flow.

VII. MARKETS, PRICES AND ECONOMICS OF WET BLUE CHROME LEATHER PRODUCTION

Developing countries often lack knowledge of the steps necessary to export their products. On the other hand, the market countries sometimes have little knowledge of the status or potential of the industry in the developing countries. Thus, there is a need for market studies that would assist the developing countries to sell their products and establish market channels.

The developing countries also lack experience in determining their cost structures and quality standards.

Only proper cost accounting methods can remedy this situation, however. Only when costs for converting the raw hide and skin into export products, i.e. pickled pelt, vegetable tanned and chrome tanned leathers, have been determined is it possible to choose a line which is more profitable to export.

Tables 3 and 4 give a break-down of prices in India. These figures are only offered as a guide as prices and costs vary with time, and from country to country.

Table 3. Cost structure and prices for Indian materials
(US cents)

Skin or hide	Average weight (kg)	Cost per piece					
		Raw Material	Processing				Total
			Chemicals	Labour per piece	Over-heads	Total processing	
Goat	1.0-1.25	100-120	5-7	6-7	5-6	16-20	116-140
Sheep(hair)	1.5-1.75	160-175	7-9	8-9	5-7	20-25	180-200
Sheep(wool)	2.0	90-105	5-6	7-8	5-6	17-20	107-127
Buffalo calf	3-4	90-105	16-18	10-12	10-11	36-40	126-156
Cow calf	4-5	130-160	20-22	13-15	13-15	45-50	176-212
Cow hides	10-11	290-320	53-60	25-30	25-30	100-120	393-440

Table 4. Cost and market prices for Indian materials
(US dollars)

Skin or hide	Average size/area	Cost price	Market price
		per piece	per piece
Goat	28-40"	1.2-1.4	1.7-1.9
	sq.in.		
Sheep (red hair)	5.00	1.8-2.0	2.4-2.6
Wool sheep	5.75	1.0-1.3	1.4-1.5
			per sq.ft.
Firsts (5 per cent) Seconds (15 per cent) Thirds (20 per cent)			0.3
Fourths (25 per cent) Fifths (25 per cent)			0.22
Rejects (10 per cent)			
Cow hides	18.00		0.25
Runs (30 per cent)			0.28
Fourths (40 per cent)		3.5-4.5	0.26
Fifths (20 per cent)			0.24
Rejects (10 per cent)			
Buffalo calf	5.5		0.34
Runs (70 per cent)		1.3-1.5	0.36
Rejects (30 per cent)			0.23

The need for market surveys and market intelligence cannot be over-emphasised. A continuous study should be made by each country of its competitive position in the world.

Serious consideration must be given to the economics of export. The primary step is to identify the products; the markets; and the capacity and competitive position of the country. The over-all picture of the industry has to be taken into account in determining the quantum, quality and type of product to be exported.

Export of leather in place of raw hides and skins means increased foreign exchange earnings and additional employment. This additional value is indicated in the following examples.

The number of raw sheep skins exported to Western Europe by the developing countries in 1966 was estimated to be around 45.8 million pieces. If these had

been exported in wet blue chrome condition, the value added would have been $12.5 million ($0.28 extra per piece). Had they been exported in vegetable tanned form, they would have yielded even greater value, namely $17.9 million ($0.39 per piece). Similarly, the added value obtained by exporting wet blue chrome leather from the 12.7 million raw goat skins exported in 1966 would have been $50.9 million (at $0.40 per piece), and $59.8 for vegetable tanned leather (at $0.47 per piece). Thus, the developing nations would have earned an additional amount of $63.7 million for the year 1966 by exporting the same raw goat and sheep skins in wet blue condition.

Other benefits include the utilization of chemicals and the growth of auxiliary industries in the country.

Export of vegetable and wet blue chrome leathers

A recent study[20], on the merits and demerits of exporting wet blue chrome as contrasted to vegetable tanned, showed that:

(a) Wet blue chrome export fetches less foreign exchange, 100 pieces of blue chrome earning only 1,177 shillings as compared to 1,272 shillings for vegetable tanned, i.e. a total loss of 7-8 per cent in foreign exchange;

(b) The labour content is reduced by 40-50 per cent in blue chrome production;

(c) Freight charges are higher, by about 50 per cent, and as most of the freight charges are paid in foreign currency net foreign exchange earning is reduced further;

(d) Where there are export duties, the revenue accrued to the Government is less;

(e) Processing time is less than one fourth that required for vegetable tanning;

(f) Small-scale units are at a disadvantage with their limited funds and machinery and are unable to compete in the raw market.

Wet blue chrome production results in concentration of business, displacing the small units. By exporting the leathers in wet blue, the country loses foreign exchange to the extent of 3 per cent in the case of hides, and 9-10 per cent in the case of buffalo calf leather exports.

However, if the production costs and sales revenues are compared, it is considerably more profitable for the tanner to produce and sell leather in wet blue than as vegetable tanned: the net profits and the turnover are higher. However, while the tanner benefits, the country loses, to the extent of 3-10 per cent in the total exchange earnings. This could be corrected by levying duties on the exports.

20/ K. Seshiagiri Rao and V. N. Mohamed Hussain, Leathers, No. 6 June (1969) p. 17.

Wet blue chrome export means diversification of product and export markets. In fact, it was the introduction of wet blue chrome in international trade that increased the prices. The market preference in Eastern Europe is for wet blue chrome, and such a demand reduces the dependence of the tanners on markets in Western Europe.

However, this diversification and the increased exports to countries in Eastern Europe has resulted in decreased earning of hard currency. There is yet another danger. The export of wet blue chrome is not conducive to the growth of the finished leather and footwear industry within the country. The best quality hides and skins are used for the wet blue chrome export. The wet blue chrome tanner, with comparatively lower risks and low capital investments, has an advantage when buying the raw material. Therefore, the exports of finished leathers and footwear suffer.

It is clear that a country has to take an over-all view of the status of the industry: its capacity to expand and export; the quantum and quality of export and the net foreign exchange earnings. Support measures such as imposing import and export duties or fixing a ceiling for the quantum of export for any one type, may be found necessary to achieve the twin objectives of promoting exports and promoting the industry within the country.

VIII. CHROME CRUST LEATHERS FOR EXPORT

In the leather trade, 'crust' denotes tanned leather before it undergoes machine operations and finishing processes. These crust leathers are tanned with vegetable tanning materials, lightly oiled, dried and trimmed, and contain only 10-14 per cent moisture. They are easily packed and baled. Area and weight can be correctly measured.

It would be advantageous if chrome tanned leather too could be exported as chrome crust in place of wet blue chrome. However, certain subtle problems arise in defining chrome crust leather.

Unlike vegetable tanned, chrome leather does not easily wet back on drying. To overcome this, wet blue chrome is further treated with vegetable tans or syntans, wetting agents, etc. before drying. Such a leather wets back more readily. This additional treatment may also involve some further machine operations, e.g. shaving, setting and staking. As this processing could be continued right up to the point of finishing, it is necessary to define the stage at which the leather can be called chrome crust.

Chrome tanned finished leathers and chrome tanned crust leathers have counted import/export duties, due to lack of definition. This problem is aggravated where incentives are given for the export of finished leathers and/or where imports of finished leathers are discouraged. A clear definition of, and differentiation between, finished and crust leathers is necessary.

A committee set up especially for this purpose at a "Tanners' Get Together" in Madras in 1970 adopted the following definitions.

Leather shall be deemed to be finished if it has been subjected to a minimum of six of the following processes/operations: shaving to required substance; dyeing; mordanting; fat-liquoring; setting; staking; buffing; pigment or aniline finishing; plating and measuring. This arbitrary definition was made to clear doubts for purposes of customs, export/import duties, etc.

There are categories of crust leathers: ready-to-wet and ready-to-finish. The crust leathers are also called natural chrome crust; mordanted crust; re-tanned crust; chrome stained crust; dry chrome crust; rough crust; off-the-board crust; etc.

The need to export chrome crust

Dry crust eliminates many of the problems involved in wet blue chrome exports (e.g. high moisture content; wrinkling in packing and transit; acid

damage in storage; partial drying, causing patchy dyeing; and difficulty in measuring.

The major problem with dry crust is the difficulty in wetting back uniformly. Once dried and stored, certain irreversible changes take place in the chromium complexes fixed in the leather and these may pose problems in re-tanning and finishing. However, present-day understanding of the chemistry of chrome complexes and chrome tannage, has made it possible to produce a readily wettable chrome tanned dry crust leather.

Chrome crust leather has several advantages: packing is easier; freight charges are reduced; grading is easy and area can be measured reliably. This means higher returns for the same unit of leather. This also takes the exporter one step closer to the production of finished leathers.

Some chrome crust leather is already on the market and there is a growing demand for it.

There are several methods of obtaining a readily wettable dry chrome leather after long storage: incorporating soft soap; wetting agents; vegetable and synthetic tans; long chain dicarboxylic acids, etc. Whatever the method or material used, it is essential that: the chrome crust leather wet back fully and uniformly; there be minimum changes in the chrome complexes; the physical and chemical properties remain the same on storage; the crust behave as normal wet blue leather when soaked back; the wetting and other agents incorporated not affect final properties of the leather (tensile strength, water resistance etc.); the crust be usable as a raw material for conversion into any type of leather, ranging from upper leather with "temper" to a glove leather with "run".

Wetting agents have a tendency to reduce tensile strength. Mordanting agents (e.g. vegetable tan) impart darker colour, making it difficult to finish the leather into pastel shades; they too tend to lower tensile strength on storage. Certain other agents cause the leather to absorb too much water and make subsequent water-proofing difficult. Some agents interfere with uniformity in dyeing and finishing.

Two distinct categories of crust were mentioned earlier: ready-to-wet and ready-to-finish. Ready-to-wet leather is obtained simply by incorporating a suitable hydrophilic agent, but ready-to-finish leather undergoes a number of mechanical and post-tanning operations. When exporting these leathers, a clear understanding should exist between the finisher/importer and tanner/exporter. Such leathers are usually re-tanned, fat-liquored and dried. Today, the demand is more for ready-to-finish.

Processes for making chrome crust from wet blue chrome goat skins

Natural chrome crust[21]

The wet blue chrome leather is sammed, shaved uniformly and the shaved weight noted. It is then soaked back, washed well and neutralized with 0.5 per cent sodium bicarbonate with 500 per cent water, run for 15-20 minutes in a drum and then washed in two changes of water.

The neutralized leathers are drummed with 0.25-0.5 per cent sodium lauryl sulphate or any sulphated alcohol and 200 per cent water for 30-45 minutes. They are then taken out, fat-liquored for 30-45 minutes in a separate bath with 0.5-1.0 per cent sulphated fish oil and 200 per cent water at 50°C, and horsed up.

Next day, the leathers are put out, oiled up with two parts kid finishing oil and one part fish oil, sammed, set and hung for drying, and piled for two to three days. The dried goods are saw-dusted, staked lightly, buffed, trimmed and assorted.

Mordanted crust[22]

The neutralized goods are treated with 0.75-1.0 per cent sulphated fish oil and 200 per cent water at 50°C for 30-45 minutes. Then 4 per cent vegetable tan extract, dissolved in a small quantity of water, is added. After drumming for 15 minutes, the goods are taken out and horsed up.

Further treatment is the same as for natural chrome crust.

Dry chrome crust

The following process has not yet been tried out on a commercial scale.

The pickled stock is tanned with $33\frac{1}{3}$ per cent basic chrome liquor added in three instalments. In the second feed 1 per cent wetting agent is added. The third portion of chrome is added after basifying to pH 3.5. After running for one hour, 0.2 per cent cationic fat-liquor and 0.5 per cent mineral oil are added to the bath. The stock is drummed for 30 minutes and further treated with 1 per cent fat-liquor containing one part emulsifier and three parts castor oil at 45-50°C. The leathers are piled overnight, dried and staked twice.

Crust lining

The rejects are washed, neutralized with 1 per cent sodium bicarbonate (pH in cut section 4.5-5.0) washed, mordanted with 1 per cent syntan and 3 per cent spray dried wattle extract powder, drained and washed.

21/ T. C. Deb and others, in Fancy, Split and Speciality Leather (Madras, Central Leather Research Institute, 1965) p. 16.

22/ Ibid.

The goods are fat-liquored by drumming for 30 minutes with a mixture of 3.75 parts Turkey Red Oil and 1.25 parts castor oil; 0.25 per cent preservative is added. The goods are piled overnight, set, sammed, re-set, dried, staked lightly and buffed.

Processes for making chrome crust from wet blue chrome sheep skins

Natural chrome crust

The wet blue chrome sheep skin rejects are sammed, weighed, washed for 20 minutes in a drum with 400 per cent water, neutralised for 30 minutes in a drum with 100 per cent water and 1 per cent sodium bicarbonate (pH of cross section 4.5-5.0), washed with hot water for 15 minutes, and fat-liquored by drumming for one hour with 100 per cent water at 60°C, 2 per cent emulsifier and 2 per cent castor oil. When the bath is completely exhausted it is drained.

Top fat-liquoring is done by drumming for 30 minutes with 100 per cent water 60°C, 0.25 per cent cationic fat-liquor and 0.25 per cent castor oil. After draining, the goods are piled overnight. Next day they are wet, re-set, dried, staked lightly by hand and trimmed.

Chrome re-tan[54]

The wet blue chrome sheep skins are sammed, weighed, washed as above, and neutralised for 30 minutes in a drum containing 100 per cent water, 0.5 per cent sodium bicarbonate and 1 per cent neutral syntan or 0.5 per cent sodium sulphite. Re-tanning is done by drumming for one hour with 4 per cent wattle spray dried powder in the same bath. After draining, the goods are washed with hot water for 15 minutes and fat-liquored in a drum for one hour with 2.5 per cent Monogen L-70 and 2.5 per cent castor oil, and re-drained.

Top fat-liquoring is done with 100 per cent water, 0.25 per cent cationic fat-liquor and 0.25 per cent castor oil. It takes 30 minutes. After draining, the goods are piled overnight. Next day they are set, dried, staked lightly and trimmed.

Chrome crust for shoe suede leather from goat and sheep skins

Wet blue chrome goat and sheep skins that are unsuitable for grain leather but that have clean flesh without flayouts, tick, pockmark, etc. are shaved to the desired thickness and washed in dilute solution of acetic acid. The leathers are neutralized to pH 6.0–6.5 with a mixture of organic and inorganic complexing agents and mild alkali.

Re-tanning

Re-tanning is necessary in order to obtain a finer nap and to equalize the leathers originating from different batches. It is done in short float at high temperature with a combination of 6-8 chrome and aluminium or zirconium tanning agents and a 2-4 per cent cationic fat-liquoring agent. Starch and flour (2-4 per cent) are also employed to stiffen the fibre for better buffing. Aluminium salts improve buffing and dyeing characteristics. The re-tanned goods are horsed up, set out lightly, dried in hot air to produce a good nap, sawdusted and staked.

The skins are pre-buffed on the grain in thicker areas, particularly the neck, before buffing on the flesh side; shaving is done similarly; final buffing is done by the finisher.

For garment suede, the process is the same as above except that 2-4 per cent cationic emulsifier is added to the cationic fat-liquoring agent in the re-tanning bath to act as a lubricant. This gives a supple, silk-like handle. Suede garment leather should never be nailed or strained after sawdusting and staking, as this eliminates the clothy feel.

Processes for making chrome crust from wet blue chrome cow and buffalo hides

Chrome crust for upper: corrected grain side

The following processes are recommended:

Re-tanning is done to give increased fullness; to tighten and give good buffing properties to the grain; and to make the hide suitable for paste and vacuum drying.

To avoid cracks in the grain, the chrome leather is first treated with a syntan before re-tanning with 3-5 per cent vegetable tannin. Syntans of pH below 2.5 are used to exert tightening of the grain; those of pH 3.5-4.0 to reduce surface charge of chrome leather, and those of pH 6.5-7.5 to impart fullness.

For corrected grain leather, water soluble fat liquors should be used in combination with raw oils in order to regulate the depth of penetration. 3-5 per cent pure oil is used.

Fat-liquoring is done in three stages. A small portion of the fat-liquor is applied before re-tannage and the rest afterwards. After the fat-liquor is exhausted with acid wash, the leather is given a top fat-liquor with a small quantity of cationic fat-liquor to give a supple and elastic surface and to reduce migration of oil during paste or vacuum drying. Instead of the above, amphoteric

fat-liquors or a suitable combination of anionic and cationic fat-liquors may be used. There should be no overloading of the oil on the surface.

The fat-liquored goods are then dried, staked, sawdusted and nailed. (Buffing is done at the finisher's end). The resultant leather should be flat. Attention should be paid to keeping the grain surface clean.

Re-tannage for corrected grain leather

There is no washing or rinsing. The wet blue chrome leather is treated with 70 per cent water, 25°C and 1-3 per cent zirconium sulphate (50 per cent basicity), and the drum run for 20-30 minutes (pH approximately 2.5).

It is then drummed for 40-50 minutes with 100 per cent water, 40°C, 1 per cent calcium formate, 0.5-1.5 per cent sodium bicarbonate (pH 4.0-4.3). Next, 2-4 per cent vegetable tanning materials and 2-4 per cent replacement syntan are added and the drum run for a further 40-50 minutes. The goods are rinsed or washed at 50°C. Then 50-100 per cent water, 60°C, 3-4 per cent sulphated sperm or neatsfoot oil, 0.5-1.0 per cent water-soluble synthetic fat-liquors and 1.0-1.5 per cent unsulphated sperm oil are added and the drum run for 40 minutes.

The goods are cold rinsed for 5 minutes and paste dried.

Re-tannage for full grain cattle hide upper leathers

The chrome leather is drummed for 20-30 minutes with 50-100 per cent water (35°C), 1.0-1.5 per cent neutral salt of a syntan or complex active auxiliary, and 0.2-0.5 per cent sodium bicarbonate (pH 4.5-4.8). To this, 0.5-1.0 per cent anionic fat-liquor resistant to electrolytes is added and the drum is run for 10 minutes. Next, 2-3 per cent anionic resin tannin and 0.2 per cent of less astringent synthetic re-tanning agent are added and the drum run for an hour (pH approximately 4.5). After washing or rinsing for 10 minutes at 50°C, 100-150 per cent water, 60°C, 2 per cent sulphonated neatsfoot oil, 2-3 per cent water soluble synthetic fat-liquor and 0.5 per cent unsulphonated neatsfoot oil are added and the drum run for a further 45 minutes. After washing or rinsing for 5-10 minutes at 25°C, the goods are either vacuum-dried or hung up to dry.

Re-tannage for full-grain cattle hide upper leathers which can also be buffed and embossed

Method A

Without washing or rinsing, the leather is drummed for 20-30 minutes with 70 per cent water, 25°C, and 1-2 per cent zirconium sulphate (50 per cent basicity) (pH 2.5-2.8). After drumming with 200 per cent water, 35°C, for 10 minutes, the float is drained off. The goods are drummed again for 20-30 minutes with

0.50 per cent water, 35°C, 1 per cent complex-forming auxiliary, 0.5-1.0 per cent sodium bicarbonate and 1-2 per cent less astringent syntan (pH approximately 4.3).

The goods are now drummed for 45-60 minutes with 4 per cent chromium sulphate (33 per cent basicity), 1-2 per cent replacement syntan and 0.7-1.0 per cent sodium bicarbonate (pH approximately 4.3).

After washing or rinsing at 50°C the goods are drummed for 45 minutes with 100-150 per cent water (50°C), 3 per cent sulphated neatsfoot oil, 1.0-1.5 per cent water-soluble synthetic fat-liquor and 0.5-1.0 per cent unsulphonated neatsfoot oil.

After rinsing/washing for 5-10 minutes at 25°C, the goods are vacuum or paste dried.

Method B

The wet blue chrome hides, after chrome tanning, need not be treated with preservative. They are sammed, set and shaved.

The goods are washed for 20 minutes in cold water, neutralized with 1.0 per cent neutral syntan, and the drum run for 5 minutes. 0.5 per cent sodium bicarbonate is added to the drum in two feeds at 5-minute intervals. Finally, the drum is run for 30 minutes and drained; the goods are washed with hot water for about 45 minutes after which they are fat-liquored.

The leather may also be neutralized with a mixture of 0.3 per cent sodium bicarbonate and 0.5 per cent formate. The central layer must show slight green when it is neutralized. After neutralization is complete, the leathers are washed and treated with 1 per cent re-tanning syntan and the drum run for 45 minutes. They are then fat-liquored.

The goods are fat-liquored for about 45 minutes in a drum containing 100 per cent hot water at 60°C and 3 per cent sulphonated fish oil and 0.5 per cent sulphonated mineral oil. When the fat-liquoring bath is exhausted, it is drained, 2 per cent syntan dissolved in water is added, and the drum run for 10 minutes. 3.5-4.0 per cent mimosa extract and 0.5 per cent myrobalan extract dissolved in minimum amount of hot water are added (preferably dissolved a day before use), and the drum is run for 45 minutes. Then 100 per cent hot water at 50°C is added and the drum run for a further 10-15 minutes. The goods are taken out and the bath is drained. Refat-liquoring is done with 1.0 per cent Turkey Red Oil, 1.0 per cent raw pungam oil, 0.5 per cent glycerine, 0.5 per cent bar soap and 100 per cent hot water at 55-60°C. The drum is run for 45 minutes. If the fat-liquor is not exhausted, 0.1-0.2 per cent of diluted acetic acid or formic acid is added in two instalments. Drumming is carried out for 10 minutes after each instalment.

The bath is now drained. To the drum, containing only the leather, 2-3 per cent china clay, made into a paste, is added and the drum run for 10-15 minutes. After rinsing, the leathers are taken out and piled overnight.

Next day, the leathers are set, first on the flesh side and then on the grain side. Then they are sammed and set again on both sides. If need be, a final setting may be given by hand slicker. The leathers are hung up to dry. They are then piled up for 2-3 days and sawdusted overnight, using uniformly moistened good quality sawdust.

The leathers are then staked carefully, nailed or toggled on frames to dry in a cool place. After this they are trimmed and the flesh side is buffed with 180 grit emery paper. The grain side is buffed with 240 grit paper if there are grain defects; otherwise it is only snuffed with 320 paper. The leathers are brushed and measured. If flesh dyeing is required, the goods are dyed in drum containing 0.5 per cent of any suitable acid dyestuff, after which the bath is acidified with formic acid.

Chrome re-tan crust cow

Wet blue chrome cow hides are sammed, shaved and washed and re-chromed with 2 per cent chrome powder (0.5 per cent Cr_2O_3) and 100 per cent water. The drum is run for two hours. Basifying is done with 0.5 per cent sodium bicarbonate to pH 3.7. To the same bath 0.75 per cent cationic fat-liquor is added and the drum run for another 30 minutes.

The goods are then washed for 30 minutes in running water and neutralised with 0.5 per cent sodium formate, 0.25 per cent sodium bicarbonate and 200 per cent water. The drum is again run for 30 minutes. After washing for 15 minutes, the goods are fat-liquored with 1 per cent sulphated fish oil, 1 per cent sulphonated mineral oil, and 1.75 per cent castor oil. The drum is run for 45 minutes.

Re-tanning is done in the same bath, with 2 per cent syntan and 4 per cent spray dried wattle extract added, without water. The drum is run for 45 minutes and the goods horsed up overnight.

Next day the goods are rinsed for 5 minutes and refat-liquored with 0.5 per cent cationic fat-liquor and 100 per cent water; the drum is run for 30 minutes; 0.125 per cent formic acid is added and the drum run for 20 minutes. The goods are horsed up overnight.

The following morning the leathers are sammed, set by machine, nailed on board, dried, piled, plated, buffed and trimmed.

Buff calf crust

The wet blue chrome leather, prepared as described above, is sammed, shaved to 1.3 mm thickness, weighed and given two 10-minute washings.

The tanned stock is neutralized with 2 per cent hypo, 1 per cent sodium bicarbonate and 150 per cent water. The drum is run for 30 minutes. After testing for two thirds neutralization, the goods are washed for 15 minutes.

The goods are treated with 1.5 per cent neutral syntan and 50 per cent water in a drum for 30 minutes, then they are rinsed.

Fat-liquoring is done with 3 per cent Turkey Red Oil (40 per cent), 1 per cent groundnut oil, and 150 per cent water at 55°C. Half of the fat-liquor, in an emulsified form at pH 7.4, is added and the drum run for 10 minutes; the rest is now added and the drum run for another 45 minutes; 0.25 per cent diluted acetic acid is added in two instalments at 5-minute interval; the drum is run for 10 minutes; 0.5 per cent cationic fixative is added and the drum run for 10 minutes; 50 per cent of the float is run down.

Two per cent French chalk is added and the drum run for 20 minutes; 2 per cent titanium dioxide is now added and the drum again run for 20 minutes. The goods are piled.

Next day they are slicked, sammed, lightly hand set and dried. They are damped back, staked, nailed lightly on board, buffed and trimmed.

Newer types of crust leathers

Several newer materials and methods are being examined with a view to producing wettable crust leather. Most of these methods have yet to be translated into commercial practice and acceptance. It is not difficult to make chrome leather wettable; the difficulty arises only when it is to be processed into finished leather.

Using dicarboxylic acids for imparting wettability

Long chain dicarboxylic acids have been used for producing wettable as well as waterproof chrome leather.[23] The wet blue leather is prepared according to the standard process, but instead of fixing 2.5 per cent Cr_2O_3, say 1.5 per cent is fixed.

The wet blue leather is neutralized with 3 per cent ammonia to get a uniform pH of 8.2. The goods are washed and then treated with 5 per cent ammonium salt

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23/ [illegible]. Briggs, Journal of the Society of Leather Trades Chemists, vol. 52 (1968) p. 206.

of long chain C_{30-36} dimeric fatty acids (dimerised oleic or linoleic). A uniform penetration is ensured with 5 per cent copper sulphate solution as an indicator. The leather is washed and the pH checked to be 6.5 throughout the cut section.

Such a leather need not be fat-liquored further. The leather is washed, set, dried and lightly staked. It is readily wettable.

For finishing at the other end, the leather may be wetted back, acidified with 5 per cent sodium sulphate and 1 per cent formic acid, and re-tanned with chrome liquor containing 10-15 per cent Cr_2O_3. Such a leather, after topping with chrome is water resistant.

Other methods for imparting wettability

The wet blue leather is re-tanned with aliphatic sulphonyl chloride or formaldehyde or glutaraldehyde. Though the leathers so prepared are readily wettable even after drying, the work is still of an exploratory nature.

Chrome-zirconium crust leather

Resin fillers and zirconium salts have been used for getting a fuller leather and an improved nap for suede leather. Some of these agents also have the ability to absorb water and wet back readily. Therefore, they may be found useful for preparing crust leather when used alone or in combination with chrome tannage.

Method 1: See the process described earlier for re-tanning with zirconium salt for chrome crust intended for upper.

Method 2: Pickled goat and sheep skins are tanned at pH 3.5-3.8 with 10 per cent cationic urea resins, 2 per cent salt and 100 per cent water and left overnight. The next day the goods are re-tanned in a separate bath with 20 per cent zirconium tanning salt added in dry powder form; the drum is run for two to three hours and then flooded with 75 per cent water and again run for two hours; the goods are basified to pH 3.8 with soda ash. The tanned material is later fat-liquored with 2 per cent cationic fat-liquor in the case of goat skins and with 5 per cent fat liquor in the case of sheep skins. The leathers are dried, sawdusted, hand staked and buffed with 240 and 320 paper. Alternatively, the zirconium tanned leather is re-tanned with chrome liquor containing 1.5 per cent Cr_2O_3 in the same bath and the final pH adjusted to 3.8; subsequent procedures are as above.

The leathers so produced have a good, tight, uniform nap with a high degree of fullness.

Sheep skins can be used for nappa leathers. The goods wet back readily.

Method 3: A combination chrome-zirconium tannage for wettable crust leathers is also recommended.

Other types of newer leathers

The following types of leathers are reported to be in demand:

V.T.H. leather: for uppers for casual shoes: Raw materials are wet blue chrome cow/buff hides of thickness 2.8 mm. The leather is dyed brown and fat-liquored, set, dried, sawdusted and staked heavily to get a very soft feel.

White softee: Wet blue chrome hides are bleached with a bleaching syntan or other bleaching agents and heavily fat-liquored. The soft, white leathers of 0.8–0.9 mm thickness are ready for resin finish to be used for children shoes.

Crust leather other than vegetable and chrome tanned

Once the idea of crust leathers is accepted by international trade, it should be possible for the leather scientists/technologists to develop crust leathers tanned with aldehydes, syntans, newer tanning agents or combinations of chrome, vegetable and other tanning agents. The leathers reacted with aldehydes can be readily washed free of aldehydes. Similar temporary or partial tannage could be given which could be washed off or blended with a re-tannage by the importer/finisher. This crust leather market opens up new vistas and there is room for intensive research.

IX. UTILIZATION OF WET BLUE REJECTS

Sorting starts with the raw and goes on to liming, pickling and wet blue. If sorting is carried out strictly in the pre-tanning stages, the number of rejects in the tanned blue state should be nil or negligible. Then the problem of utilizing the blue rejects does not arise.

If a tanner has the production capacity and sales flow for pickle, vegetable and wet blue chrome, the rejects at every point can be utilized, if treated appropriately. Limed stock which cannot be considered for chrome leathers because of grain flaws etc. goes directly to vegetable tanning. The pickled rejects are de-pickled and vegetable tanned.

On the other hand, if the tanner's entire production is chrome leather, in spite of strict selection in the raw stock, he may get 5-10 per cent (and in a bad season even 25 per cent) rejects. Unlike vegetable tanned leather, where even rejects can be sold, chrome leather rejects are not that easy to sell, either locally or abroad. The chrome leather finishing industry in the developing countries is not sufficiently advanced to absorb these rejects. Therefore the blue chrome tanner/exporter has to face the serious problem of processing the rejects into cheaper finished leathers. For this, a finishing unit with the minimum machines has to be added to his tannery. Alternatively, a group of blue chrome tanners may form a co-operative; or the Government may set up a "common facility finishing unit" with the appropriate machines, materials and also competent technologists.

A tanner with large produotion, can either go into simultaneous vegetable and chrome production or add the required machines and set up a unit for finishing the rejects. However, a small- or medium-scale tanner has neither the facility nor the funds for this. A common facility finishing centre in the vicinity may help. His only other alternative is to do contract work, i.e. the large tanner/exporter may offer him job work, giving him the raw hides and skins and lifting the entire stock after wet blue chrome tannage according to the prescribed standards and paying the prescribed charges.

There is a current demand in international markets for wet blue rejects. Spain and Italy are reported to be buying large quantities of them, particularly goat and sheep, rejects for the manufacture of gloving, lining and other leathers.

If the wet blue rejects are well utilized, the tanner benefits greatly. The type of leathers that can be made out of rejects depends upon the type and extent of damage on flesh and grain surfaces of the leather. Some cheaper types, like

garment and suede clothing, gloving, lining, upper, shrunken grain, pearl finish and woven types of leathers can be made. A study undertaken at the Central Leather Research Institute has shown that wet blue goat rejects can be utilized profitably for clothing, lining, pearl finished and woven leathers.

Manufacture of grain garment leather from goat wet blue chrome rejects

Method A

Raw material

Rejected large size wet blue chrome goat skins

Re-wetting

The good are soaked overnight in 200 per cent water and 0.5 per cent wetting agent. Next day they are sammed and shaved to 1 mm thickness. (The shaved weight is recorded and the percentages given thereafter based on this weight). The shaved goods are washed for 30 minutes and treated with 100 per cent water and 0.5 per cent sodium formate for 10 minutes in a drum. This is followed by adding 0.75 per cent sodium bicarbonate and running the drum for a further 40 minutes. The pH all through the cut section should be 5.5. The goods are rinsed for 10 minutes.

Fat-liquoring

The goods are drummed for 5 minutes with 1 per cent cationic oil, 1 per cent raw oil and 75 per cent water; 3 per cent syntan is added and the drum again run for 5 minutes. The pH of the bath should be 4.9. Chrome liquor (1 per cent Cr_2O_3 equivalent) is added along with 0.25 per cent sodium bicarbonate and 1 per cent sodium sulphite and the drum run for an hour. The pH of the exhaust bath should be 4.8. The goods are rinsed for 5 minutes.

Dyeing and refat-liquoring

The goods are drummed for 20 minutes with a 1 per cent combination of acidic and pre-metallized dye and 100 per cent water at 50°C. Refat-liquoring is done with 4 per cent sulfated fish oil, 13 per cent Turkey Red Oil, and 1 per cent emulsifying agent. The emulsion is prepared and added to the dyebath; after running for 45 minutes, the goods are piled and left overnight.

Finishing

Next day the leathers are slicked, hooked for drying, sawdusted, staked twice, buffed on flesh and snuffed on grain with 400 grit emery paper, stained

and finished with resin and pigment finish. They are given one spray coating of water repellent.

Method B

The rejects, size 36"-40", with a minimum of grain defects, are sammed, shaved to 0.8 mm and treated in a drum with 200 per cent water and 2 per cent Catalix G.S. for 30 minutes. They are then neutralized in the same bath with 2 per cent sodium bicarbonate for 30 minutes, washed thoroughly, mordanted with 2 per cent wattle extract and 1 per cent syntan, dyed with 3 per cent of a combination of acid and pre-metalized dye, fat-liquored in the same bath with 12 per cent fat-liquor (9 per cent Turkey Red Oil and 3 per cent Castor oil), exhausted with 2 per cent acetic acid, top fat-liquored with 1 per cent Catalix G.S., drained and piled. Next day they are set, dried, sawdusted, staked, dry drummed and toggled.

The finishing composition is as follows: 1 part pigment; 1.5 part resin; 0.2 part Turkey Red Oil; 0.1 part 10 per cent wax emulsion, and 5 parts water. The leathers are sprayed once, dried and staked, then sprayed and staked again. Two cross coats of top coat (1 part lacquer emulsion and 0.5 part water) are sprayed on and the leathers once more dried and staked

Suede garment leather from goat wet blue chrome rejects

Raw material

Wet blue chrome goat skins, size 36"-40", with minimum defects on the flesh (e.g. cuts, pooks, white spots, pin holes) and with full substance

Re-wetting

The goods are sammed, shaved on the grain to level substance (0.7-0.8 mm) and washed well with water. They are then treated with 2 per cent Catalix plus 200 per cent water and run in the drum for 30 minutes. They are neutralised for 30 minutes in the same bath, using 1.5-2.0 per cent sodium bicarbonate, and washed thoroughly.

Mordanting

The goods are treated with 2 per cent wattle extract and 2 per cent syntan.

Fat-liquoring

Fat-liquoring is done with 10 per cent Turkey Red Oil and 2 per cent free castor oil. The goods are piled overnight, crusted as usual, dried, staked, buffed with 240 - 320 - 400 grit papers, and dusted. They are wetted back with

80 per cent water at 50°C and 1 per cent ammonia for an hour, and left overnight. Next day they are drummed for an hour in the same bath and washed with hot water for 30 minutes.

Dyeing and refat-liquoring

The goods are drummed for 15 minutes with 300 per cent water at 60°C and 1 per cent liquor ammonia; 2.5 per cent Naphthalene Black 12 B3 and 2.5 per cent Sandopel Black (on dry crust weight) are added and the drum run for an hour. Turkey Red Oil is now added and the drum run for 30 minutes; 3 per cent acetic acid is added in slow feeds; the drum is run for 30 minutes; the bath is exhausted and drained.

The drum is run for 30 minutes with 300 per cent water, 0.5 per cent basic dye and 0.5 per cent acetic acid. After draining, the stock is topped with acid dye, as above, with 2.5 per cent Naphthalene Black and 2.5 per cent Sandopel Black. The drum is again run for 30 minutes and the bath exhausted with 3 per cent acetic acid.

The goods are top fat-liquored with 200 per cent water (55°C) and 1 per cent Catalix G.S. The drum is run for 30 minutes. The goods are rinsed and piled. Next day they are set, dried, sawdusted overnight, staked, dry drummed for four hours, boarded and completely dried, and trimmed. They are then further finished.

Lining leather from goat wet blue chrome rejects

The blue chrome skins are shaved to 0.8 mm, washed for 10 minutes in a drum, neutralized with 1.5 per cent sodium bicarbonate and 150 per cent water in a drum for 30 minutes and then washed for 5 minutes.

The goods are re-tanned with solid 3 per cent wattle extract, the drum being run for 20 minutes. To the same bath, acid or direct dye is added and the drum run for 30 minutes at 45°C.

To the same bath are added 2.5 per cent Turkey Red Oil, 1 per cent groundnut oil and 0.25 per cent soft soap and the drum run for 45 minutes. 0.75 per cent acetic acid (diluted in water) is added in three instalments, 5 minutes apart. The drum is run for another 15 minutes and the leathers taken out and piled.

Next morning the goods are sammed, set, dried, sawdusted, staked by hand and nailed. After two hours they are taken out, buffed, trimmed and smooth plated.

Pearl finished leathers

Raw materials

Wet blue skins with minimum grain defects are sammed, shaved to 0.7-0.8 mm thickness, washed and neutralized with 200 per cent water and 0.5 per cent sodium bicarbonate in a drum for 30 minutes, washed again for 10 minutes; re-tanned and dyed with 200 per cent water, 3 per cent syntan and 1 per cent acid dye, the drum being run for 30 minutes; the dye is fixed with 0.2 per cent formic acid. The goods are taken out and rinsed.

Fat-liquoring

The goods are fat-liquored with 80 per cent water, 3 per cent sulfated fish oil and 1 per cent raw oil, the drum being run for 30 minutes. After they have been fixed, with 0.2 per cent formic acid, and rinsed, the leathers are set, re-set, hooked for drying, sawdusted, staked, nailed to dry, trimmed and snuffed lightly on the grain side.

Finishing

The bottom coat is prepared with 100 parts pigment, 10 parts Turkey Red Oil, 30 parts 20 per cent wax emulsion, 680 parts water and 150 parts resin binder. Two cross coats are sprayed on and the leathers dried.

Seasoning

Two coats of 100 parts clear lacquer, 6 parts pearl essence and 200 parts thinner are sprayed on. When completely dry, a top coat of 1 part clear lacquer top and 2 parts thinner is sprayed on.

Metallic finish leathers

The bottom coat is given as described above. Only the seasoning is different. It has the following composition: 100 g clear lacquer, 2 g aluminium powder, 50 cm^3 3 per cent dye in a solvent and 150 cm^3 thinner.

Two spray coats are given. After complete drying, a top coat of 100 g clear lacquer top and 200 cm^3 thinner is sprayed on. The leathers are dried.

Woven leathers

The blue chrome rejects are finished into upper leathers following standard procedures. Leathers that have many holes and are of poor substance are cut into strips of different widths and the strips woven together. (They can also be woven

together with silk or man-made fibres.) The woven leathers are given a fixing coat of lacquer emulsion and plated.

These leathers could be used as uppers for fashionable shoes, curtains, table mats and ties.

Bandhani or tie-and-dye leathers

There is a great demand all over the world for Bandhani textiles. The process employed is as old as India, but of late many centres in Japan and America are using it. Known as tie-dying, it gives a multicoloured floral effect to the textiles. It has been adopted to utilize poor grade sheep skins for making suede garment leathers. Tie-dyeing masks natural defects such as white spots in the suede leathers.

Raw material

The raw material used is wet blue sheep skin rejects. The process is as follows:

Neutralization

The goods are washed for 30 minutes in water and neutralized with 1.5 per cent sodium acetate and 100 per cent water in a drum for one hour. The pH of the cut section is checked to be 6.5

They are now fat-liquored with 3 per cent sulphated groundnut oil, 1 per cent cocoonut oil, 0.25 per cent pine tar 40 and 100 per cent water at 50°C. The drum is run for one hour. The bath is exhausted with 0.5 per cent syntan and the goods drummed again for 30 minutes. The bath is drained and the goods drummed with 3 per cent china clay, 2 per cent wheat flour, 1 per cent titanium dioxide and 0.25 per cent nonionic wetting agent.

The drum is run for 15 minutes and the goods piled. The skins are sammed next day and hooked to dry. They are sawdusted, staked, trimmed and buffed on flesh, first with 150 grit, then with 240 grit paper.

Tie-dyeing

The skins are soaked back overnight using 1 per cent ammonia, 1 per cent nonionic wetting agent and 300 per cent water. Next day they are squeezed, tied with thread, and dyed. By repeated tying and dyeing in different colours, a multi-coloured floral effect is achieved.

Annex I

SETTING UP A TANNERY FOR THE MANUFACTURE OF WET BLUE SKINS FOR EXPORT (CAPACITY: 10,000-12,000 SKINS A DAY)

The exercise presented here is based on the earlier discussion of the general principles involved in drawing up a feasibility report. Price and wage levels in India are used to show the general format and guidelines.

The object of the exercise is to set up a tannery to process 10,000-12,000 skins (i.e. 10-12 tons) per day in a single shift into wet blue chrome leathers for export. In designing the tannery, the following considerations are kept in mind:

(a) It should be possible to tan goat and/or sheep skins;

(b) To avoid rejections in wet blue, provision must be made for the vegetable tanning of a portion of these skins (20 per cent);

(c) Equipment should be so chosen and space so allotted that the capacity per shift can easily be increased by at least 25 per cent; and if required, the production of the tannery doubled by operating two shifts;

(d) Allowance should be made for expansion;

(e) As the tannery is capable of processing 10-12 tons in a single shift, it may process skins or hides - 10,000 skins or 750-1,000 hides being processed.

(f) For processing hides the hair of which is not to be saved and if de-hairing is to be done in drum, the fleshing, scudding and setting machines must be bigger in width though fewer in number.

(g) The tannery may also wish to process a portion of the stock into chrome crust or even finished leathers. Additional machines are required for this.

Three schemes are presented here.

Scheme I: Combined wet blue chrome and vegetable tanned skins

A considerable degree of flexibility is designed into the tannery to enable it to produce a wide variety of leathers in addition to wet blue chrome. It is designed primarily for three-line production: pickle, wet blue chrome and vegetable goat and sheep skins and/or hides, but with slight additions, it can also go into crust leather production. If finished leather is to be produced, an additional bay may have to be constructed and further machinery added.

Technology

The raw material is wet salted skins. These are soaked in paddles, washed with at least two changes of water, drained, painted to save hair, piled flesh to flesh overnight, de-haired by machine, plumped or re-limed in a paddle for three days, fleshed, weighed, sorted, de-limed, bated, scudded and pickled in drum. They are then sorted and tanned in the drum. Preservative is added. They are set, piled, sorted, measured and packed. The pelts not selected for wet blue chrome in the limed and pickled sort (20 per cent) are pre-treated, vegetable tanned in drum, set, oiled, hooked to dry, slickered by hand, dried, staked, buffed, weighed and graded.

Capital

Non-recurring	$US	$US
Preliminary expenses	2,500	2,500
Preparation of a project/feasibility report 3 per cent on value of machines ($278,000 - table C (d))		8,000
Land		
Cost of 5 acres @ $1,000/acre	5,000	
Land development @ $1,000/acre	5,000	
Registration etc.	1,000	
		11,000
Buildings		
Civil construction (table A)	112,000	
Lights, fittings, etc.	8,000	
Sanitary fittings, etc.	2,500	
Drainage	2,500	
Overheads, supervision etc. @ 2 per cent	2,700	
		127,700
Machines and equipment		
Cost as per table C (d)	278,000	
Cost of erection @ 2 per cent on the above value	5,500	
Freight, insurance, handling charges, customs @ 10 per cent	27,800	
		311,300
Total		460,500
For convenience:		460,000

Working capital

As the process is completed in 7 days, one month's stock is taken into account (though ordinarily 2-3 months stock is accounted for).

	$US	$US
Cost of raw material for one month (25 working days)		
Skins, 12,000 x 25 x 1	300,000	
Production cost @ $0.25	75,000	
		375,000
Outstanding bills for one month,		
12,000 x 25 x 1.5	450,000	
Contingencies	25,000	
		475,000
Total capital outlay		850,000
Non-recurring capital	460,000	
Working capital	850,000	
Total		1,310,000

Production costs, based on 300 working days a year

Cost of raw skins, 12,000 x 300 x 1	3,600,000
Cost of chemicals @ 5 per cent on raw cost	180,000
Cost of power, steam and water, sewage treatment @ 3 per cent on raw cost	108,000
Cost of labour and supervision (table B)	170,000
Cost of management expenses, sales overheads @ 3 per cent on raw cost	108,000
Interest on capital outlay (@ 8 per cent on $1,300,000)	104,000
Depreciation	
@ 10 per cent on machinery ($311,300)	31,130
@ 5 per cent on buildings ($127,000)	6,350
@ 20 per cent on furniture etc.	1,250
	38,730
Maintenance and repairs @ 3 per cent on machinery, 5 per cent on buildings and 20 per cent on furniture, vehicles etc. - taken on average 4 per cent on machinery and buildings ($311,300 + $127,700 = $439,000)	17,560
Packaging, freight, insurance charges @ 3 per cent on raw cost, ($3,600,000)	108,000
Total	4,434,290
For convenience:	4,430,000

Manufacturing cost per skin: $0.23

Sales revenues

	$US
Wet blue chrome leather - 80 per cent of the total skins - @ $1.5 per piece	4,320,000
Vegetable tanned leather - 20 per cent of the total skins (average quality) - @ $1.5 per piece	1,080,000
Goat hair: yield 100 g/piece @ $0.2/kg	72,000
	5,472,000

Gross profit

Total sales revenues	5,472,000
Total manufacturing costs	4,430,000
Profit (i.e. 23 per cent)	1,042,000

Net profit

Gross profit less taxes, dividends etc.

Table A. Civil construction costs
(Indian rates: mason, carpenter $2/day;
other skilled labour $1/day;
cement $1.5/bag;
mild steel rods $133/ton)

Unit	Area (m^2)	Cost ($US)	
		Per m^2	Total
Processing unit stores and workshop	3,125	30	93,750
Administration	150	30	4,500
Canteen	150	30	4,500
Boiler house	60	12	720
Transformer house	70	12	840
Pump house	15	12	180
Cycle shed	60	10	600
Wool washing	60	12	720
Boundary wall	550	2	1,100
Effluent treatment	-	-	3,000
Internal roads	-	-	2,000
		Total	111,910
		For convenience:	112,000

Table B. Personnel costs

Designation	Number	Monthly salary ($)	Yearly salary ($)
(a) Management and supervision			
General manager	1	600	7,200
Works manager	1	500	6,000
Technologists	3	150	5,400
Works chemist	1	150	1,800
Engineer	1	150	1,800
Technicians and supervisors	8	100	9,600
Stores and purchase staff	1	150	1,800
Boiler foreman	1	75	900
Maintenance and workshop staff	10	75	9,000
Total	27		43,500
Contribution (20 per cent) towards pension fund etc.			8,700
			52,200
(b) Non-production staff			
Secretary	1	250	3,000
Accountant	1	250	3,000
Cashier	1	150	1,800
Office manager	1	150	1,800
Administrative assistants	6	75	5,400
Watch and ward	4	50	2,400
Messengers	4	50	2,400
Total	18		19,800
Contribution (20 per cent) towards pension fund etc.			3,960
			23,760
(c) Direct labour			
Skilled labour	60	75	54,000
Unskilled labour	40	50	24,000
Total	100		78,000
Contribution (20 per cent) towards pension fund etc.			15,600
			93,600
Total personnel costs			169,560
For convenience:			170,000

Add 10 per cent for each subsequent year (for salary increments etc.).

Table C. Equipment and machinery requirements

(a) Auxiliary equipment and machines

(Valid for any of the three schemes)

Equipment	Size	Number of units	Cost per unit ($)	Total cost ($)
Boiler	400 kg per hr of steam 200 p/in^2	1	20,000	20,000
Steam connexions	-	-	-	5,000
Transformer	100 kVA 400 V 3 phase	2	6,000	12,000
Electrical connexions fittings	-	-	-	5,000
Water reservoir	25,000 gal	2	3,000	6,000
Pumpset and water supply connexions etc.	-	-	-	5,000
Workshop equipment	-	-	-	3,000
Laboratory equipment	-	-	-	2,000
Spare parts for two years	-	-	-	9,000
Tools	-	-	-	3,000
Office equipment and furniture	-	-	-	2,000
Vehicles	-	2	3,000	6,000
Total				78,000

(b) Machinery and equipment required for processing 10,000-12,000 goat skins (10-12 tons) a day into wet blue chrome

Equipment	Size	Output	Rpm	Horse-power	Number	Cost per unit ($)	Total Cost ($)
Paddles	10'x9½'x4½' (3.05mx2.89mx1.37m)	1,750-2,000 kg	8-16	7.5	18	1,000	18,000
Drums	10'x10' (3.05mx3.05m)	2,500-3,500 kg	2-8	15.0	6	2,000	12,000
De-hairing machine	5'(1,520mm)	200 skins/h	-	7.5	4	8,000	32,000
Fleshing machine	5'(1,520mm)	200 skins/h	-	10.0	4	8,000	32,000
Scudding machine	5'(1,520mm)	500 pieces/h	-	7.5	2	8,000	16,000
Setting machine	5' 4" (1,620mm)	3000 pieces/day	-	12.0	4	10,000	40,000

Table 3 (b) (continued)

Equipment	Size	Output	Rpm	Horse-power	Number	Cost per unit ($)	Total cost ($)
Sulphide coating	5'(1,520mm)	4000 pieces/ day	-	6.0	2	10,000	20,000
Hair washing paddles	-	-	-	2.0	2	1,000	2,000
Drying equipment	-	-	-	-	-	-	2,000
							174,000
Total costs (a) + (b)							252,000

(c) Additional machinery and equipment required for processing 10,000-12,000 goat and/or sheep skins into wet blue chrome

Cleaning, deliming, bating and washing	4' 7" (1,400mm)	1,200 pieces	-	-	2	7,000	14,000
De-wooling	5' 4" (1,620mm)	2,000 pieces	-	-	2	9,000	18,000
Centrifuge Wool washing Drying	-	-	-	-	-	-	13,000
							45,000
Total costs (a) + (b) + (c)							297,000

(d) Additional machinery and equipment for processing 20 per cent of the skins into vegetable tanned leather (in addition to (b))

Drums	10'x10' (3.05mx3.05m)	2,000-3,500 kg	2	15.0	2	2,000	4,000
Oil wheel drum	10'x10' (3.05mx3.05m)	2,000-3,500 kg	-	15.0	1	2,000	2,000
Setting machines	5'x4" (1,620mm)	3,000 pieces	12	12.0	1	4,000	4,000
Drying cabinet	Tunnel drier		-	-	1	10,000	10,000
Staking wheels	-	-	-	1.0	3	500	1,500
Buffing machines	-	-	-	3.0	3	1,500	4,500
							26,000
Total costs (a) + (b) + (d)							278,000

Table C (continued)

Equipment	Size	Output	Rpm	Horse-power	Number	Cost per unit ($)	Total cost ($)
(e) Additional machinery and equipment for processing 20 per cent of the skins into crust leathers (to be added to (b))							
Hydraulic setting/ sammying machine	5'4" (1,620mm)	300 pieces/h	-	15.0	1	12,500	12,500
Staking machines	5'4" (1,620mm)	-	-	3.0	2	5,000	10,000
Buffing machines	4' (1,220mm)	-	-	3.0	2	3,000	6,000
Tunnel drier	30'x65' (9.14mx19.81m)	-	-	-	-	10,000	10,000
Shaving machines	-	-	-	5.0	2	7,000	14,000
							52,500
Total costs (a) + (b) + (e)							304,500
(f) Additional machinery and equipment required if a portion of the skins is converted into finished leathers (to be added to (e))							
Dry splitting machine	5' (1,520mm)	-	-	10.0	1	40,000	40,000
Automatic spraying machine	-	-	-	5.0	1	12,000	12,000
Automatic seasoning	-	-	-	3.0	1	10,000	10,000
Glazing machine	-	-	-	1.5	2	2,500	5,000
Hydraulic press	600 tons	-	-	20.0	1	25,000	25,000
Fluffing wheels	-	-	-	3.0	1	2,000	2,000
Staking wheels	-	-	-	3.0	4	2,000	8,000
Re-tanning, colouring, fat-liquoring drums	8'x6' (2.44m 1.83m)	-	-	7.5	2	1,500	3,000
Measuring machine	-	-	-	0.5	1	10,000	10,000
							115,000
Total costs (a) + (b) + (e) + (f)							419,500

If the same tannery is used for tanning hides, it can still process 10-12 tons/day per shift, i.e. 750-1,000 pieces of hide for upper leathers. The hair is not saved and as a drum de-hairing process is used, the paddles and machines for sulphide coating, de-hairing, washing and drying hair are not required. Scudding machines may be replaced by drums and detergents. Also, liming and re-liming processes take only two days, as compared to four for skins. Fleshing and setting machines are required. While larger machines are needed, fewer are required (only 750-1,000 skins being processed in contrast to 10,000).

The machine requirements, in addition to the auxiliary equipment listed in Table 3 (a), would be: 6 to 8 drums (10' x 10' (3.05m x 3.05m)); 2 fleshing machines; and 2 setting machines.

Scheme II: Wet blue chrome goat skins only

Capacity

10,000-12,000 goat skins per day - all converted into wet blue chrome.

Inputs

	$US
Approximately the same as in Scheme I, i.e.	4,430,000

Sales revenues

90 per cent selection	@ $1.5 per piece	4,860,000
10 per cent rejection	@ $0.8 per piece	288,000
Goat hair as in Scheme I		72,000
		5,220,000

Gross profit

Total sales revenues	5,220,000
Total manufacturing costs	4,430,000
Profit (18 per cent)	790,000

If the tannery is to produce only wet blue chrome leathers, the covered floor area and the equipment and machinery requirements will be reduced to some extent, thus reducing the overheads and other costs. The profits may then go up to 20 per cent.

It can be seen that converting the rejects into vegetable tanned leather is more profitable than selling them as rejects in wet blue.

Scheme III: A small economic unit for wet blue chrome skins

Capacity

2,000-2,500 goat and/or sheep skins a day.

Capital outlay

	$US	$US
Non-recurring		
Preliminary expenses	1,000	1,000
Preparation of a report		2,500
Land		10,000
Buildings and auxiliary items		50,000
Machines and equipment and services (table D)		96,500
		160,000
Working capital		
Cost of raw materials for a month		
Skins, 2,500 x 25 x $1	62,500	
Chemicals @ $0.25	15,625	
		78,125
Outstanding bills for 1 month, 2,500 x 25 x 1.5		93,750
Contingencies		8,125
		180,000
Total capital outlay		340,000

Production costs, based on 300 working days a year

Cost of raw skins, 2,500 x 300 x 1	750,000
Cost of chemicals, 5 per cent on raw cost	37,500
Cost of power, water etc. @ 3 per cent	22,500
Cost of labour and supervision	49,000
Cost of management, sales, overheads etc. @ 2 per cent	15,000
Interest @ 8 per cent on $34,000	27,200
Depreciation	12,500
Maintenance and repair	5,500
Packaging, freight, insurance, etc. @ 3 per cent	22,500
Total	941,700
For convenience:	942,000

Manufacturing cost per skin: $0.25

Sales revenues

	$US	$US
Wet blue, 90 per cent, 2,500 x 300 x $\frac{90}{100}$ x $\frac{3}{2}$	@ $1.5	1,012,500
Wet blue chrome, 10 per cent	@ $0.8	60,000
Goat hair (100 g/piece)	$0.2/kg	15,500
		1,088,000

Gross profits

Total sales revenues	1,088,000
Total manufacturing costs	942,000
Profits (15.5 per cent)	146,000

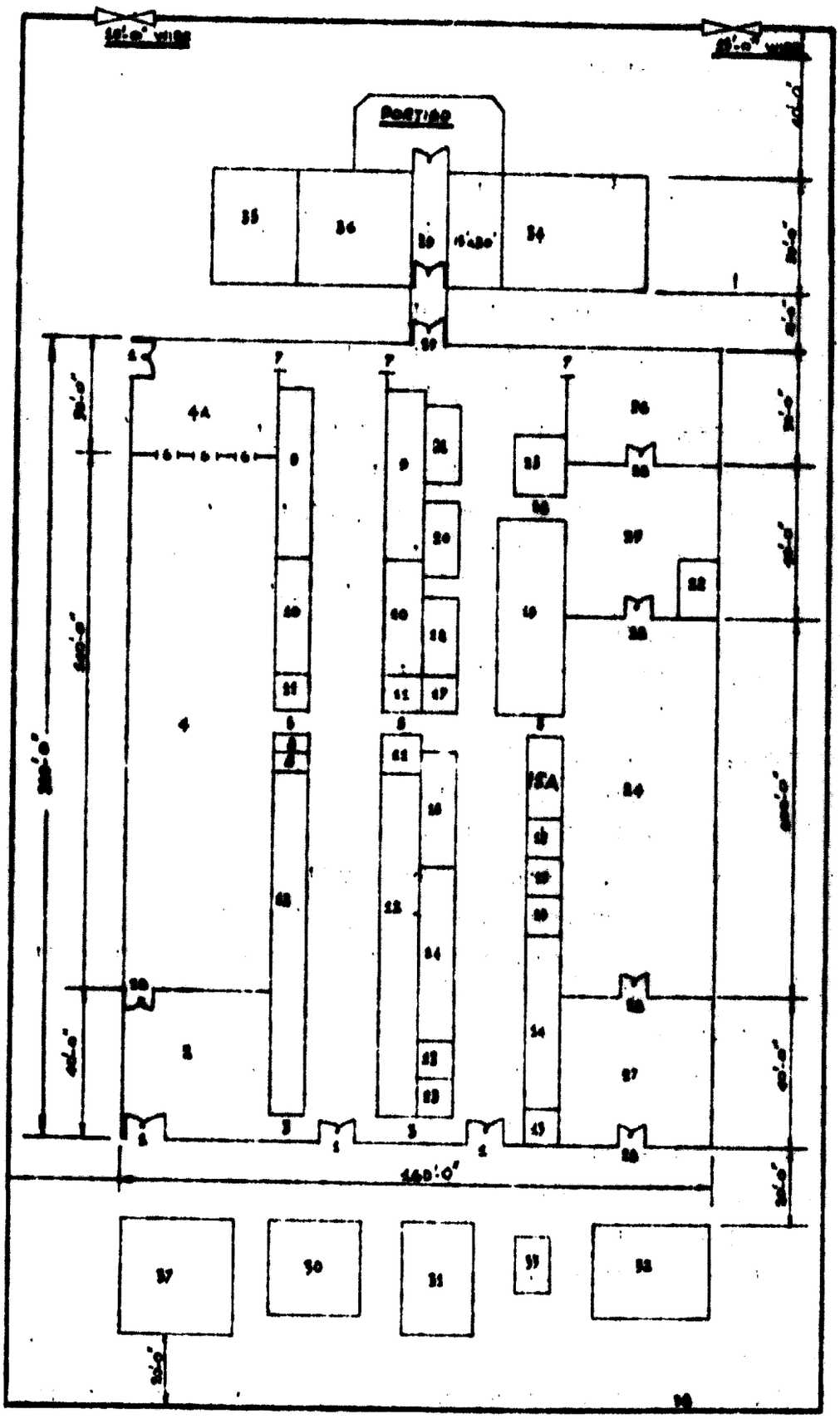
Table D. Machinery and equipment and services for a unit processing 2,000-2,500 goat and/or sheep skins a day in wet blue

Equipment	Size	Number of units	Cost per unit ($)	Total cost ($)
Paddles	8'x6'x3' (2.44mx1.83mx0.91m)	6	750	4,500
		6	750	4,500
Drum	8'x6' 600-750 kg (2.44mx1.83m)	4	1,000	4,000
Fleshing machine 200 skins/h	5' (1,520mm)	1	8,000	8,000
Setting machine	5' 4" (1,620mm)	1	10,000	10,000
Hair washing paddles	-	-	-	4,000
				36,500
Auxiliary equipment (boiler, water reservoir, spare parts, workshop tools etc.)				50,000
				86,500
Services				10,000
				96,500

Table 3. Personnel costs

Designation	Number	Monthly salary ($)	Yearly salary ($)
(a) Management and supervision			
General manager	1	400	4,800
Works manager	1	300	3,600
Supervisors	3	100	3,600
Maintenance staff	4	75	3,600
Stores/purchasing staff	1	100	1,200
			16,800
Add 20 per cent			3,360
			20,160
(b) Non-production staff			
Manager	1	150	1,800
Accountant	1	150	1,800
Assistants	2	75	1,800
Watch and ward	3	50	1,800
Messengers	2	50	1,200
			8,400
Add 20 per cent			1,680
			10,080
(c) Direct labour			
Skilled	12	75	10,800
Unskilled	8	50	4,800
			15,600
Add 20 per cent			3,120
			18,720
Total			48,960
For convenience:			49,000

Layout of main processing unit of a tannery with 10,000-12,000 skins/day capacity



Legend

1. Gateways - 10' wide
2. Chemical and material stores - 40' x 40' x 7'
3. Passage between chemical stores and beamhouse - 7' wide
4. Raw skin store house - 140' x 40'
4A. Stores received room - 30' x 40'
5. Interbay passage - 6' wide
6. Gangways - 5' wide
7. Interbay passage - 7' wide
8. Paste pits, 2 nos. - 5' x 5' x 4'
9. Soak paddles, 6 nos. - 10' x 9' x 4½'
10. Painting machines, 2 nos. - 10' x 30'
11. De-hairing machines, 2 nos. - 4' x 40'
12. Re-liming paddles, 12 nos. - 90' x 10' x 2'
13. Fleshing machines, 3 nos. - 10' x 10'
14. Drums for pickling and tanning, 6 nos. - 10' x 10'
15. Setting machines, 3 nos. - 3' x 10' x 10'
15A. Space for two extra machines, if necessary - 10' x 20'
16. Tanning drums, 2 nos. - 2' x 15' x 10'
17. Setting machine for vegetable leather - 10' x 10'
18. Oil wheel (drum) - 15' x 10'
19. Drying cabinet (tunnel dryer) 20' x 50'
20. Tables for hand slickering - 20' x 10'
21. Staking wheel, 3 nos. - 15' x 10'
22. Buffing machines, 3 nos. - 15' x 10'
23. Test room (laboratory) - 15' x 15'
24. Blue chrome store room, packing section - 100' x 40'
25. Assortment room for vegetable tanned crust, 30' x 40'
26. Warehouse for packed leathers, blue and vegetable crust - 40' x 40'
27. Work shop - 40' x 40'
28. Passages - 6' wide
29.
30. Wool cleaning section - 25' x 25'
31. Boiler house - 30' x 20'
32. Transformer shed - 30' x 25'
33. Pump house - 15' x 10'
34. Office - 30' x 15', 30' x 40'
35. Cloakroom - 30' x 25'
36. Canteen - 30' x 30'
37. Tannery effluent treatment, open tanks, 6 nos. - 50' x 50' x 4' filter bed
38. Compound wall

Annex II

SPECIMEN CONTRACT FORM

OFFICIAL SOLD C.I.F. CONTRACT FORM

CHROME TANNED LEATHER (INCLUDING SPLITS) IN THE WET BLUE OR DRY CONDITION OR RETANNED CHROME LEATHER No.1

agreed by:
SKIN, HIDE AND LEATHER TRADERS ASSOCIATION LIMITED
[illegible] LEATHER FEDERATION

Contract No.	Date

Parties

To

From

Particulars

1. We have this day sold to you on the terms and conditions of this contract:—

(a) Mark
(b) Description
(c) Quantity
(d) Quality or selection
(e) Size Range, Weight or substitution
(f) Price
(g) Cr_2O_3 content (as % of dry weight) Min. % Max. %
(h) Shipment
(i) Port of Shipment
(j) Destination
(k) Place of Arbitration
(l) Any other particulars

Quality

2. The goods to be of fair average quality of the mark and/or description. For any inferiority in quality an allowance to be made. The seller does not guarantee the goods as being fit for the purpose for which they may be required or used; neither is he responsible for latent defects appearing after the goods are put into work.

Analysis

3. Goods required to conform with a chromic oxide (Cr_2O_3) content or other chemical specification stated in Clause 1 shall be deemed so to conform provided an analysis yields figures within the limits specified; the analysis to be carried out by an independent analyst in accordance with the Schedule hereto.

Quantity

4. Quantity understood to be 5% more or less but in the case of default this margin not to be taken into account for assessment of damages.

Shipment

5. To be shipped with all convenient speed as per bill of lading by any fully powered primarily engine-driven vessel or vessels direct and/or indirect, with or without transhipment. The on-board bill(s) of lading to be considered proof of the date(s) of shipment in the absence of conclusive evidence to the contrary. Each shipment to be considered a separate contract except as regards assortment and weights and/or measurement. In the case of a contract for different grades at a round price, seller shall be entitled to ship the different grades by different vessels and the goods so shipped shall be invoiced at a price in proportion to their grade. Failing amicable agreement, such price to be fixed by arbitration at the joint expense of buyer and seller.

Declaration of Shipment

6. Declaration of shipment, stating name of vessel, to be made by airmail within seven days of sailing of the vessel and if required by cable or telex at buyer's expense.

Insurance

7. Seller to provide marine insurance policy or policies and/or certificate(s) of insurance with a British insurance company or Lloyd's underwriters or as stipulated in Clause 1 for invoice value plus 10%, subject to institute cargo clauses (all risks), institute war clauses and institute strikes, riots and civil commotion clauses. Any cost of war risk cover in excess of 1% to be for buyer's account. Any part shipment differing from the contract assortment at a round price to be covered at their relative values plus 10%.

Documents

8. Documents to consist of invoice, specification, full set of on-board bill(s) of lading or satisfactory guarantee for missing copies, and/or ship's delivery order(s) (the latter to be countersigned by banker, shipbroker, captain or mate if so required), policy or policies and/or certificates of insurance. If the goods, at time of shipment, are entitled to free entry into or preferential duty in the United Kingdom, the documents to include a Commonwealth Preference Certificate or Certificate of Origin as appropriate and in the form valid at the time of shipment. Any other certificate(s) required by buyer shall be supplied (if obtainable) at buyer's expense. The documents travel at seller's risk until presented.

Payment

9. Payment shall be made by nett cash against documents on or (at buyer's option) before arrival of the vessel, but in no case later than 90 days after the date of the bill of lading. Should the vessel be officially reported lost, payment becomes due on first presentation of documents.

Weight or Measurement

10. When landed weights are material the goods must be weighed at buyer's expense by public wharfinger, dock official or other officially appointed weighter at port of destination named in this contract and in the presence of a representative of the seller should the latter so desire. Official weight notes to be supplied by buyer within thirty days from arrival of vessel. Any conversion of weights to be on the basis of 1,016 kilos to 2,240 lbs. English. In the case of goods sold by measurement the buyer shall be entitled, at his expense, to have the measurement officially checked by one of the following, namely the National Leathersellers College, the Northampton College of Technology or (for dry materials only) the London Chamber of Commerce, whose certificate of measurement shall be final. The following procedure shall be observed: A minimum sample of 5% of the total, or less by mutual agreement, shall be drawn from original bales or cases (if required in the presence of a representative of the seller) and shall be measured by pinwheel machine if appropriate. Wet materials shall be soaked back for a minimum period of two hours and shall be laid flat before measurement by arcameter. The final invoice shall be adjusted pro rata in accordance with the certificate.

Claims

11. No claims for quality, tanning, condition or chemical analysis shall be valid unless notified and confirmed in writing by buyer to seller within twenty-eight days from the last day of landing of the goods at the port of destination. The landing account or wharfinger's certificate shall be evidence of the date of landing.

Rejection

12. In the event of an allowance for inferiority to contract warranty, other than on chemical specification, for which seller is liable and which amounts to or exceeds 10% of the contract price, the buyer to have the option either of taking the goods with the allowance or of rejecting them without prejudicing his rights under the contract. If the chromic oxide content or other chemical specification mentioned in Clause 1 is outside the stated limit or limits, the buyer to have the option either of taking the goods with a mutually agreed allowance, or of rejecting them without prejudicing his rights under the contract.

Export Duty

13. In the event of any export duty being levied additional to that already in force at the time of making the contract, both buyer and seller shall have the right to cancel the contract, unless within 14 days of the announcement of the levy, either of them agrees to pay the duty or unless some other arrangement can be arrived at amicably.

Default

14. In case of default by either party, the defaulter shall make good the loss (if any) on demand, on the basis of the market value of the goods on the seventh day after the last day allowed for shipment, unless the default is declared in writing, by telegraph or telex before the period of shipment has lapsed, in which case the basis of settlement shall be the market value of the goods on the seventh day after the date on which such declaration is received by the other party. The damages shall be limited to the difference between the contract price and the market value. In case it is impossible to ascertain the market value of the goods, the basis of settlement shall be the market value of goods comparable in quality and selection with those sold. If the parties fail to agree on the market value, the case shall be submitted to arbitration.

Force Majeure

15. If shipment within contract period be prevented by Act of God, strikes, lockouts, labour disturbances, trade disputes, war, Government action, riot, civil commotion, fires, floods or epidemics, or other circumstances beyond the seller's control the period for shipment shall be extended for one month. Should shipment not be made within the extended time for aforementioned reasons, buyer to have the option of granting a further final extension (not exceeding two months) or of cancelling the contract; such option to be declared within seven days of receiving written notice from seller. Any request for extended shipment must be made promptly and, if required, the seller must furnish proof to justify his request.

Arbitration

16. Any dispute arising out of this contract shall, if possible, be settled by private treaty, failing which it shall be referred to arbitration according to the custom of the trade but such prior settlement to be without prejudice to either buyer or seller. A decision shall be appointed within twenty-one days of notification of arbitration. Should buyer or seller fail to appoint an arbitrator within such period an arbitrator shall be appointed by the British Leather Manufacturers in the case of the buyer and by the Hide, Skin and Leather Trades Association Limited in the case of the seller. The arbitration shall be held on neutral premises or collected unopened bales or cases except where a particular grade is represented by one bale or case. Before entering upon the arbitration the arbitrators shall agree upon an umpire. The decision of arbitrators, or umpire, shall be final and binding on all concerned. For the purpose of arbitration in this contract, arbitrators and umpire shall be persons recommended in the trade and, in the case of supply, to the type of goods. Unless the arbitrators determine otherwise payment(s) under award(s) are due immediately.

Bankruptcy

17. If either party shall suspend payment of his debts or commit an act of bankruptcy, the contract shall forthwith be cleared, either at the market price then current for similar goods or, at the option of the other party, at a price to be ascertained by arbitration or in such manner and the difference between the contract price and the closing price shall be the measure of damages payable or receivable under this contract.

Law of Contract

18. This contract shall be governed by English Law.

SCHEDULE

Analysis of goods for discount under contract or other standard specification.

(1) Samples shall be drawn from unopened bales or cases in the presence of buyer and seller or their representative(s).

(2) Samples thus taken at time of discharge at public wharf or destination shall be acceptable for arbitration purposes.

(3) The buyer may select the bales or cases from which the samples shall be drawn.

(4) Samples shall be taken from a minimum of one bale or case out of every five or part thereof, on the following basis:—

*Number of *units per bale or case*	*Number of **samples per bale or case*
up to 25	6
26 to 50	8
51 to 100	10
over 100	12

*Unit, means skin, hide, side, split or other piece.
**Each sample to be a minimum 3 sq. inch.

(5) If shall be agreed before the bales or cases are opened the method in which units are taken for sampling (e.g. every fifth or tenth).

(6) Samples shall be taken consecutively from neck, belly and shoulder.

(7) The quantities, sufficient to be divided into three sets of samples subsequent to one by the analyst to be made, shall be drawn. One of these sets shall be retained by a public body for arbitration purposes, if subsequently required.

(8) The buyer shall pay the charges for drawing the samples.

(9) The analysis shall be carried out in accordance with the official methods of analysis of the Society of Leather Trades Chemists.

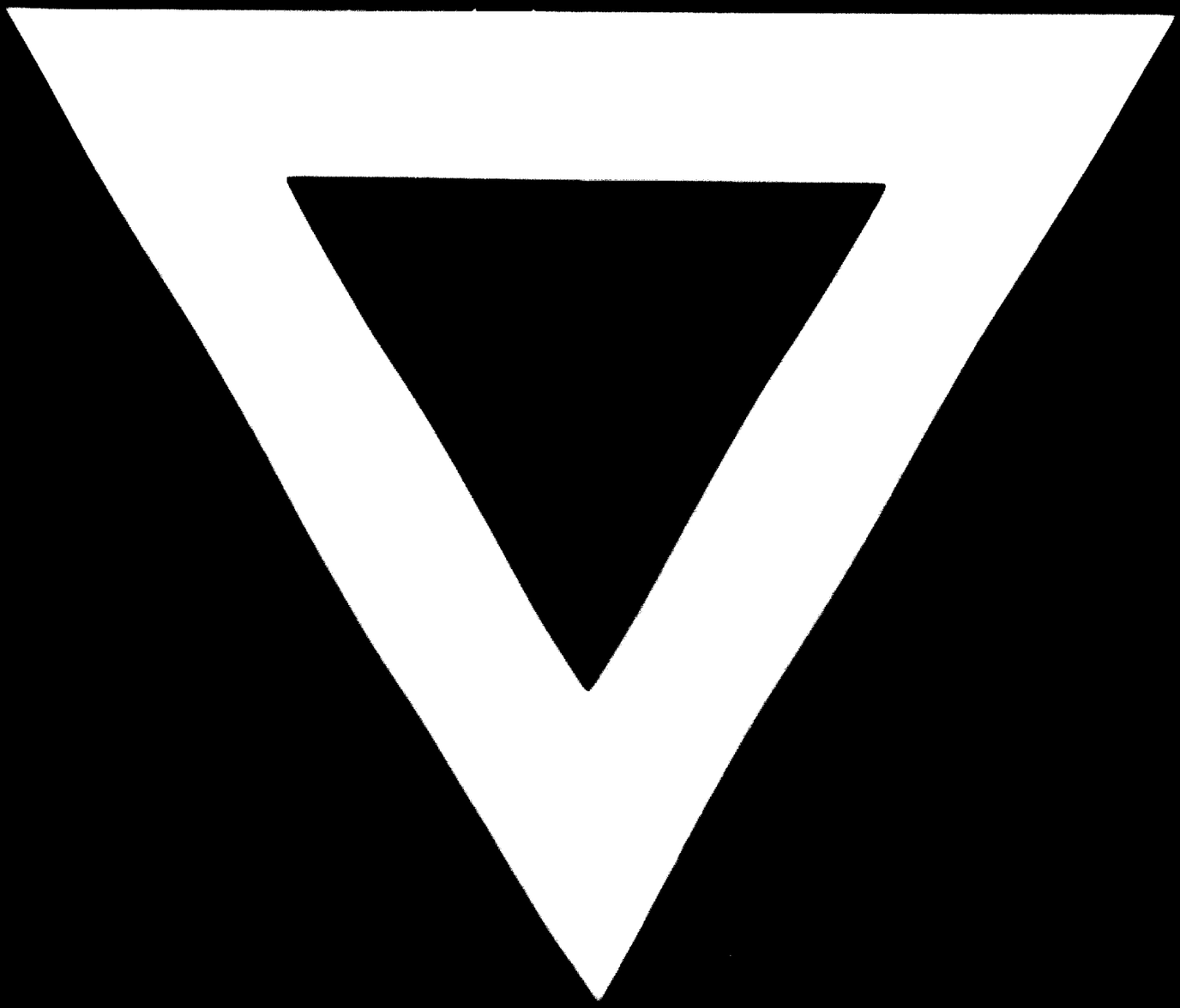
For and on behalf of the seller:

SIGNED

We hereby confirm contract as above
For and on behalf of the buyer:

[redacted]

SIGNED



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