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LEATHER AND LEATHER PRODUCTS DEVELOPMENT

DP/ETH/78/001

ETHIOPIA

Technical report: Study on the development of an industry for tanning materials and chemicals

Prepared for the Government of Ethiopia
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of P. Hanumanta Rao,
consultant on tannery chemical industries

United Nations Industrial Development Organization
Vienna

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Explanatory notes

The monetary unit in Ethiopia is the birr. During the period covered by the report the value of the birr in relation to the United States dollar was $US 1 = birr 2.0545.

A slash between dates (e.g. 1970/71) indicates a crop year, financial year or academic year.

Totals may not add precisely because of rounding.

The following abbreviations of organizations have been used in this report:

FAO	Food and Agriculture Organization of the United Nations
ILO	International Labour Organisation
NLSC	National Leather and Shoe Corporation

Sq.ft. A square foot, equivalent to 0.0929 m^2, is the common unit used in leather production.

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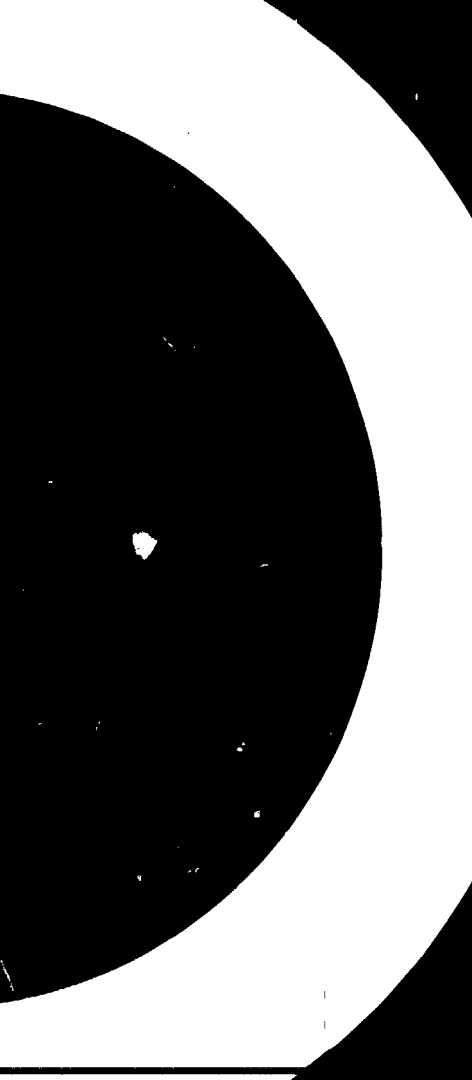
ABSTRACT

The three-year project, "Leather and leather products development" (DP/ETH/78/001) was begun for the Government of Ethiopia by the United Nations Industrial Development Organization (UNIDO), acting as executing agency for the United Nations Development Programme (UNDP). The counterpart agency in Ethiopia is the National Leather and Shoe Corporation (NLSC) of the Ministry of Industry. Within this project, a consultant on tannery chemical industries worked with NLSC for one and a half months from 15 March to the end of April 1981 to study the current and prospective situation of the leather-tanning industry and assesses the chemical requirements of the industry up to 1990. The consultant concluded that it would be possible and economically feasible to produce vegetable-tanning extracts and fat liquors to replace the full range of these chemicals imported at present. Steps should be taken immediately to ensure an adequate supply of raw materials by planting tannin-bearing trees. The production of other tannery chemicals might become feasible if all available hides and skins were processed into finished leather in Ethiopia. Even then it would depend on a sufficiently large demand and on the availability of raw materials. The situation should be reviewed at a later stage.



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INTRODUCTION

Following a request by the Government of Ethiopia for assistance in the development of the leather and leather products industry, the project "Leather and leather products development" (DP/ETH/78/001) was approved by the United Nations Development Programme (UNDP) on 24 September 1979. The United Nations Industrial Development Organization (UNIDO) was designated as executing agency in association with the Food and Agriculture Organization of the United Nations (FAO). The Government's implementing agency is the National Leather and Shoe Corporation (NLSC) of the Ministry of Industry. The project is designed to last for three years and involves the services of several long-term experts and some short-term consultants in addition to the provision of fellowships and some equipment.

Within this project, a consultant on tannery chemical industries was recruited for one and a half months to work in co-operation with NLSC to study the possibility of developing local production of chemicals for the tanning industry.

The consultant's mission to Addis Ababa lasted from mid-March to the end of April 1981.

Project background

The livestock population of Ethiopia is estimated at 26 million cattle and 43 million sheep and goats. Using an estimated annual slaughtering rate of 10% for cattle and 35% for sheep and goats, the estimated annual production is 2.6 million hides and 15 million sheep and goat skins. However, the actual supply of hides and skins reaching the market in 1980 was only 819,000 hides and 11 million sheep and goat skins. The rest, about 1.8 million hides and 4 million skins, are partly used in rural areas and partly unaccounted for, including those smuggled to neighbouring countries as livestock or as hides and skins. During the fiscal year of 1980/81, the quantities of hides and skins industrially processed within Ethiopia were 335,000 hides and 4,814,000 skins, representing 23.5% and 35.3% respectively of the actual supply.

The overall objective of the project DP/ETH/78/001 is to develop the entire leather and leather-products industry including the improvement of the collection of raw materials, processing technologies in the tanneries, footwear and other leather-products factories, to develop a nucleus of trained manpower and experienced managerial staff, and to establish marketing

strategies for the local market and for export.

Objective of the present mission

Within the framework of the overall development of leather and leather products in Ethiopia, the Government requested a consultant on tannery chemical industries to carry out a comprehensive study and prepare a master plan for the development of domestic tanning materials and related chemicals.

The objectives were to assess the potential of this industry based on current levels of chemical consumption and taking into account future requirements in line with the expected availability of raw hides and skins in the country and the needs of the other sectors of the economy; to initiate basic steps towards the domestic manufacture of tannery chemicals; and to follow up their subsequent development in a planned and organized manner.

Details of the main duties of the consultant are given in the job description in annex I. A list of organizations visited and sources of information consulted during the study period is given in annex II.

CONCLUSIONS AND RECOMMENDATIONS

The conclusions and recommendations (numbered) are grouped below according to topic.

Chemicals suitable for production

Of the major chemicals used in tanneries, only two could feasibly be produced in Ethiopia at present. These are vegetable-tanning extracts and fat liquors. The raw materials for these are potentially available in the country, and these two types of chemicals alone will account for more than 50 % of the tanner. chemicals required in 1990.

1. Steps should be taken to start production of vegetable-tanning extracts and fat liquors.

2. A survey should be made as soon as possible of tannin-bearing plants in the country and a minimum of 232,000 tannin-bearing trees should be planted to obtain the necessary supply of vegetable tannin for production of extracts.

3. The use of animal by-products from the slaughterhouses, particularly neatsfoot oil from shin-bones, should be developed, both as such and as a raw material for fat-liquor production.

Other chemicals

The other major tannery chemicals cannot be manufactured locally at present as requirements are too small for economic production and the raw materials are not available. It is better to spend a proportion of the foreign-exchange earnings from the export of finished leather to pay for the import of these chemicals for the time being.

Some auxiliaries (casein solution and turkey red oil) could be produced centrally for supply to the tanneries and some chemicals used in the footwear industry (shoe stains, edge and sole-finishing waxes and softening solutions) could also be produced on a small scale. This would give experience to the chemists and subsequently some of the simpler shoe adhesives could also be produced.

4. For both auxiliaries and footwear chemicals, the necessary expertise has to be acquired and facilities for regular quality control created. The services of a full-time chemist or technologist will be necessary.

Setting up production

The capital investment required to set up production plants for vegetable-tanning extracts and fat liquors is estimated at $US 950,000

Training is very important as tannery chemicals are a very specialized field. Lack of technically-qualified personnel could be the most serious impediment to the development of production.

5. The production units should be located in Addis Ababa or Asmara near the leather and footwear production units where transport facilities are adequate.

6. At least four people with appropriate qualifications in chemistry should be sent for specialized training. Negotiations should be started to arrange this, preferably in another developing country.

Future prospects

The requirement for chemicals will increase as a higher proportion of hides and skins are processed to the finished state in Ethiopia. Even in 1990, it is estimated that only 18.4% of hides and 3.5% of skins will be processed up to finishing. If all available hides and skins were fully processed, the quantities of chemicals required would be five times greater for hides and thirty times greater for skins than at present.

At that stage, it may become feasible (depending also on the raw-material situation) to consider producing some of the other tannery chemicals. The capacity of the vegetable-tanning-extract and fat-liquor plants can anyway be expanded.

7. The situation should be reviewed again as and when more hides and skins are processed to the finished stage.

I. BACKGROUND AND PRESENT SITUATION OF THE LEATHER INDUSTRY IN ETHIOPIA

A. Availability of hides and skins

The livestock population in Ethiopia and the country's production of hides and skins are the largest in the African continent. The offtake rate is around 10% for hides and 35% for skins. Quite a big percentage of hides and skins on this offtake basis is not accounted for. They are either not collected and processed or they are smuggled over the borders of the country in some form or other. The increase in the livestock population has been taken as 4% per year.

Using the offtake rates given above, the following figures show the present livestock population and the supply of hides and skins and their projected amounts for 1985 and 1990:

Livestock population

(Millions)

	1981	1985	1990
Cattle	26	30	37
Sheep and goats	43	50	61

Availability of hides and skins

(Million pieces)

	1981	1985	1990
Cattle hides	2.6	3.0	3.7
Sheep and goat skins	15	18	21

It is expected that, in 1990, there will be a total of about 25 million hides and skins available for processing.

B. Processing of hides and skins

There are eight organized tanneries in Ethiopia, all under the administration of the NLSC. In 1980/81, they processed a total of 335,000 hides and 4,814,000 skins to various stages. Hides and skins processed to the pickled, wet-blue and crust stages are exported. Only a relatively small proportion of hides and skins are processed to the finished stage.

Table 1 gives the details of hides and skins actually processed in 1980/81 and the amount by which this falls short of the total hides and skins available. In the next three tables, the shortfall has been kept constant throughout 1981, 1985 and 1990 in spite of increased availability of hides and skins. Percentages are based on the total of hides and skins finished in the tanneries or exported at an intermediate stage.

Table 1. Processing and export of hides and skins in 1980/81

Type	Finished in tanneries		Exported		Total	Shortfall
	(thousand pieces)	(%)	(thousand pieces)	(%)	(thousand pieces)	(thousand pieces)
Cattle	335	23.5	1 093	76.5	1 428	1 172
Sheep and goat	4 814	35.3	8 812	64.7	13 626	1 074

In 1985, it is expected that more hides and skins will be processed in the tanneries as shown in table 2.

Table 2. Estimated processing and export of hides and skins in 1985

Type	Finished in tanneries		Exported		Total	Shortfall
	(thousand pieces)	(%)	(thousand pieces)	(%)	(thousand pieces)	(thousand pieces)
Cattle	549	29.4	1 321	70.6	1 870	1 172
Sheep and goat	7 191	43.5	9 325	56.5	16 516	1 074

It is planned to bring some new tanneries into production by 1990. The projected combined capacity of all the tanneries, old and new, are given in table 3.

Table 3. Estimated processing and export of hides and skins in 1990

Type of skin	Finished in tanneries (thousand pieces)	(%)	Exported (thousand pieces)	(%)	Total (thousand pieces)	Shortfall (thousand pieces)
Cattle	1 400	55	1 200	45	2 600	1 172
Sheep and goat	14 000	69	6 300	31	20 300	1 074

It is therefore expected that in 1990, of the estimated 25 million available hides and skins, 22.8 million will enter the tanneries, of which 15.4 million will be processed to the finished stage.

C. Exploitation of available hides and skins

As mentioned earlier, only a small proportion of the total available hides and skins is processed into finished leather. The rest of the input into the tanneries is exported after processing up to the wet-blue and crust stages in the case of hides, and pickled, wet-blue or crust in the case of skins.

The following figures give the percentages of the total estimated offtake of hides and skins entering the tanneries in 1981, 1985 and 1990 for processing to all stages including pickled, wet-blue, crust and finished:

	1931	1985	1990
Cattle hides	15.5	18.1	37.9
Sheep and goat skins	37.0	41.0	65.6

It is important to know what proportion of these will be fully processed into finished leather. The estimated figures are (percentages):

	1981	1985	1990
Cattle hides	9.7	11.7	18.4
Sheep and goat skins	4.2	4.9	3.5

The percentages of the total offtake processed up to pickled, wet-blue and crust stages in the case of skins and up to wet-blue and crust stages in case of hides are estimated as follows:

	1981	1985	1990
Cattle hides	5.3	6.4	19.5
Sheep and goat skins	32.8	36.1	62.1

The effective economic exploitation of hides and skins can be taken as follows for each stage of the processing:

Pickled	20%
Wet blue	33%
Crust	66%
Finished	100%

Only hides and skins processed completely up to the finished stage yield the full economic value. With hides and skins exported at intermediate stages, a part of the economic value is lost to the country. Using the above percentages, the effective economic exploitation of hides and skins in Ethiopia is much lower, as shown in table 4 in the next page.

The inputs into the tanneries in 1980/81 were:

	Pieces (thousands)	Approximate area (thousand square feet)
Hides	335	8 040
Skins	4 814	21 663

These inputs have been further analysed to show the amounts processed to various stages and this is shown in table 4. Here the numbers of hides and skins have been converted into areas of finished leather based on 24 square feet per hide and 4.5 square feet per skin for convenience of comparison. The effective exploitation is given as a percentage of the total fully-processed value.

Table 4. Area processed to various stages and effective exploitation in 1981

Process stage	Hides			Skins		
	Area (thousand sq. ft.)	Proportion of total (%)	Effective exploitation (%)	Area (thousand sq. ft.)	Proportion of total (%)	Effective exploitation (%)
Pickled	-	-	-	9 796	44.9	9.0
Wet blue	882	11.5	3.8	7 258	33.3	11.0
Crust	728	9.5	3	2 048	9.4	6.2
Finished	6 040	79.0	79.0	2 720	12.5	12.5
Total	7 650	100.0	89.1	21 822	100.0	38.7

The total area of hide processed in these figures represents 318,750 pieces, or 16,250 pieces less than the input of hides for 1980/81. Part of these might have been processed into sole leather. There is also the likelihood that the factor of 24 square feet per hide taken for the calculation is not correct. The discrepancies in the case of skins is not very big and is not gone into in detail.

However, if we use the same factors to make a calculation for 1990 (which can anyway only be very approximate), we get the following figures for estimated input into the tanneries:

	Pieces (thousands)	Area (thousand square feet)
Hides	1 400	34 000
Skins	14 000	63 000

and the break up of the above into the various stages of processing is as follows:

Table 5. Area processed to various stages in 1990
(Thousand square feet)

Process stage	Hides	Skins	Total
Pickled	-	28 000	28 000
Wet blue	3 900	21 000	25 000
Crust	3 200	6 000	9 000
Finished	27 000	7 900	34 000

The chemicals required for processing the hides and skins in the tanneries are calculated and details given in the next chapter.

II. REQUIREMENT OF CHEMICALS FOR THE TANNERIES

The requirement of chemicals for the leather industry depends on the number of hides and skins processed in the tanneries in the country. These amounts have been estimated up to 1990 in chapter I and form the basis of the calculations in this chapter. Another factor is that the recipes used in different tanneries vary widely but for calculating the chemicals needed, average or standard recipes have been used. For convenience, the requirements have been given as kilogram per million square feet. The processes used are for corrected-grain upper leather and for sole leather (quick process).

A. Chemicals required for upper-leather production

Soaking to pickling	Kilogram per million square feet
Soaking agent	500
Preservative	500
Sodium sulphide concentrate (fused)	15 000
Sodium sulphahydrate powder	2 500
Slaked lime	12 500
$NH_4Cl/(NH_4)_2SO_4$	7 500
Bating agent	1 500
Salt	40 000
H_2SO_4	5 000
Formic acid	1 000
Pickling to chrome tanning	
Chrome tan salt (33% basic)	44 000
Basic aluminium sulphate	11 000
Sodium bicarbonate	5 500
Neutralization, retanning and fat liquoring	
Syntan (neutralizing) or	2 000
$NaHCO_3$	2 000
Syntan (retanning)	4 000
Mimosa powder	4 000
Quebracho powder	6 000
Sulphited fish oil	1 000
Sulphited sperm oil	5 000

	Kilogram per million square feet
Cationic oil	2 000
Synthetic fat liquor	1 000
Formic acid	600
Finishing	
Impregnating binder	2 350
Penetrator	4 650
Black pigment	3 000
Modified protein powder	555
Acrylic binder	4 500
Cationic grounding agent	370
Wax emulsion	235
Formaldehyde (30%)	235
Lacquer emulsion	930

B. Chemicals required for sole-leather production

	Per cent on pelt weight
Conditioning agent (acidic)	5.0
Bisulphite	0.2
Formic acid	1.6
Various syntans	10.7
Fat liquor	1.0
Mimosa	20.0
Quebracho	8.0
Valonia	4.0
Magnesium sulphate	3.0
Olinor K	1.0
Molasses	1.5
Fixing agent	1.0

Of the chemicals given for sole leather, 32% (varying from 30 - 35%) are vegetable-tanning extracts. For calculating total quantities, the figure of 30% has been used. Syntans used amount to 10.7% but the figure of 10% has been taken for calculation. Fat liquors amount to 2%.

C. Total chemicals required

It is estimated that the amount of hides and skins that will be processed in 1990 will amount to 34 million square feet of finished leather for uppers and 9 million square feet of crust. (Crust leather sometimes requires different chemicals and proportions but is here calculated as for finished leather.) In addition, the estimated production of sole leather will be 437 tons (946 tons pelt weight).

The quantities of the six major items which would be required in 1990 for this amount of leather are as follows:

	Upper	Sole (tons)	Total
Vegetable-tanning extracts	435	284	719
Fat liquors	392	19	411
Syntans	261	95	356
Acrylic binders	196	0	196
Pigments	131	0	131
Lacquers (emulsions)	40	0	40

Assuming that some syntans and acrylic binders would still have to be imported, table 6 gives the required production capacity for these selected chemicals in 1990 and their approximate value based on predicted prices in birr per kilogram.

In principle, all these chemicals could be produced. However, it has been noted during discussions with personnel of the organizations visited and information available from the NLSC that not only are all the chemicals for processing leather, with the exception of salt and lime, imported at present but the raw materials for the production of these items are not at the moment available in Ethiopia.

In the near future raw materials for two of the items, i.e. vegetable-tanning extracts and fat liquors, could be made available by taking suitable action. Such action would include establishing wattle plantations, developing fish-oil production and extraction of neatsfoot oil.

Table 6. Production and estimated value of selected chemicals in 1990

Chemicals	Price (birr per kilogram)	Production (tons)	Value (thousands of birr)
Vegetable-tanning extracts	2.00	800	1 600
Fat liquors	4.5	500	2 250
Syntans	4.00	200	800
Binders	4.5	150	675
Pigments	8.00	150	1 200
Lacquers and lacquer emulsion	4.5	60	270
Total chemicals			6 795
Total vegetable-tanning extracts and fat liquors			3 850 (56.7% of value)

As two of these items (vegetable-tanning extracts and fat liquors) together account for over 50 % of the value of the major chemicals required and as the raw materials for them could be made available locally, it is recommended that production of these two types of chemicals should be started by 1990. The next chapter discusses production of these two chemical types in detail.

The other chemicals listed are not dealt with in greater detail since their raw materials are not readily available and this situation is not likely to improve in the near future. Also, the amounts required would not justify a production unit of an economic size.

Requirements for all chemicals will, of course, increase if and when it becomes possible to process all hides and skins into finished leather. Annex III gives the amount of chemicals which would be needed under these circumstances. If the total requirement for chemicals becomes considerable, it might then be worthwhile to consider producing some of the other items and the situation should be reviewed at that stage.

D. Production requirements

The buildings, machinery, equipment and personnel required to set up production plants for vegetable tanning extracts and fat liquors are detailed in annex IV. Further information on chemical supplies, standards and standardization, and import policy is given in annexes V-VII.

III. CHEMICALS SELECTED FOR STUDY

A. Vegetable-tanning extracts

Vegetable-tanning extracts are widely employed in the manufacture of leather as tanning and retanning agents and as mordanting and filling agents in the final stage of leather processing. In addition, myrobalan extract (spray dried) is useful as a water-softening compound in the internal treatment of boiler-feed water.

There are two classes of tannins, condensed or catechol tannins such as wattle, avaram, babul and other barks, and hydrolysable or pyrogallol tannins such as myrobalans, divi-divi pods etc. Of these, the condensed tannins are chiefly responsible for the main tanning properties while hydrolysable tannins yield a leather mellow in feel and brighter in colour. Vegetable tannins are of plant origin and are obtained from aqueous infusions of barks, roots, fruits, leaves and sometimes even hard wood. Tannins occur normally in plants as part of their protective metabolism and can be obtained from trees of 7 to 10 years of age. Being natural products, they are seldom found in isolation but are usually mixed with gums, waxes, resins, starches, etc. which are non-tannins. Tannins are those which convert hide protein into leather.

Large quantities of vegetable-tanning materials and extracts are used in the production of sole leather. They are also used in the production of corrected-grain upper leather; hence, they will be required even if sole-leather production goes down as is the present trend in world production.

If a survey of tannin-bearing plants in the country is carried out in the near future and adequate thought given to planting potential tannin-bearing plants, the country could be largely independent of imports of tannin extracts. It is hoped that the necessary action will be taken soon. The climate seems to be suitable for this because the most important tannin-bearing plant, Mimosa, is grown widely on the African continent.

Annex VIII forecasts future vegetable-tannin requirements and indicates how many trees ought to be planted to yield an adequate supply.

Process (extraction technology)

At present, vegetable-tanning extracts are imported in solid or spray-dried

forms. There is no need for Ethiopia to go directly into the production of solid or spray-dried extracts as the technology is more complicated and the liquid concentrate is good enough. The advantage of using the solid or spray-dried extract over the liquid extract is not so much in the quality of the leather produced, but in the ease of packing and transporting the extract. However, liquid extract can be transported to the tanneries around and near Addis Ababa in plastic containers without much difficulty.

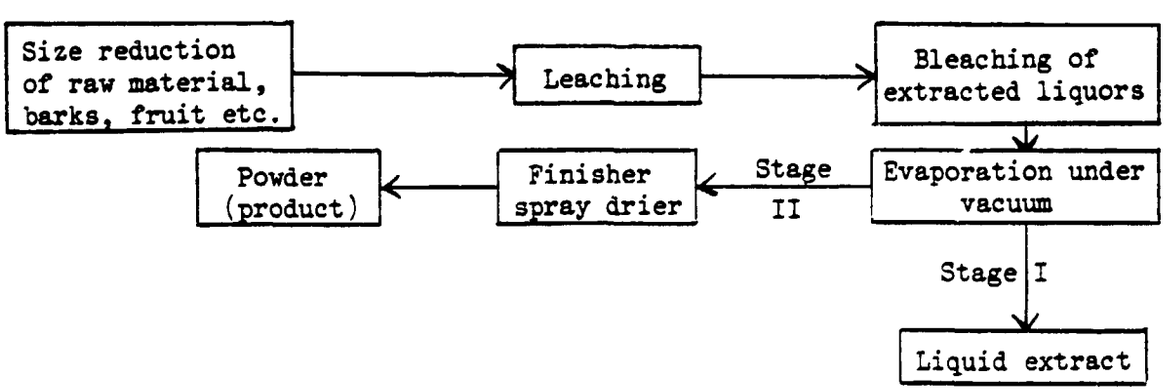
The extraction technology involves the following steps and equipment in addition to the workforce:

1. Cutting the trees (cutting tools)
2. Peeling the bark (peeling tools)
3. Transporting the bark to dry in shade (carts, shaded area)
4. Grinding the bark (crushers)
5. Loading of powdered bark into extractor
6. Extraction (extracting tanks made of copper or stainless-steel sheets, pumps, boiler for steam generation
7. Concentration (copper or stainless-steel tanks, vacuum pumps)

At the concentration stage, the extract cannot just be heated to evaporate the water. The tannin decomposes and loses its tanning property if heated above 80°C. Because of this, the concentration is carried out under reduced pressure at a temperature not higher than 50°C.

Some more of the extract may be required for boiler-scale prevention and as a mud thinner. This will be in addition to the above tanning requirements.

Figure I. Process flow sheet for vegetable-tanning extracts



B. Fat liquors

These are compositions consisting of emulsifiers or wetting agents and raw or modified vegetable, marine, animal or mineral oils. These are incorporated in leathers after tanning, while still in wet condition, in the form of dispersion or emulsion. Important sources of raw material are animal by-products from slaughterhouses, in particular neatsfoot oil from shin-bones (see annex IX).

Fat liquors are classified according to their fibre charge as anionic (e.g. soaps, sulphated and sulfonated oils, sulphited oils and esters), cationic (e.g. quarternary ammonium salts of fatty acids) or amphoteric (which has both positive and negative charges built up in the same molecule). Anionic fat liquors are best suited to chrome-tanned leather while cationic liquors are suited to vegetable-tanned and retanned leathers. Amphoteric fat liquors are generally used for semi-chrome and combination-tanned leathers for special effects.

Sulphated and sulphonated oils are obtained by reacting the oils or esters with sulphuric acid under controlled temperature conditions and thorough mixing followed by washing with salt solutions to remove unreacted acid. The sulpho-oils are then neutralized with alkalies to pH 6.5-7.5.

Sulphited oils are generally produced by passing air through a mixture of oil and bisulphite solution under controlled temperature conditions and by adjusting the pH.

Cationic fat liquors are obtained by reacting the oils with triethanolamine at an elevated temperature followed by quarternizing the nitrogen with one of the lewis acids.

Process technology

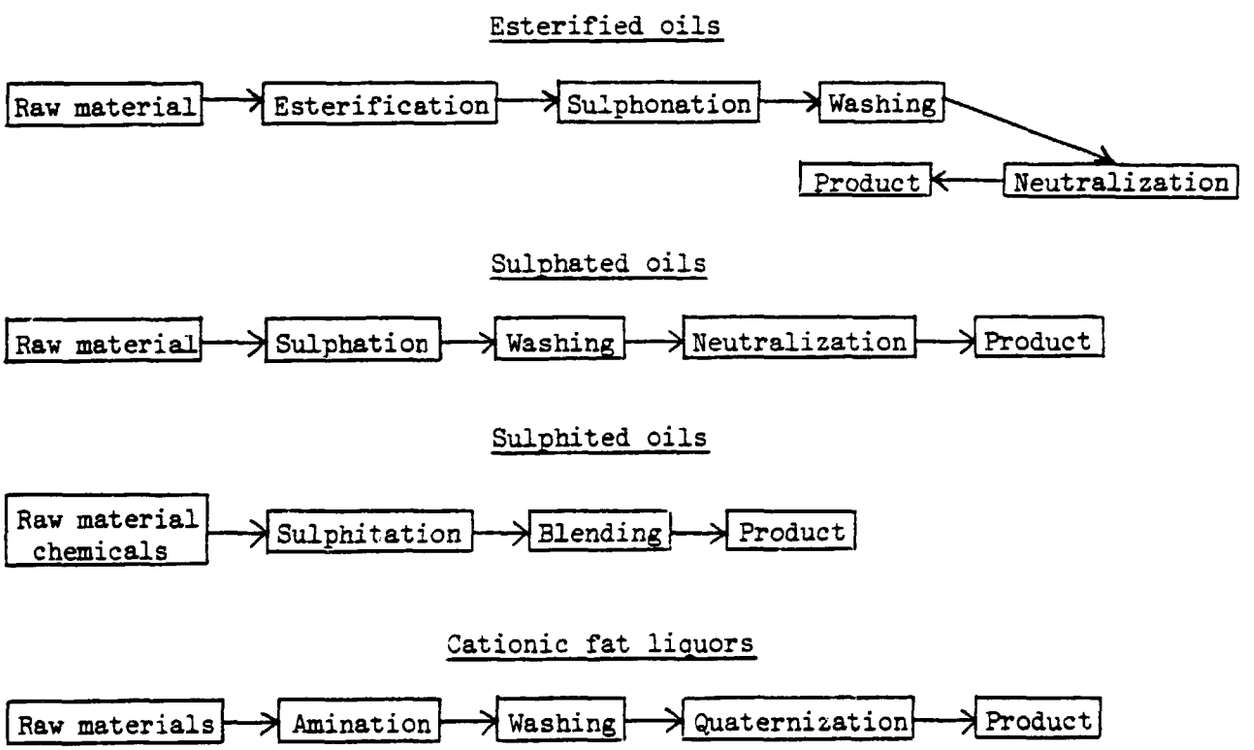
Interesterified. Oils, fats or fatty acids are interesterified with polyhydric alcohols or oxyethylene condensates and further subjected to sulphonation under appropriate conditions. The treated oil is washed with brine to remove excess acid and the sulfo-oil fraction is neutralized with sodium hydroxide solution to the required pH.

Sulphated (anionic). The oils can also be simply treated with sulphuric acid under controlled conditions so that sulphated oils are obtained. These are washed with brine and neutralized to the required pH as above.

Sulphited oil (anionic). The oils or fats are reacted with inorganic sulphates or sulphites in the presence of oxygen and with stirring for 10-12 hours. On settling, a clean, transparent sulphited oil is produced.

Cationic (fat liquors). Oils, fats or fatty acids are treated with quarternary ammonium compounds at high temperatures with mechanical agitation. The base material thus formed is washed with brine and quarternized with a suitable acid to the required pH. Synthetic fat liquors (sulphorchlorinated paraffins) are left out for the present.

Figure II. Process flow sheet for fat liquors



IV. TRAINING

A. Specialized training in tannery chemicals

Tanning materials and chemicals play an important role in the production of leather. The tanning agents are responsible for transforming putrescible hide substance into leather. Tanning agents, however, must be supplemented by many chemicals and the leather industry uses a wider range of industrial chemicals than any other manufacturing industry. Many of these chemicals are standard market products, but quite a few are specially formulated and produced for the leather industry. This is particularly true of finishing materials which are developed exclusively for leather production and hence special training is needed to deal with them either for development or production.

The best investment a country can make, and this applies specially to a developing country like Ethiopia, is in human resources and skills. Many developed countries offer aid in the form of capital, technology, experts and training facilities. There is a need here for persons with a good background in chemistry to be trained in the field of tanning chemicals and auxiliaries, their production and development.

The lack of technical personnel and skills could constitute a significant bottle neck to the implementation and operation of the project. Extensive training programmes in this special field should therefore be undertaken.

It may be more appropriate to arrange the training in a developing country where conditions would be comparable.

This training should include:

(a) Basic chemical concepts relevant to the field of chemicals and auxiliaries used in the leather industry;

(b) Development of such products in laboratories and pilot plants;

(c) Operation of commercial-scale units in this field to get the right type of product;

(d) Detailed knowledge of equipment and machinery used for the purpose so as to be able to look after routine maintenance and do minor repairs to the plant.

It should be emphasized that it is pointless to train personnel to use sophisticated gadgets that are not likely to be available (and most often out of place) in developing countries. Hence, staff should be trained to

work with hand tools or modern machinery so that they can use their skills in small- or large-scale industry as required.

It should be noted that, under favourable conditions, one experienced and highly-qualified expert can establish and train a modest-sized production force within two years. The training of a small number of managerial and technical personnel is therefore the fundamental necessity.

B. Qualifications and experience for managerial and supervisory personnel

Managerial personnel. (Master's degree in chemistry with knowledge and experience in the field of leather and in the chemical industry.) One or two persons should be sent either to The Federal Republic of Germany (Technische Hochschule, Darmstadt) or to India (Central Leather Research Institute, Madras) for a specially-oriented course on leather chemicals and auxiliaries.

Supervisory personnel. (Bachelor's degree in chemistry with knowledge and experience in leather production or the chemical industry.) Three or four persons should be trained, two in wet-process chemicals and auxiliaries (preservatives for hides and skins, soaking to fat-liquoring and paste-drying) and two in finishing chemicals and auxiliaries.

These persons can train a skilled work-force after their return from their own training. The managerial and supervisory personnel can also study the details of the equipment required and its operation so that suitable equipment can be ordered in time.

Annex I

JOB DESCRIPTION

DP/ETH/78/001/11-09/B/31.7.D

Post title: Consultant on tannery chemical industries

Duration: One and a half months

Date required: As soon as possible

Duty station: Addis Ababa, with possibility of travel within the country

Purpose of project: To undertake a study in which a masterplan for the development of tanning-materials industry in the country would be drawn up. It basically involves making an appraisal of the country's resources and development potential for medium- and long-range perspective plans and establishment of priorities among feasible programmes.

Duties: The consultant will work in co-operation with the National Leather and Shoe Corporation and, under the administration of the International Team Leader, is specifically expected to:

1. Carry out a study which is expected to pay particular attention to:

(a) The assessment of tanning-material requirements of the leather industry and other branches of the economy;

(b) The evaluation of domestic availability of raw materials for these products and of the possibility of making them locally available;

(c) Energy and other infrastructural needs;

(d) Manpower requirement by skill;

(e) Identifying projects for manufacturing tanning materials from local raw materials and/or imported semi-finished materials;

(f) Determination of potential locations and sizes for the identified projects;

(g) Future expansion possibilities;

(h) Investment requirements in terms of local currency and foreign exchange;

(i) Establishing priorities among the identified feasible factory units and time of approximate realization;

(j) Policy and organisational measures.

The consultant will also be expected to prepare a final report, setting out the findings of the mission and recommendations to the Government on further action which might be taken.

Qualifications: Extensive experience in the leather manufacturing industry and particularly in the tannery chemical industries; experience in working in developing countries and in advising on the medium- and long-term development of tannery chemical industries.

Language: English

Background information: The livestock population in the country and the production of raw hides and skins are the largest in Africa. The livestock population stands at about 26 million heads of cattle, 24 million sheep and 18 million goats. With a national average off-take rate of about 8 per cent for cattle and 35-40 per cent for sheep and goats, annual potential supply of hides and skins in estimated to be 2 and 15 million pieces respectively.

Currently the country's annual tanning capacity is 628,000 hides and 10.8 million skins. In view of the potential availability of raw hides and skins, the existing tanning capacity could be expanded to reach about 2 million hides and 15 million skins.

Great importance is attached to fully exploiting the country's resources of raw hides and skins by processing them into finished leather. Consequently, the Government has given priority to the development of the leather and allied industries.

Apart from raw hides and skins, equally important is the availability of tanning chemicals for the development of the leather industry. However, the country is totally dependent on imports for its chemical requirements.

Currently, annual consumption of chemicals for an approximate capacity utilization rate of 40 per cent for skins and 60 per cent for hides, is in the order of 6 million birr. As utilization of existing tanning capacity increases and new capacities are brought into operation, the requirements of tanning chemicals is expected to grow substantially.

Therefore, based on current levels of chemical consumption and taking into account the perspective requirements in line with the potential availability of raw hides and skins in the country and the needs of the other sectors of the economy, basic steps leading towards the domestic manufacture of tanning chemicals have to be initiated

and their subsequent development followed up in a planned and organized manner.

In view of the above, the National Leather and Shoe Corporation proposed that a comprehensive study, expected to result in a masterplan for the development of a domestic tanning-chemicals industry, be undertaken.

Annex II

VISITS MADE DURING THE MISSION

The consultant visited the following during the period of study:

FAO experts in the Ministry of Agriculture

Ministry of Mining and Geology

National Chemical Corporation

Ethiopian Food Corporation

Cereals and seeds task force

Awash Tannery

Anbessa Shoe Factory

Slaughterhouse

Ethiopian Tannery

Modjo Tannery

The visits were useful, valuable information was obtained during the discussions and the consultant is thankful to the authorities.

Annex III

CHEMICAL REQUIREMENTS IF ALL HIDES AND SKINS ARE PROCESSED INTO FINISHED LEATHER

Taking the estimated figures of hides and skins available in 1990, the amount of leather for processing would be:

		(Million square feet)
3.7 million hides @ 24 sq.ft.	=	88.8
21.35 million skins @ 4.5 sq.ft.	=	96.1
Total	=	184.9

If this entire amount is processed into finished leather, the chemicals required will be:

	Amount (tons)	Value (thousands of birr)
Vegetable-tanning extract	1 849	3 698
Fat liquors	1 664	7 488
Syntans	1 109	4 436
Acrylic binders	832	3 744
Pigments	555	4 440
Lacquers/emulsions	172	774
Total		24 580

The requirement of chemicals will therefore be much larger and the value of the six selected chemicals alone will be 24 to 25 million birr. However, even though the quantities required are sufficient to justify an economic-size production unit, it may not be feasible to attempt local production of all the chemical items because of the sophistication of the production processes and technical services needed and because of the non-availability of raw materials.

Nevertheless, the vegetable-tanning-extract and fat-liquor plants can be expanded considerably and foreign collaboration can be entered into to obtain the advantages of technical expertise and service and expanded markets. It will be still better to have regional collaboration to increase the markets even further.

Once the technical expertise and technical-service facilities are available, the following quantities would be the minimum economic to produce and these amounts could even be produced in a pilot plant:

	(Tons per year)	
Syntans	300-350	
Acrylic binders	10- 20	Pilot plant
Pigments	10- 20	
Lacquers and lacquer emulsions	10- 20	

The situation should be reviewed after the conversion of all hides and skins into finished leather has been achieved and it is possible to consider a decision on production of further chemicals. None of the above chemicals are used in other industries. Some adaptation work would be necessary and also pilot-plant trials before commercial production could start. For this purpose, a suitable laboratory with facilities to conduct pilot-plant trials would be very useful.

Annex IV

SUMMARY OF CAPITAL INVESTMENT NEEDED FOR THE PRODUCTION OF VEGETABLE-TANNING EXTRACTS AND FAT LIQUORS

	Local currency (birr)	Foreign currency ($US)	Total ($US)
1. Land, development and buildings	840 000		420 000
2. Machinery and equipment		150 000	150 000
3. Utilities, miscellaneous items, vehicles, furniture, boiler, etc. (estimates)	100 000	250 000	300 000
4. Training of technical personnel, 4 persons for one year each (@ $20,000 per person per year)		80 000	80 000
Total	940 000	480 000	950 000

The above are all estimates and are approximate. The recurring expenditure will depend on the cost of raw materials and their storage period, the price of finished products and their storage period, salaries of staff and water, fuel and power costs.

The details of personnel (manpower) requirements are given further on.

Water and steam requirements will be as follows:

Water - 75,000 litres per day (45,000 litres for tanning extracts,
10,000 litres for fat liquors,
20,000 litres for miscellaneous purposes)

Fuel requirements will depend upon the choice of boiler.

The costs for items 1 - 4 above are broken down below.

1. Buildings

	Size (metres)	Cost (birr)
(a) Administrative building. Brick and cement construction (2 floors) (@ 600 birr per square metre)	20 x 10 x 7	120 000
(b) Raw material stores. Hollow columns and brick wall, truss with asbestos cement sheet roof (@ 450 birr per square metre)	30 x 10 x 5	135 000
(c) Tanning extract plant. Hollow columns with asbestos cement roof (@ 450 birr per square metre)	30 x 10 x 10	135 000
(d) Fat-liquor plant. Hollow columns with asbestos roof (@ 450 birr per square metre)	30 x 15 x 10	202 000
(e) Boiler house (@ 450 birr per square metre)	15 x 10 x 10	67 500
(f) Workshop (@ 450 birr per square metre)	10 x 10 x 10	45 000
(g) Finished-goods store (@ 450 birr per square metre)	30 x 10 x 5	135 000
Total built-up area	1 800 m^2	
Total cost		840 000
		(or $US 420 000)

2. Equipment, machinery and power requirements

Tanning extracts

Equipment	Number	Power (kW)	Cost (birr)
Crusher	1	3.75	12 500
Disintegrator	1	3.75	6 000
Pumps (@ 5,000 birr each)	3	2.25	15 000
Evaporator pumps (5,000 birr each)	2	4.00	10 000
Cooling water pump	1	3.75	5 000
Finisher pump	1	3.75	5 000
Subtotal		21.25	53 500

Fat liquors

Equipment	Number	Power (kW)	Cost (birr)
Blower	1	7.5	5 000
Esterification vessel	1	4.0	25 000
Heater stirrer	1	2.0	5 000
Sulphonator	2	7.5	35 000
Chilling plant	1	4.0	10 000
Acid pump (@ 2,500 birr each)	3	3.0	7 500
Alkali pump	1	0.75	7 500
Oil pump	1	1.5	5 000
Chilled water pump	1	1.5	5 000
Sulphitation vessel	1	4.0	30 000
Subtotal		35.75	135 000
In addition			
Platform balance	1		10 000
Trollies (0.5 ton capacity)	3		20 000
Hoist (1.0 ton capacity)	1		
Fire extinguishers	10		2 000
Distilled water plant (capacity 5 litres per hour)	1		2 000
Overhead tanks	6		15 000
Subtotal			49 000
Exhaust fans		5	
Lights and fans		10	
Laboratory equipment		5	50 000
Total		77	287 500
(Rounded up)		88	300 000
			or
			$US 150 000

	Local currency (birr)	Foreign currency ($US)
3. Utilities, miscellaneous items, vehicles, furniture, boiler, etc.	100 000	250 000
Total		300 000

4. Number of personnel needed and cost of training

(a) Factory administration

Managing director	1
Production manager	1
Shift engineers	2
Shift operators	6
Quality control assistants	2
Workers	18
R & D chief	1
Chemists	2
	33

(b) Office administration

Administration officer	1
Purchase officer	1
Sales officer	1
Accountant	1
Cashier	1
Stenographer	1
Typist/clerk	2
Sales & purchase assistant	2
Security Officer	1
Drivers	2
Watch and ward	4
Attendants	4
Sweepers	2
	23

(c) Auxiliaries

Foreman	1
Electrician	1
Welder	1
Carpenter	1
Filter operator	1
Pump operator	1
Boiler attendant	1
Workshop assistant	1
Turner	1
Plumber	1
	10

Training expenses for four persons (@ $US 20,000 per person per year) = $JS 80,000 (foreign currency).

The cost of the project has to be worked out in more detail at the time of execution or shortly beforehand. In any case, only the two units (vegetable-tanning extracts and fat liquors) will be started to begin with.

Annex V

CHEMICAL SUPPLIES

There should be sufficient chemicals to ensure continuity of production, taking into account the time necessary for fresh supplies to arrive from possibly remote suppliers. The quality of all chemicals, dyes, fat liquors, syntans, finishes etc., even if they are produced by well-known organizations, should be checked regularly. They should be stored under cover, away from the effects of sun, rain and process liquors.

Wherever possible, multi-purpose products should be used as a means of economizing on the inventory and simplifying processing. Syntans, dyes, fat liquors and finishes that can be used on both mineral- and vegetable-tanned leathers should be evaluated. For this purpose it is essential to have a laboratory to test chemical products and leathers. It is also important to establish technical service arrangements with suppliers of chemicals and machinery.

Annex VI

STANDARDS AND STANDARDIZATION

Many developing countries have already realized the importance and value of establishing standards of quality. Business improves and higher prices on the world markets can be obtained.

Throughout the world, there are about 120 national standards institutes or similar organizations that are concerned with quality control. Thirty-four of these are in developing countries.

It is desirable that leathers should be able to pass certain tests when entering the markets in the developed world. The European Economic Community has already been discussing agreed minimum test performances in leather for certain purposes. A commission in the Federal Republic of Germany has been drawing up suggestions for test schedules for leather and footwear.

Establishing national quality standards in a nationally-controlled industry is not as difficult as in private industry. For example, the Union of Soviet Socialist Republics has a quality mark that may be shown only on products satisfying the official requirements. Permission to use the mark (standard) can be withdrawn immediately if a decline in quality is proved. The Moscow trade-union paper Trud reported at the beginning of 1975 that, during the third quarter of 1974, 43 types of product were struck off the list. Today, Soviet consumers may complain if articles they buy are of poor quality, particularly if the goods bear the quality mark.

In Ethiopia, where the NLSC controls all the organized tanneries, it should be easier to have quality-control requirements introduced in each unit, although the processes used may vary considerably from tannery to tannery.

Annex VII

IMPORT POLICY

Some developing countries actually hinder the production of good finished leather by imposing excessive import duties and import limitations on special chemicals and machines necessary for leather production. The export revenue obtainable from finished goods far outweights the revenue from import duties. Such expenditure by the tanner represents only a small fraction of the total value of the finished leather so that the balance of trade in such a situation is hardly affected.

Governments hope that, by restricting such imports, they will encourage the growth of indigenous chemical and engineering industries. These industries will, in fact, only grow when they have acquired the technological abilities and the right production plant. Few developing countries can enter into the manufacture of the specialized auxiliaries and the precision processing machinery for the leather industry that have been perfected by European and North American companies. Government and industry in developing countries will be well advised to make full use of what is available on the world market in these areas of supply in order to improve the quality of their own products. This is certainly the case if the raw materials for the production of the auxiliaries are not available and have to be imported, and even more so if the local or regional market is not sufficiently big to warrant a production unit of a minimum economic size.

Annex VIII

FORECAST OF FUTURE VEGETABLE-TANNIN REQUIREMENTS AND THE NUMBER OF TREES TO BE PLANTED

The present consumption of vegetable tannin is 500 tons of extract a year. It takes about six to seven years for a mimosa tree to give a good yield of tannin. It is estimated that, at the present rate of consumption, the government-owned tanneries' requirement in 1990 will be 800 tons of vegetable tannin. This includes a certain amount required for boiler-water treatment and as a mud thinner.

The amount of bark that can be obtained from a tree	= 11.5 kg (minimum)
Amount of tannin (on a dry basis) that can be obtained from bark of one tree	= 11.5 x 0.3 = 3.45 kg
Number of trees that are required to get 800 tons of tannin	$= \frac{300,000}{3.45}$ = 232,000 trees

This is the minimum number of trees that has to be planted to obtain the tannin after seven years. Assuming that there will be an increase of 50 tons of tannin needed every year the number of trees to be planted has to increase by about 14.[illegible]nually.

This annex is based on a note available in the NLSC office from the leather expert. If all the hides and skins can be converted to finished leather, the requirements will be still higher.

Experience in India is very favourable in spite of the area with a suitable climate being limited there. About 10% of the imports have been replaced with indigenous material. The situation should be even more favourable in Ethiopia.

Annex IX

MANUFACTURE OF NEATSFOOT OIL

In western countries, neatsfoot oil is a valuable by-product from slaughterhouses. It is obtained from the shin-bones of cattle legs by extraction with boiling water. The oil floating on the surface is then separated and refined as required.

Experiments in India

Shin-bones between knee and hoof were collected at the abattoir at Deonar, Bombay on the day of slaughter. As it was not possible to extract the oil immediately, they were kept in the freezer overnight and the processing started the next day. In all, three extractions were made using five to ten times of water each time. The heating was done by a steam coil in a stainless-steel container for three hours. After this period, the contents of the vessel were cooled to room temperature and the floating oily layer was separated. After each extraction, the oil collected from the floating layers was warmed up and separated in a separating funnel. After the first extraction, 0.1% of a suitable preservative was added to prevent fermentative action and foul smell in the second and the third extractions.

Experiments were conducted with shin-bones from bulls and from buffaloes. The yield of oil in all the three extractions was 3.8% in the case of bull and 3.9% in the case of buffalo bones.

Analytical data

The analytical data for the oils (without any treatment) obtained from the Indian abattoir are given along with the values for neatsfoot oil given in the literature (from the Federal Republic of Germany):

	India		
	Bull	Buffalo	Literature
Relative density	0.90	0.905	0.905
Acid value	0.45	0.70	0.6-1.0
Saponification value	163	220	192-196
Unsaponifiable matter	1.61%	1.43%	0.1-0.6
Iodine value	85.0	80.0	67-72
Solidification point	-6°C	-6°C	-6° to -12°C
Refractive index	1.463	1.463	1.4697

The Indian analytical values correspond more or less to those reported in the literature, although the solidification point and unsaponifiable matter are higher.

A copy of this note has been given to the slaughterhouse authorities in Addis Ababa. There are many other by-products from the slaughterhouse that can be utilized in addition to neatsfood oil from shin-bones. These include liver, spleen, intestines and other parts of the body which can give valuable pharmaceutical and other materials.