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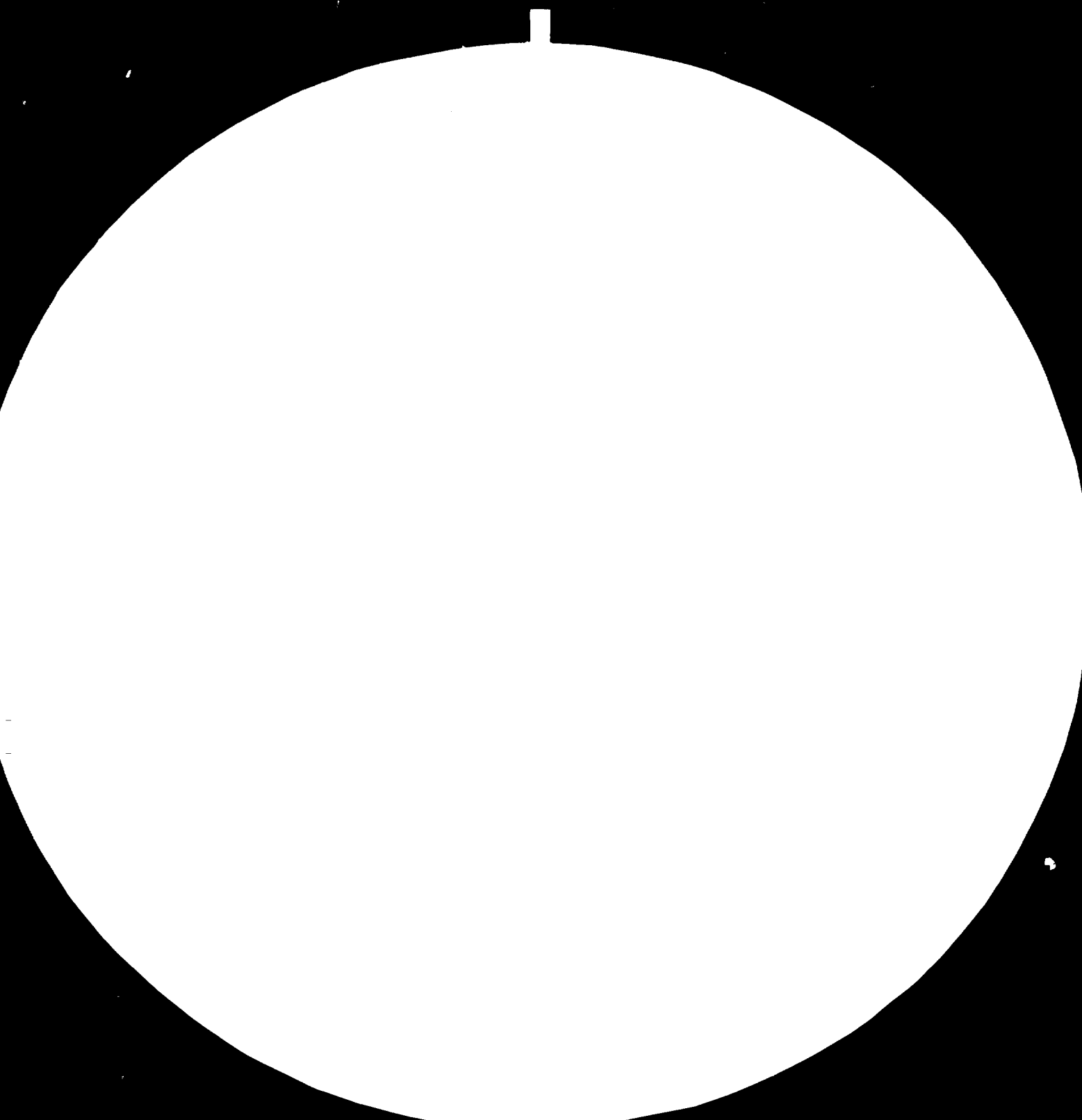

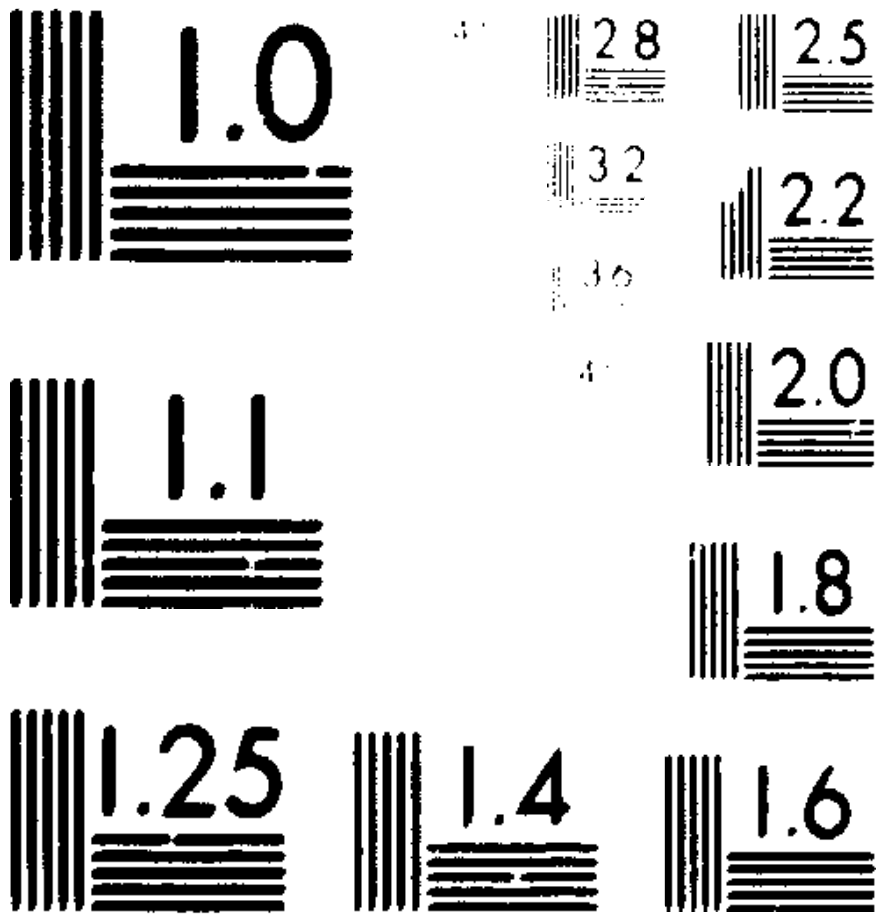

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14 January 1982
English

LEATHER AND LEATHER PRODUCTS DEVELOPMENT

DP/ETH/78/001

ETHIOPIA

Technical report: Tannery Effluents */

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 David Winters,
consultant on tannery effluents

United Nations Industrial Development Organization

Vienna

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SUMMARY

The consultant accompanied three officers of the National Leather and Shoe Corporation (NLSC) on an eighteen-day study tour, visiting four countries in Europe and Africa to examine the technologies employed in mitigating pollution and environmental degradation due to tannery effluents.

On their return to Ethiopia the three NLSC officers and the consultant jointly agreed on the appropriate technology for tannery effluents to be employed in Ethiopian tanneries and based on this jointly prepared an outline design for a treatment plant suitable for Combolcha Tannery (Annex I). It is suggested that the NLSC officers could, when necessary, adapt such design for other tanneries.

Following a brief visit to the tanneries at Modjo and Edjersa the consultant offered advice regarding the strategy to be employed at the Ethiopian Tannery S.C. (ETSC) in order to better utilize the effluent treatment plant already installed there.

BACKGROUND INFORMATION

1. Purpose of the assignment:

To complete Phase II of a multi-phase consultancy which will ultimately yield detailed design and technological recommendations, in order that the National Leather and Shoe Corporation (NLSC) may have available all pertinent information to allow the preparation of tender documents relating to plant and equipment necessary to mitigate the environmental nuisance currently caused by tannery effluents and solid wastes.

Note: Phase I of this consultancy was carried out by the same consultant from 19 March to 29 April 1981.

2. Duties:

The consultant will be attached to the National Leather and Shoe Corporation (NLSC) and will specifically be expected to carry out the following duties:

(a) Three days (in October 1981) at his home base, to make contact with supplier firms and plants to be visited and arrange the study tour programme;

(b) For approximately eighteen days accompany the three NLSC officers on their study tour in Italy, Spain, U.K. and Kenya and advise them as necessary on the technicalities of plants seen and their appropriateness to Ethiopian conditions and if possible agree to the most appropriate technologies;

(c) Two weeks in Addis Ababa; return with the NLSC officers to Addis Ababa and finalize the discussions with NLSC management and advise on blue prints for the treatment plants for each tannery concerned.

Note: Owing to the approach of the Christmas holidays the consultant was only able to be present in Ethiopia for nine days. He completed his mission on 24 December after debriefing in Vienna on 23 December 1981.

FINDINGS OF THE MISSION/STUDY TOUR

1. Technologies seen:

During the study tour visits were made to ten tanneries and a variety of treatment techniques were examined and evaluated with respect to suitability for operation under Ethiopian conditions. In particular the following major technologies were seen:

(a) Separation of tannery flows into:
  (i) chrome liquors
  (ii) lime/sulphide liquors
  (iii) others.

(b) Recovery of chrome by precipitation, decantation of supernatent and resolubilizing of precipitates.

(c) Catalytic oxidation of sulphide bearing liquors.

(d) Self-cleaning and brushed screens.

(e) Primary sedimentation aided by chemical flocculation.

(f) Secondary treatment - activated sludge.

(g) Secondary treatment - oxidation ditches.

(h) Sludge handling - filter press and other.

2. Appropriate Technology:

Consensus was found between the consultant and NLSC officers that in the majority of situations in Ethiopia the need for secondary biological treatment would not currently justify the expense of such units and their need for higher levels of control. In such circumstance all agreed that screening, separation of flows, specialized treatment of chrome (recovery) and sulphide liquor, chemical coagulation and efficient primary sedimentation would prove suitable under Ethiopian conditions. Such treatment should yield an effluent with approximately 90 per cent removal of suspended solids (ss), a liquor with virtually zero colour or turbidity and a sludge which being non-toxic, free of sulphide and chrome, could easily be disposed of as an agricultural conditioner/fertilizer.

3. Pilot Outline Design:

Based on the above the consultant and the NLSC officers prepared an outline plan for an effluent treatment plant for Combolcha Tannery. A schematic flow chart may be seen in Annex I. Further details were discussed with the NLSC officers and more detailed data left with them. Some design parameters may be seen in Annex II.

The NLSC officers concerned should be able to extrapolate the Combolcha model to suit other tannery situations.

Note: Alternatives for sludge treatment will be evaluated by the Ethiopian officers, i.e. cost/efficiency of filter press viz-à-viz sludge drying beds.

4. Bench Trials:

(a) Flocculants

Bench trials were held at Modjo Tannery to demonstrate the use of flocculants (to aid sedimentation) and show the need to carry out trials or equalize effluents to obtain minimum bulking conditions of sludge.

(b) Chrome precipitation

The method of precipitating chrome from used chrome liquors, discarding the supernatent and redissolving the precipitate was outlined to the NLSC chemist who will prepare a cost/benefit accounting.

5. Utilization of Effluent Plant at Ethiopian Tannery S.C.:

In the absence of complete engineering plans of the existent treatment plant and with only a cursory survey of the situation, the consultant was unable to give definitive advice but suggested the following be evaluated by the Ethiopian officers:

(a) Use the mixing, dosing and primary sedimentation units to obtain an efficient primary treatment (90 per cent removal of ss).

Note: Would need to ensure all sulphide-bearing liquors were diverted to lagoons; equalization tank operated efficiently/float switches reactivated and not allowed to be emptied.

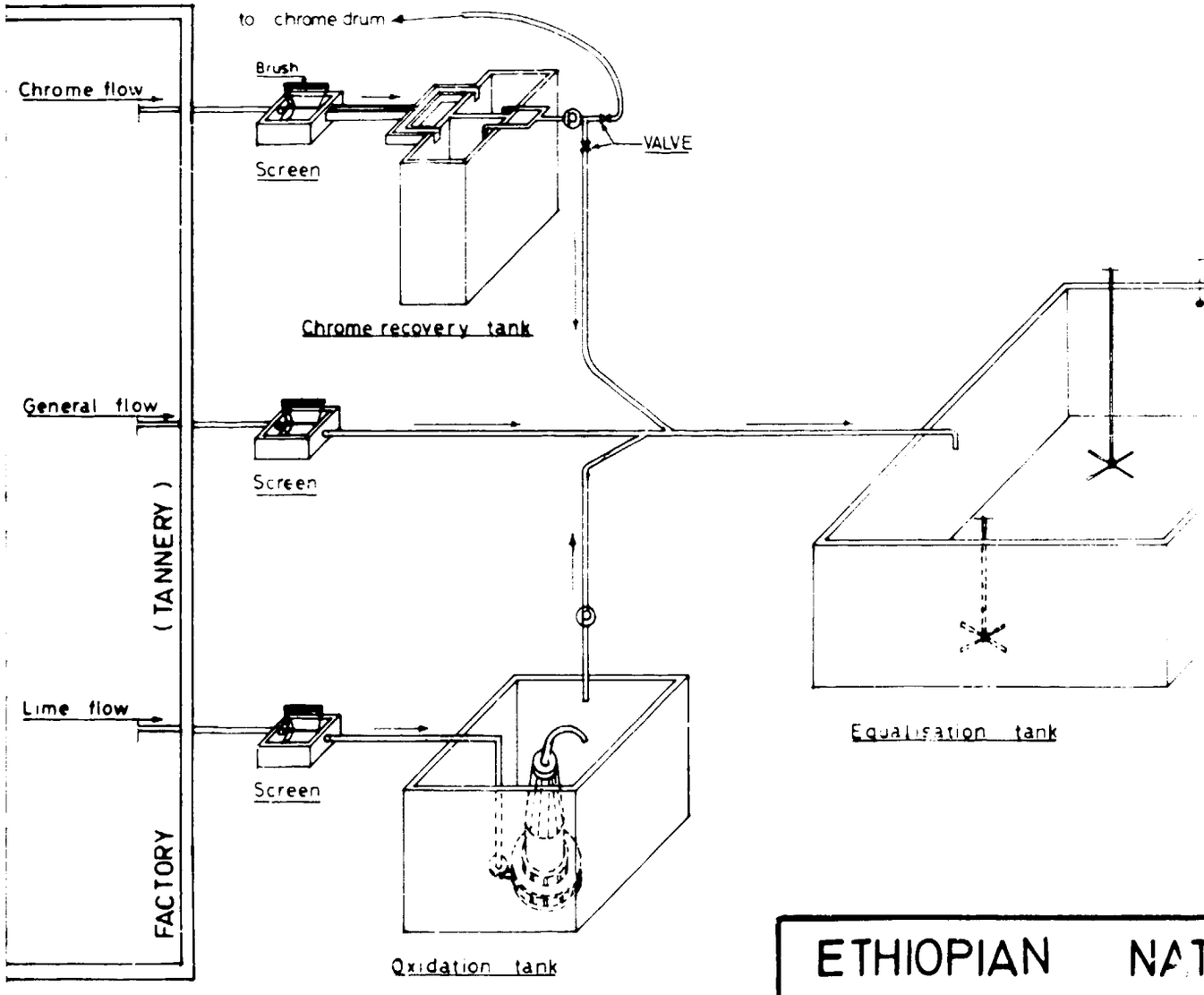
Flocculant dosing facilities would need to be reinstalled and possibly pH control (manual?) instituted.

Supernatent from an efficient primary sedimentation should bypass the activated sludge unit.

(b) Although the original Czech plans showed a pipeline connecting the overflows of the lagoons to the effluent pump system, it appears this line was not installed. It could be that if such line were installed, together with a crude holding tank, the lime liquors could be catalytically oxidized utilizing the aerators installed in the activated sludge unit and then passing to secondary sedimentation unit.

Note: Would need survey of volume of all lime/sulphide liquors viz-à-viz volume of the activated sludge unit.

ANNEX I



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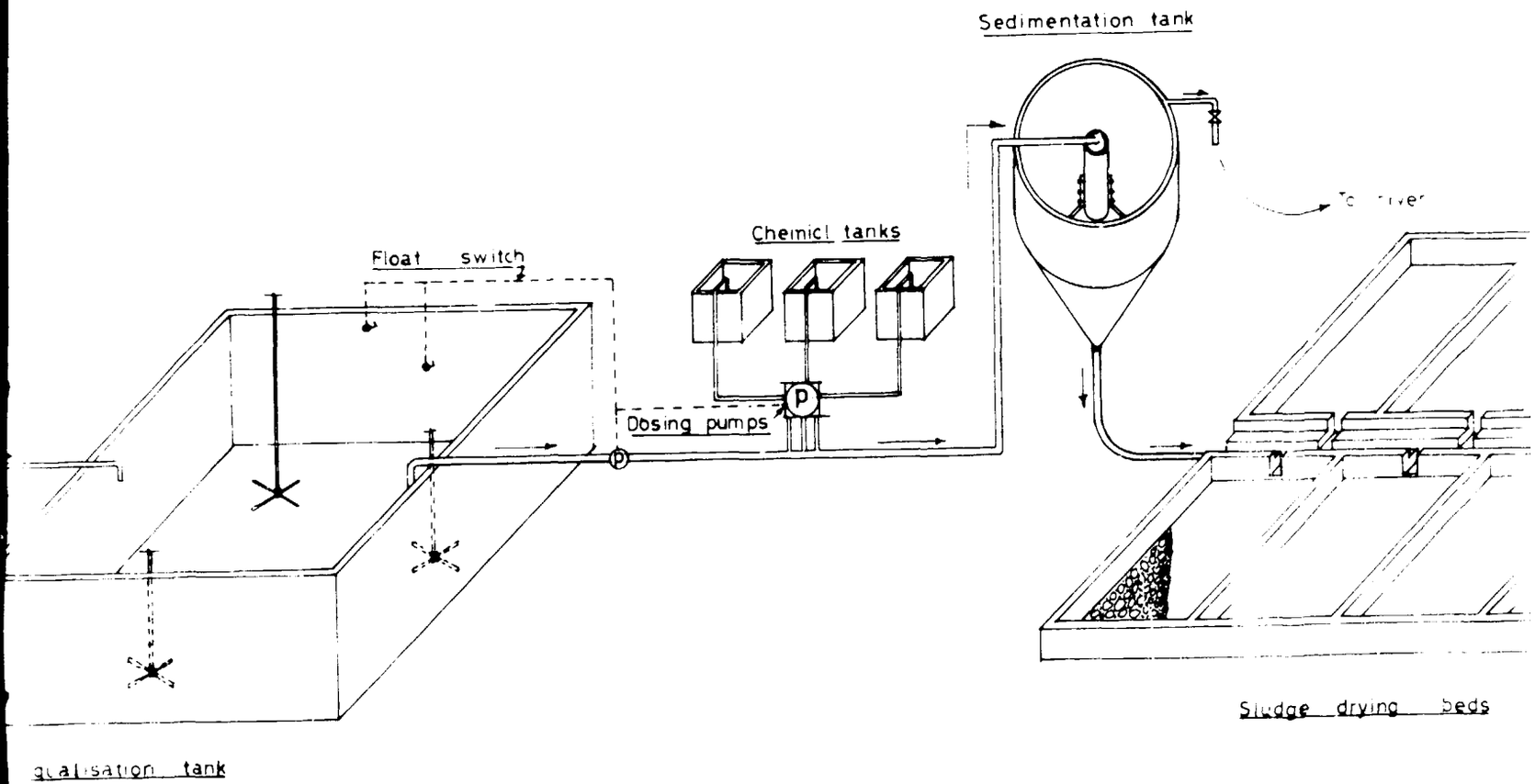
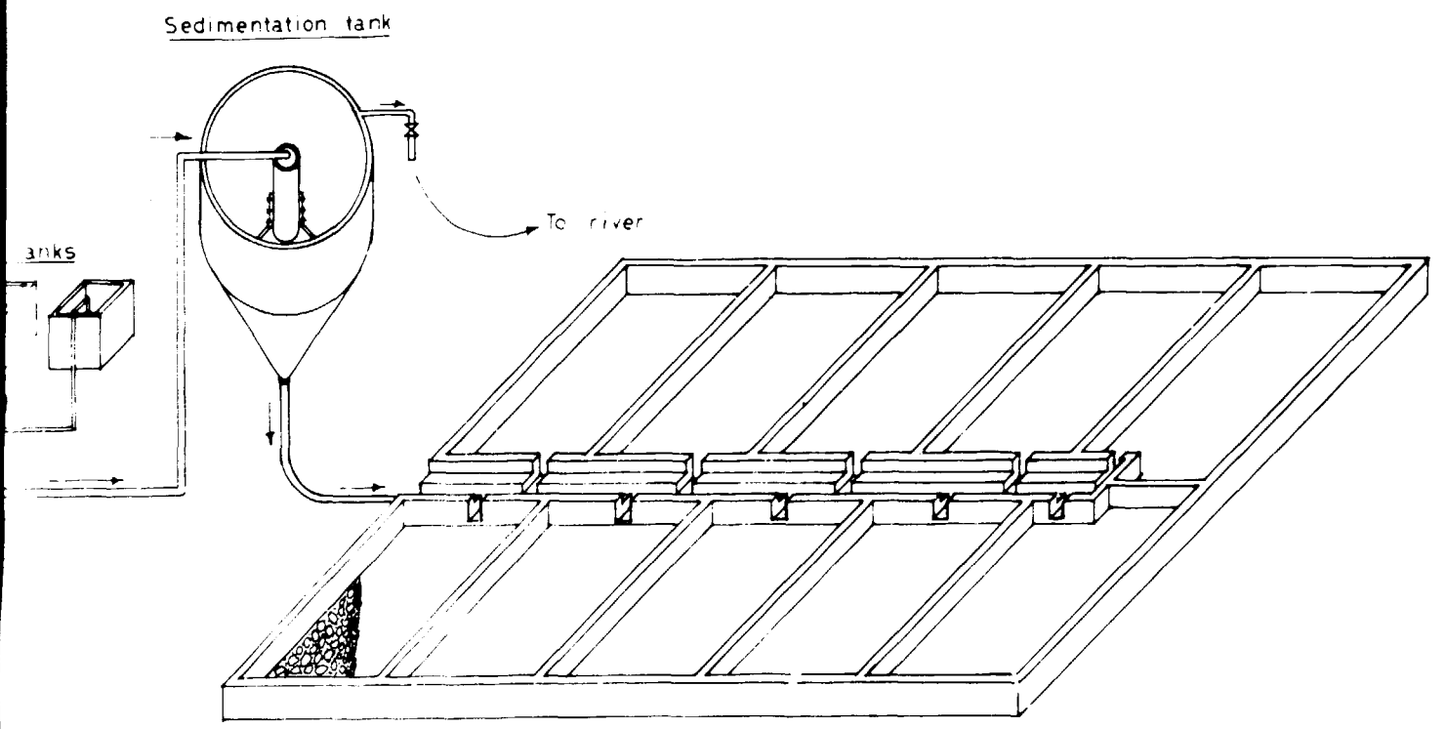
AND SHOE

SECTION 1



ETHIOPIAN NATIONAL LEATHER AND SHOE CORPORATION	Schematic flow chart COMBOLCHA TANNERY

SECTION 2



Schematic flow chart COMBOLCHA TANNERY	DRAWN	Berhanu Chekol
	CHECKED	David Winters
	SCALE	1 : 100
	DATE	11-4-1974 ___ 20-12-1981

SECTION 3

ANNEX II

COMBOLCHA TANNERY

Assume 4,000 skins/day processed to wet blue = 200m^3/day.

1. Chrome Recovery

   (a) For precipitation use $Ca(OH)_2$ to pH 7.0
   Settle 12 hours - decant supernatent.
   (Magnesium hydroxide gives denser precipitate but is more expensive.)

   (b) Redissolve using H_2SO_4 to pH 3.5 then pump to tan drum.
   (If technicians not agreeable could pump the chrome hydroxide precipitate to a drying bed and dispose separately.)

2. Catalytic Oxidation of Sulphide

   Possible residual sodium sulphide could require up to 80 kg O_2 a day.

   Aerators supply approximately 2.2 kg oxygen per KW hour. Therefore 5 KW aerator suitable.

   Catalyst (technical $MnCl_2$ $4H_2O$ or $MnSO_4H_2O$). Usually approximately 100 mg/L. (Downton were using 32 kg per 200 m^3 $MnSO_4H_2O$ = 160 mg/L.)
   See paper by D.A. Bailey and F.E. Humphreys.

3. Flocculant Beds

   Typical levels:

   $FeSO_4$ - 500 mg/L (S= precipitant)
   $FeCl_3$ - 500 mg/L
   $Al_2(SO_4)_3$ - 200 mg/L

   May need to adjust pH to obtain efficient flocculation.

4. Screen

   Brushed type (? Parkwood)
   Maximum flow? 1 drum float in 10 minutes
   = 36 m^3/hr. Therefore Parkwood Type D12
   (44 m^3/hr)

5. Pumps

(a) Chrome to discharge 3 m^3 in 15 minutes i.e. 12 m^3/hr.
Head 6 - 7 m.
(virtually free of solids.)

(b) Equalized Flow
$\frac{200\ m^3}{24}$ = 8 m^3/hr. Head 8 - 9 m.
(Some fine solids - may need bypass to adjust.)

(c) Dosing
Possible 4 dosing head.

6. Equalization Agitators

Total power = 8,000 Watts
Therefore 3 stirrers at 60 rpm, 3KW each, 3 m propellers

OR

if more economic a 5.5 KW aerator.

7. Sludge Flow

Assumed up to 10 m^3/day.

8. Dimension of Vessels

As described in more detailed drawings left with Berhanu and Michael.

ANNEX III

POSSIBLE SUPPLIERS

A.B.S. Pumps Ltd. Devereux Works Coleshill Birmingham B46 1JT U.K.	Sludge and Sewage Pumps, and Submersed Aerators
Environmental Engineering 15 Melville Terrace Stirling Scotland U.K.	Submersed Aerators Self-clean Screens
Longwood Engineering Co. Ltd. Parrwood Mills Longwood Hudders Field West Yorks HD3 4TP U.K.	Parkwood Brushed Screens
Whitehead and Poole Ltd. P.O. Box 9 Milltown St. Radcliffe Manchester M26 9NU U.K.	Surface Aerators and Sludge Pumps
Aqua-Aerobic 6306 N. Alpine Rd. P.O. Box 2026 Rockford, Ill 61130 U.S.A.	Floating Aerators
Flygt Pumps Ltd. Colwick Nottingham NG4 2AN U.K.	Drainage Pumps (Slight sludge) and Air Injectors
British Guinard Pump Ltd. 470 London Road Langley Berks SL3 8QT U.K.	Drainage Pump (Light sludge)

Mono Pumps Engineering (Ltd.) Arnfield Wks. Audenshaw Manchester U.K.	General Effluent Pumps
Doulton Industrial Products Ltd. Filleybrooks Stone ST15 OPU U.K.	Filters Presses
Thomas Willett Warner St. Hanley Stoke on Trent U.K.	Flow Control Pumps (i.e. to Filter Press)