Environmental Pollution
Prevention Project

A Report of the
Office of Environment and Natural Resources
Bureau for Global Programs
United States Agency for International Development

POLLUTION PREVENTION DIAGNOSTIC STUDY
CURTIDOS BAS SA.
SANTIAGO, CHILE

Final Report

Prepared for :

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HBI Reference No. 94-003
4703-002

Environmental Pollution Prevention Project (EP3)
Project Number 936-5559
Contract Number PCE-5559-Q-00-3022-00

January 1994

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ACKNOWLEDGEMENTS

This publication is one of a series of technical outputs from the Environmental Pollution Prevention Project (EP3). The publication was made possible through support provided by the Office of Environment and Natural Resources, Bureau for Global Programs, U.S. Agency for International Development, under the terms of Contract No. PC-5559-Q-O-O-3022-00. The opinions expressed herein are those of the author(s) and do not necessarily reflect the views of the U.S. Agency for International Development.

The pollution prevention audit/assessment reported on herein was conducted by a team of EP3 and industry representatives. The primary purpose was to assist industry or facility management in creating a sustainable pollution prevention and waste minimization program. This report presents information from the first step in the process; a base line survey and a definition of actions which can be taken to prevent pollution, improve efficiency and pay back any required investments.

The overall EP3 program in the countries in which EP3 has activities includes a wide range of activities including audits/assessments, information dissemination, training and small scale demonstrations. These country programs are all designed to create the conditions in the country which will assure the continuation of urban and industrial pollution prevention and establish locally sustainable pollution prevention programs.

This report was prepared for RCG/Hagler Bailly, Inc. by Thomas C. Thorstensen, T S G Inc., 35 Monadnock Drive Westford, MA 01886.

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The wastes generated by the tannery come from the hides and the chemicals used in the production. From data taken by the Environmental Protection Agency (US) on a large number of tanneries operating similar to the Bas tannery plus data on the chemicals used by the tannery the pollution load was calculated. The tannery wastes are discharged in a number of batches during the production day. For efficient pollution prevention and control an on-stream continuous pre-treatment system is recommended. This system is cost effective and can be designed to achieve results as needed to meet the proposed regulations.

Recommendations for pollution prevention included recycling of the spent chrome tanning wastes, Oxidation of the sulfide containing wastes, decreasing the volatile organic discharge (VOC) by materials change, decrease of water use by batch washing and use of solid wastes from the waste stream as fertilizer.

Table 1
Summary of Pollution Prevention Opportunities

Material	Opportunity	Pollution Prevention Potential	Cost of Implementation	Action Required
Chromium Tanning*	Recycle Chrome Tanning	Decrease Chromium to less than 3 mgl	$20,000 USD saving $60,000/year**	Install Pumps and Storage Tank
Solvent Discharge	Change to Water Based Lacquer Finish	Decrease VOC Discharge by 60-90%	None	Evaluate New Finishes Available
Water Usages	Change to Batch Washes	Decrease Water Usage by 20-40%	None	Modify Production Formula
Solid Wastes	Save Leather Trimmings for Reconstituted Leather	Decrease Leather Waste by 60-80%	$10,000 USD	Install Leather Grinder
Sulfide Wastes*	Destroy Sulfides by Air Oxidation	Decrease Sulfide Waste by 95-98%	$30,000 USD	Install Sulfide Treatment System
Suspended Solids*	Primary Treatment	Decrease Suspended Solids by 70-85%	$100,000 USD	Design & Build Treatment System
Sludge From Effluent*	Dry Sludge for Land Application	Dispose of Sludge to Fertilize	$20,000 USD	Drying System for Primary Sludge
Secondary Treatment*	Treat Primary Waste	Decrease BOD by 60-80%	$50,000 USD Trichlins Filter	Build Secondary System
Totals			$230,000 USD Cap Costs	

* All these items are required under the provisional Pollution Control requirements.

** Savings in Chromium Chemical costs should cover all operation and maintenance costs

Introduction

This study was done under the Agency for International Development, Environmental Pollution Prevention Project (EP3) under the direction of AMCHAM-CHILE by ACG Hagler/Bailly, Inc. Dr. Thomas C. Thorstensen was the technical consultant to Hagler Bailly for the project. The services of Geotechnica Consultores, represented by Solange Gantelbein, were used to assist in the technical and operational aspects of this project. Mr. Miguel Angel Ponti Bas, of Curtidos Bass was most helpful with his cooperation.

Objective

The purpose of this study was to perform an environmental assessment of the tannery and to propose a program of pollution prevention.

The tannery CURTIDOS BAS SA. is a cattle hide tannery producing chrome tanned shoe upper leather from salted cattle hide. The factory has modern machinery, is well maintained and the leather quality is good.

CURTIDOS BAS SA. has a nominal capacity of five hundred hides per day. Monthly data was obtained on the chemical consumption during typical production. Their monthly production was 25 days at 400 hides per day, with an average weight of the hides at 23 kg. The total weight of hides per day was 9.200 kg.

3.1 Methodology

Visits were made to the tannery over a four day period. During these visits Dr. Thorstensen was accompanied by Mrs. Gentbein and other members of the EP3 team. The organization of the days work was under the guidance of Eduardo Maal by daily team meetings. Dr. Mauricio Rodan, EP3 coordinator for AMCHAM and Mario Salazar, of AID also visited the tannery during the project.

To determine the pollution load of the tannery, direct analysis of the widely fluctuating streams was not practical in the time available. The data from the tannery's studies was available but inconclusive. For more meaningful quantitative data, the findings of the EPA in studying similar to the Bas tannery and the chemical usage by the tannery, were used in the determination of load. This approach was discussed in detail with Mr. Miguel Ponti Bas and he agreed to supply data on chemical use, as well as any other technical data needed.

From the visits at the production facilities and the company policies of scheduling and process interrelations, the practicality of pollution prevention approaches in the companies production were determined.

Table 2
Environmental Protection Agency
Hair Pulp, Cr Tan, Retan, Wet Finish

Parameter	Load Data Kg/1000 Kg Hides
BOD	62.3
TSS	92.3
COD	178
Oil & Grease	15.4
Nitrogen (TKN)	12.6
Total Cr	2.9
Sulfide	2.5

Table 3
Chemical Used in 25 Days (*)

Chemical Product	Consum Kg
Salt from hides (12%)	27000
Salt from process	14000
Lime ($CaOH_2O$)	10000
Sulfides ($Na2_S$, NaSH)	7200
Ammonium Sulfate	5500
Sulfuric Acid	3700
Formic Acid	2500
Chrome Tan (25% Cr_2O_3)	15500
Sodium Bicarbonate	1360
Magnesium Oxide	3100
Vegetable Tanning Materials	15000
Leather Oils	10000
Dyes and Synthetics	15000

* 450 hides per day, 25 kg/hide, total = 12000 kg hides/day
water consum 1.5 m^3/hide, total consum 700 m^3 water/day

3.2 Findings

The 1979 Environmental Protection Agency study of the United States leather tanning industry provides information on the pollution generated by tanneries, based on the type of production methods. The data gave the weights of the significant parameters per 1000 kg of hides processed. This data is helpful in the preliminary estimation of the pollution load of any given tannery. CURTIDOS BAS SA. uses the "Hair Pulp, Cr Tan, Retan and Wet Finish" (EPA Category 1) process.

Data from the EPA for this type of process was used to estimate the pollution load. The expected concentrations of the EPA loads were calculated based on the water usage reported by the Company.

The normal water usage in manufacturing is 55 l/kg of hides or 1 mt^3 per hide. The chemicals used by the tannery are listed in ***Table 2***; from this tne kg of chemicals per 1000 kg of hide has been calculated. Also the amount of (mg/l) of these chemicals as they would be found in the effluent has been estimated. Some of the materials are bound to the hides during the process; this is evident with the vegetable tannins, tanning oils, etc. For those materials a calculation is made on the composition of the effluent. Chrome tanning materials, for example the chromium in the effluent, is calculated on the basis of 75% fixation. The sulfate (SO_4) is calculated as not fixed and the total sulfate is that from all of the chemicals used.

The effected pollution load of the tannery in kg/1000 kg of hides and in mg/l is given in ***Table 3***. The tannery effluent is the result of batch processes; these batches are widely different in pH composition, concentration and time of discharge. From the information given by the company we know the volumes and the times of discharge for each process in the production. This data is given in ***Table 4***.

It is evident that the greatest pollution loading comes from the unhairing process. This material is high in suspended solids, BOD, lime ($Ca0-H_20$) and sulfides. The remainder of the wastes are all slightly acidic and in a large volume. The chrome tanning wastes contain chromium, sulfate and salt. The lime wastes are discharged during the period (8.00 - 13.00 each day). Coloring and fat liquor wastes are dumped essentially constantly during the normal production day.

Data supplied by the tannery of the pH during a normal production day also is given in ***Figure I***. This data shows the wide variations in the nature of the effluent (***Figure II***). It is evident that sampling of tannery effluents by the "grab" method can lead to erroneous conclusions. A comparison of the Plant data, with the parameters in the temporary proposed regulations is given in ***Table 5***. We can see that the main problems of the tannery effluent are sulfide, chromium, oil and grease, BOD, and suspended oils.

Table 4

Chemicals from Tannery Use and Skins Calculated After Estimated Take Up by the Hides

Parameter	Load Data kg/1000 kg Hides	Estimated mg/l
BOD	62.3	1132
TSS	92.3	1678
Oil & Grease	15.4	280
Nitrogen (TKN)	12.6	229
Salt	300	2800
Lime	37	672
Ammonium Sulfate	25	62 (NH_3) 138 (SO_4)
Sulfuric Acid	8.2	149
Formic Acid	11	220
Chrome Tan (1)	92	39 (Cri) 556 (SO_4)
Leather Oils (2)	60	55
Veg Tans (3)	25	55
Bicarbonate (Soda)	16	145
Dyes & Syntans (4)	60	55

116 M^3/1000 Kg Dry Skins

(1) 75% take up
(2) 90% take up
(3) 75% take up
(4) 90% take up

FIG. 1: PROCESS FLOW SHEET FOR CATTLE HIDE CHROME TANNING

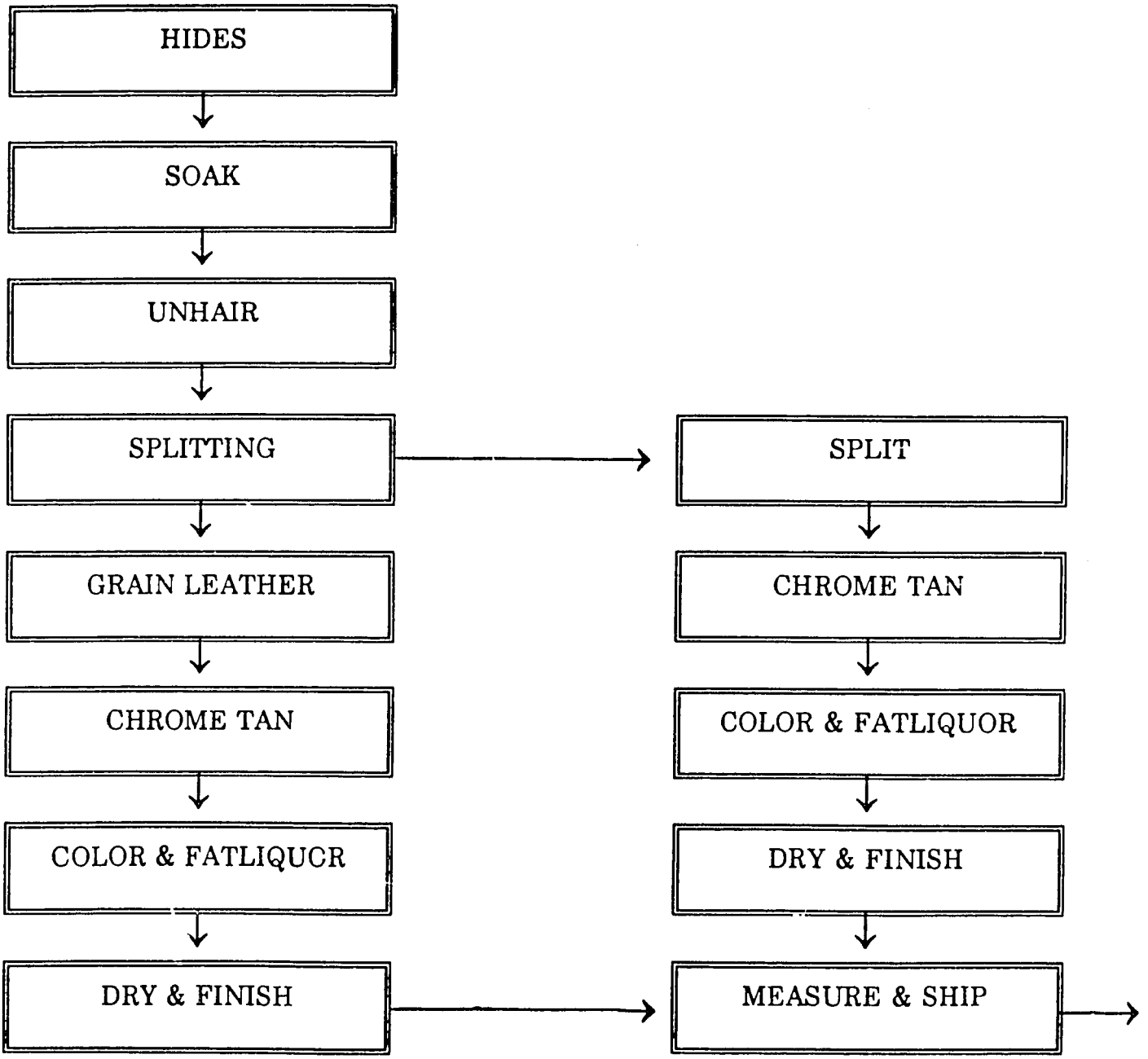


FIG. 2: DATA SUPPLIED BY THE TANNERY OF THE pH

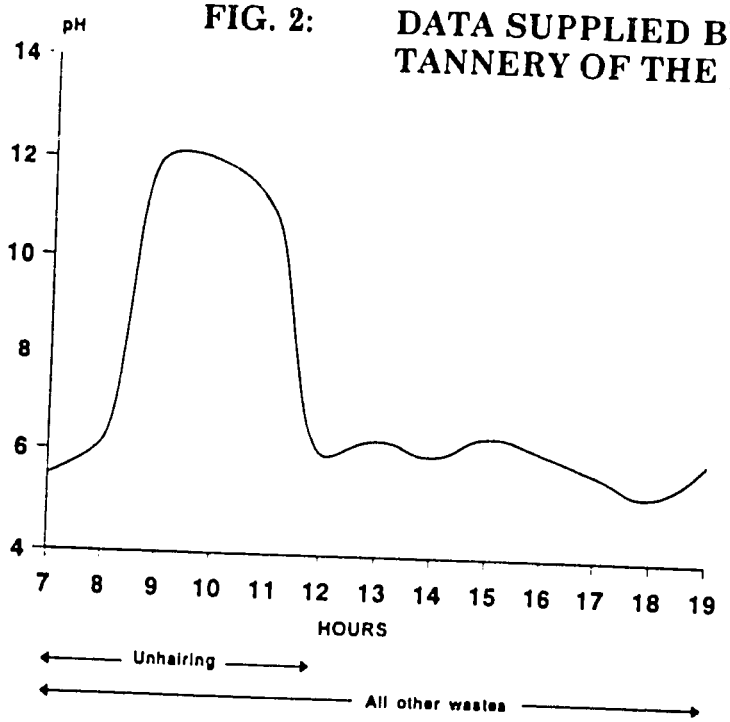
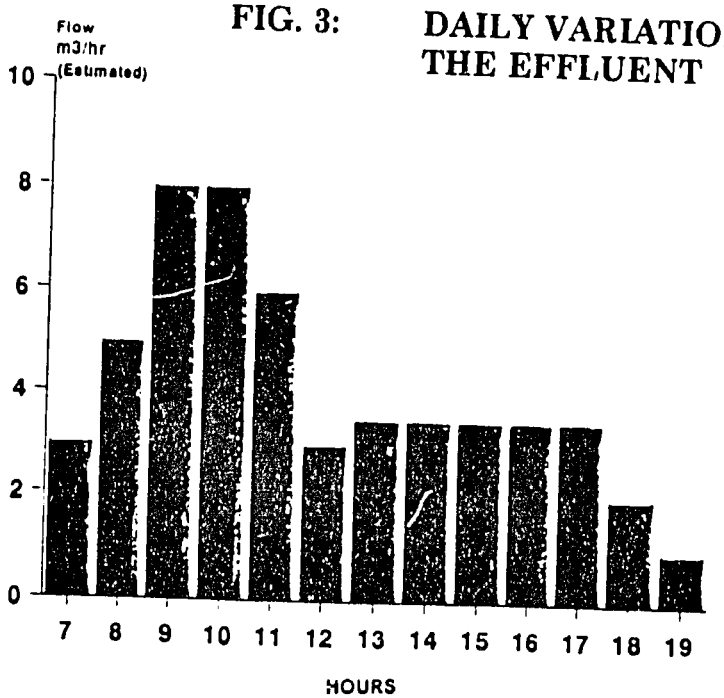


FIG. 3: DAILY VARIATIONS IN THE EFFLUENT



Estimated flow per 1,000 kg Hides

Table 5

Water Used in Each Process and General Characteristic of the Wastes Generated

Process	Volume M^3/1000 kg hides	Pollutants
Hide Soak	4	Salt pH = 6 - 8
Unhairing	10	High BOD, TSS, Lime, S pH = 12 - 13
Bate & Delime	3	BOD $(NH_4)SO_4$ pH = 7 - 8
Cr Tan	3	Cr, SO_4, Salt pH = 3,5 - 4
Retan	30	low BOD, SS pH = 4 - 6
Other	5	Weak Wastes pH = 6 - 8

Table 6
Project Composition of Treated Wastes

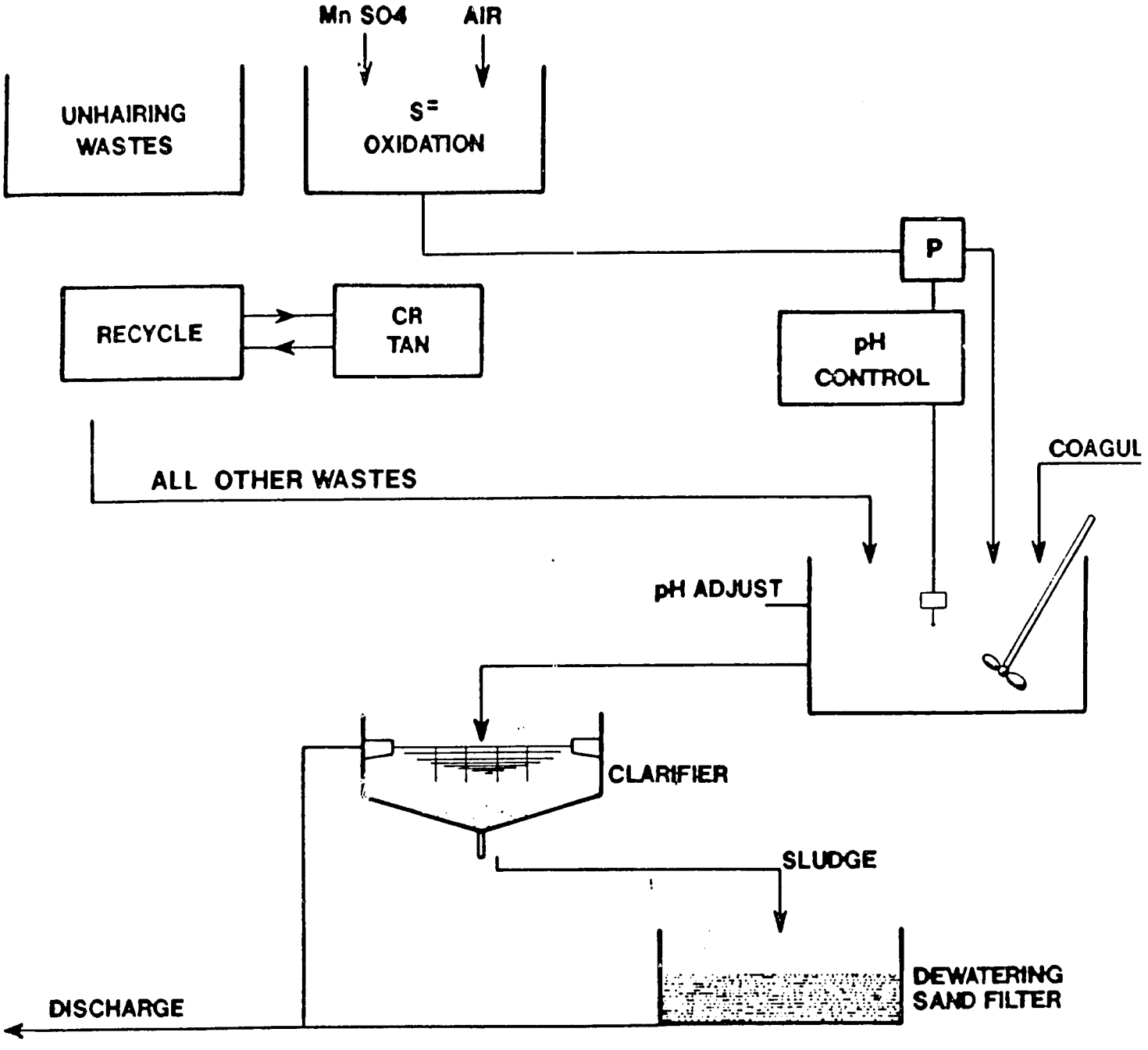
Parameter	Discharge without Treatment mg/l	Treated Waste mg/l (1)	Provisional Requirements mg/l (2)
pH	12 - 4	6 - 8	5,5 - 9
TSS	1678	100 - 200	300
Set Solids	N.D	N.D	20 ml/l
Oil & Grease	280	50 - 100	150
Hydrocarbons	N.D	N.D	20
BOD	1132	500 - 600	300
CR^{+3}	39	< 3	3
SO_4	843	< 800	1000
Sulfide	254	< 5	5
Nitrogen	N.D	N.D	80

(1) The waste effluent will be colorless, odorless, pass on CR & $S^{=}$, only BOD is high. Secondary treatment can be added later if needed.
(2) Norma Provisoria de la Superintendencia de Servicios Sanitarios SISS, Chile.

Table 7
Treatment Plant Description

Process		Treatment type
SOAK	to pH adjust	Primary
UNHAIRING	to Sulfide Oxidation to pH adjustment	Primary
DELIME	to pH adjustment	Primary
Cr TAN	Recycle	
RETAN	to pH adjustment	Primary
OTHER	to pH adjustment	Primary

FIG. 4 Primary Treatment Plant



Low/no cost. The leather industry, during the past two decades has extensively studied pollution problems and several cost effective methods have been developed. Of the methods the most accepted in the industry is the recycling of the spent chrome.

4.1 Chrome Recycling

The construction of the drum system will allow the collection of the spent chrome tanning solutions, without dilution or contamination. The spent solution can be used without chemical treatment in the pickle and tan process. Since the tannery also tans splits (from lime splitting), the spent chrome tanning solution can be used here also. The tanning of splits results in very good fixation of chromium so the concentration of chromium in the final effluent should meet the regulations. This system results in a saving of about 25% in the chromium chemicals used. Pollution control, in this case, becomes profitable.

4.2 Solvents

Most tanneries are no longer the source of objectionable odors. However, many tanneries use highly volatile organic solvents to apply final finishes to leather. Alternatives exist which release much lower amounts of volatile organic compounds without detriment to the quality of the leather. The suppliers of finishing products have developed water based lacquers with significantly lower volatile solvent contents. These materials are now widely accepted as quality products and their use is strongly advised.

4.3 Process Water

The minimization of waste water becomes an important concern once effluent standards require the installation of treatment systems. In most cases the design of primary and secondary treatment systems is influenced by their hydraulic loading and the decrease in the generation of waste waters is accompanied by significant savings.

In some hide wetting processes there is a possibility to recycle the final rinses. The final rinse waste-water in this process is compatible with fluids used for the first wetting of the hides. The judicious recycling of rinse waters and automated systems could result in savings of up to 50% of water consumed. Trials should be made to determine the type of recycling required and if results are positive, then the system should be implemented.

4.4 Solid Waste

Several solid wastes are generated in the tanning process. These wastes are generated in the fleshing and lime trimming for glue stock or gelatin. Most of these wastes are easily biodegraded; however, trimmings of tanned leather are resistant to biodegradation and will remain in the soil for many years.

Eventually, the space for landfill may become scarce and the disposal for this type of material may be severely restricted. The tanneries should investigate the possibility of using their trimmings in reconstituted leather.

4.5 Capital Intensive Modifications

Table 6 shows treatment type for different processes, ***Figure III*** shows primary treatment plant purpose for this tannery.

4.5.1 Sulfide Removal

The removal of sulfides from the effluent is very important; this toxic material will corrode pipes, cause objectionable odors, and may cause fatal accidents. The sulfide-lime solution, and washes from this process in this tannery can be easily collected without contamination from other solutions. These collected wastes can be placed in a tank and the sulfides oxidized by air with a catalyst. This method is effective and can destroy the sulfide in 4 - 8 hours.

4.5.2 Separation of Suspended Solids

At this point the lime waste, with high BOD and suspended solids can be used to neutralize the acid wastes that are being continuously discharged. The acid and alkaline wastes from the tanning process can react to produce a co-precipitation of much of the suspended solids and BOD. To achieve this, an even balanced mixture of the streams with complete mixing can be attained with a large enough mixing tank to hold a full day's production. Such a large tank (500 mt^3) would be very expensive.

4.5.3 Coagulation

A more cost effective method is to use the lime solution as a neutralizer for the remaining acid wastes. This is done with a mixing tank and with automatic pH control. Coagulants can also be added at this point.

4.5.4 Clarification

The neutral streams can then flow to a primary clarifier for the removal of suspended solids as sludge (about 10% solids). The clarified solution will have the composition as given in ***Table 5***.

4.5.5 Sludge Disposal

The sludge can be further dewatered in a sand bed to more than 50% solids for disposal. Although this effluent is somewhat high in BOD over 80% of the pollution load has been removed. The effluent will be colorless, odorless, near neutral pH and slightly turbid. Leather waste sludge from a primary treatment system has been tested and shown to be a good soil conditioner. If this sludge is properly dewatered, their use as a soil conditioner may eliminate possible high disposal costs. The entire system recommended from sulfide removal to sludge disposal, is seen as being cost effective and simple to maintain.

4.6 Secondary Treatment

In the future, for BOD removal, a secondary system can be added. This secondary system requires only to be as large as is needed for the clarified wastes and it may consist of a trickle filter, a secondary clarifier and/or a filter press. The expandable system is very cost effective and has been found practical in commercial applications.

4.7 Sludge Disposal

Leather waste sludge from a primary treatment system has been tested and shown to be a good soil conditioner. If the sludge is properly de-watered, its use as a soil conditioner may eliminate possible high disposal costs.

4.7.1 Secondary Treatment

In the future, for BOD removal, a secondary system can be added. This secondary system need only be as large as is needed for the clarified wastes. The expandable system is very cost effective and has been found practical in commercial applications.

4.7.2 Non-Compliance

The recommendations described above will satisfy the "Temporary" Chilean liquid effluent requirements with the **exception** of the BOD. Secondary treatment would be required to comply and can be added at a later date and at additional capital cost.

The implementation of the recommendations given in this report will depend on two important factors. These are cost and benefit. The recycling of the chrome tanning solutions is the most cost effective recommendation in that the company will have a large saving in material costs in addition to a significant pollution prevention. In the case of secondary treatment of the waste stream the costs will be high and the main incentive for the treatment will be the requirement for compliance with the regulations. It is the nature of the pollution problems of the leather industry that the main sources of pollution are related to the hides processed and the salt used in the cure. As large as these problems are they cannot be solved without a major change in the commercial practices of the industry. The differences between pollution prevention and pollution control are not clearly defined in this complex industry.

5.1 Chrome Recycling

The value of chrome recycling to the tannery and it's low capital costs should be very attractive for this company. Implementation of this recommendation should be very rapid and may be accomplished in 3 months.

5.2 Solvents

The decrease in the use of lacquer finishes by the industry through the use of low VOC finishes is now well accepted for regulation compliance. The shift to these new finishes should occur between 6-12 months as the system is accepted by the company for each of the leathers it is making.

5.3 Process Water

The decrease in process water can be done without a capital investment. The batch washing of coloring and fatliquoring batches could result in savings of about 50% in these operations. With the recommended pretreatment system a decrease in flow would decrease the capital and operating costs of the treatment system. The shift to lower water use should come gradually over the next 12 months.

5.4 Solid Waste

At present the tannery has useful disposal of most of its solid wastes in the form of fleshings, trimmings and leather shaving. With the introduction of the pretreatment system recommended there will be a daily generation of about 1000 Kg of solid sludge (dry weight). This sludge should contain 120-150 Kg of nitrogen. This organic nitrogen and the other materials in the sludge have been proven to be very valuable as fertilizers and soil conditioners. The implementation of the primary treatment system will result in an environmental benefit to the community in addition to the cleaning of the liquid wastes.

5.5 Pretreatment

The implementation of the pretreatment system will be required by the regulations. In preparation for the construction of the system, design data will be needed, the system engineered and constructed. The time of completion of this system including the design work should be 12-15 months.

6.0 Effect on the Environment

The recommended actions are based on cost effective methods that have been proven in commercial applications.

6.1 Chromium Recycling

Decrease the chromium in the discharge by 80-90%.

6.2 Volatile Solvent Reduction

Decrease VOC release to the atmosphere by 60-75%.

6.3 Water Usage

Decrease effluent volume by 30%.

6.4 Solid Leather Wastes

Eliminate solid leather waste discharges to the landfill.

6.5 Sulfide Distribution

Eliminate Sulfides discharged to the canal.

6.6 Suspended Solids Removal

Decrease the suspended solids discharged by 80% and create a useable by-product in the form of an organic fertilizer.

6.7 Secondary Treatment

With the primary and secondary treatment, the BOD discharge can be reduced by 75% resulting in a cleaner canal.

Table 8
Pollution Prevention Opportunities
Estimated Schedule of Implementation

Opportunity	Months	Comment
	0 3 6 9 12 15 18 21 24	
Chromium Recycling		Profitable
Volatile Solvent Reduction		Leather Quality Controls Acceptance
Water Usage		Water Usage Will Affect System Design
Solid Leather Wastes		Acceptance Will Depend on the Use in Reconstituted Leather
Sulfide Destruction		Needed for Primary Treatment System
Suspended Solids Removed Primary Treatment		Design, Construction and Start-Up of Primary System
Sludge for Fertilizer		Acceptance of the Dry Product is by Others
Secondary Treatment		The Secondary System Depends on the Efficiency of the Primary

APPENDIX A

Statement of Work

AMCHAM-CHILE
ENVIRONMENT COMMITTEE

EP3 CHILE PROGRAM.

TANNERIES INDUSTRIES.
TECHNICAL ASSISTANCE REQUISITION.

BACKGROUND.

The Environmental Steering Committee of AMCHAM has approved two Tanneries to participate in EP3 projects, technically assisted by the Prime Contractor.

The plan is to perform Environmental Industrial Pollution Prevention Diagnostic studies in the two Plants selected.

In order to do the job, the Prime Contractor will provide its assistance through US.experts,Probono consultants and local chilean consultants, contracted and paid by the Contractor.

All the Consultants should posses proven technical capabilities in PP for the Tannery industrial processes, as well as expertise in dealing with gaseous emission, liquid discharge and solid waste situations in these industries.

US.CONSULTANT WORK TASK.

To technically assist the Plant Team in the identification of changes/ modifications to the processes, in order to reduce or abate the generation of contaminants, resulting in increased productivity and improved profitability to the operations.

SPECIFIC TASKS.

To assist and/ or work with the plant Team, the EP3 Coordinator and the local consultant to achieve the listed objectives.

.-Diagnostic Study of the Plant processes.
.-P2 opportunities identification and analyses.
.-Determination of the effluent base line .
.-Technical recommendations and Reports.
.-Implementation of P2 recommendations and options.
.-Monitoring of changes and follow up of results.
.-Evaluation of results.
.-Exchange and transfer of technical information.
.-Identification of possible capital investment solutions.
.-Recommendations for ongoing environmental improvement.
.-Participation in Seminars and workshops on P2.
.-Education and training to Plant personnel.

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AMCHAM-CHILE
ENVIRONMENT COMMITTEE

QUALIFICATIONS OF THE US.CONSULTANT.

.-Proven expertise and know-how in P2 measures and procedures.
.-Experience in developing and supervising tanneries P2 projects. (Assessment, implementation, monitoring, evaluation and reporting).
.-Capability to specify and recommend technical solutions.
.-Ability to train plant personnel.

REQUIREMENTS FOR THE US.CONSULTANT.

.-Provide a biodata sheet for each proposed consultant.
.-Computer data/ info. processing (Wordperfect, Lotus).
.-Bilingual spanish-english desired.

CONDITIONS FOR THE US.CONSULTANT.

.-Should be selected and contracted by the Prime Contractor.
.-Will belong to the Plant team.
.-Will supply his own computer, printer and software.
.-Will coordinate activities with EP3 Coordinator.
.-Will report to the Prime Contractor.

DATES FOR IMPLEMENTATION.

1st.VISIT: NOVEMBER 15 through DECEMBER 03.
(or earlier if Technical Assistance Agreements signed out by Plant Board/ Managers in advance).

BEST AVAILABLE DOCUMENT

AMCHAM-CHILE
ENVIRONMENT COMMITTEE

EP3 WORK PLAN FOR TANNERIES.

BACKGROUND.
The AMCHAM Steering Committee has approved two TANNERIES as candidates to initiate individual Plant projects.

These Projects should start right after signature of a Private Agreement with each candidate plant.

INDUSTRIES SELECTED.

CURTIEMBRE JORGE DE CAMINO Y CIA. LTDA.(Mid size plant).
CURTIDOS BAS SA.(Mid size plant).

POLLUTION SITUATION.
Both industries work in batch and semi-continuos processes, producing mostly semifinished leather from row hides,sold to the finishing manufacturers : JORDEC treats only goat hides and BAS specializes in cow hides.

Main concern here is the water pollution from extensive usage of a variety of chemicals to treat, dye and finish the hides; waste water containing salt, sulphides, chromiun,etc. flows directly into the sewage system or an open cannal.

The gaseous emissions come from their boilers and some treatment processes, whereas the solid waste is restricted to trimmings, hair, fat, skin and residues left behind in the vessels and tanks, after washing or cleaning.

WORK PLANS.
The Prime Contractor should conduct a Diagnostic Study in each of these Plants in order to identify Pollution Prevention opportunities, aimed at reduction/ abatement of pollution through low cost changes and modifications to their processes.

In order to perform the Study, the Contractor must develop a specific Execution Work Plan for every Industry Sector (and/ or plant) already approved by AMCHAM Steering Committee.
The Execution Work Plans should be submitted to the Steering Committee for approval, right after the first plant visit as per the Work sequence to follow.

BEST AVAILABLE DOCUMENT

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AMCHAM-CHILE
ENVIRONMENT COMMITTEE

TASKS AND ACTIVITIES-WORK SEQUENCE.

The Contractor Execution Plans for each Plant will include tasks and activities following the sequence below.

.-Orientation meeting with EP3 Coordinator upon arrival of Prime Contractor team to Chile (1st.visit of Experts).
.-Meeting with Plant Board and/or Managers.
.-Diagnosis Study of plant and processes.(Plant tour assessment).
.-Develop Execution Work Plan (Copy to Steering Committee and Plant Board).
.-Effluent base line: recommendations and determination.
.-Plant data/ information collection:cost, processes,functions.
.-Pollution prevention opportunities analyses /identification.
.-Draft report on recommendations with strategies and actions, incorporating the Execution Work Plan.
.-Review of draft Report with Plant Managers.
.-Team formation and task definitions.
.-List of criteria to analyze/ select P2 options.
.-Exit meeting with Steering Committee.
.-Final report on Recommendations to Plant Board with confirmatory analyses and suplemental information for best preferred option to implement in plant.
.-Implementation of best option in plant (2nd.visit of Experts)
.-Monitoring/ follow-up.
.-Information transfer and control.
.-Periodical reports on progress.
.-Evaluation of results (3rd.visit of Experts).
.-Final report of results.
.-PLAN II assessment after evaluation (Capital intensive solutions).
.-Report recommendations for PLAN II capital intensive solutions.

During the visits of P.C.team, time should be spent in seminars, workshops and training sesions to members of the Plants involved.

Similarly, the participation of experts in open seminars dealing with general P2 topics, waste minimization techniques and procedures, clean technologies and related subjects directed towards Academia, Industry Associations and University students may be considered if time permits.

PRIME CONTRACTOR RESPONSIBILITIES.
The Contractor will have to select and contract US.experts and Probono consultants, as well as hiring local chilean consultants in order to provide in-plant assistance to the projects.

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TIMEFRAME.
First visit of US.Team experts should be programmed and take place immediately after Contractor receives written fax notice from EP3 Coordinator, of the signature of Technical Assistance Agreement by the Plant Board/ Managers.

It is expected that the entire process of Diagnostic Study to the stage of Exit meeting with the Steering Committee, will not extend beyond 5-6 working days for every one of the Projects, during the first visit of the team of experts.

On return to the US. the experts will review their preliminary analyses and recommend the most attractive P2 options to address waste reduction opportunities; a Final Report sent to the EP3 coordinator for review of the Plant Board, will allow the Plant to choose the option which would best fit its capabilities and undertake its action plans.

The implementation of the best option selected by the Plant will take place immediately after Plant Board approval, during the second visit of the Team of experts. This step may not take more than 2-3 working days.

Time for monitoring/ follow-up will vary for every particular project and plan.

A third final visit of experts has been programmed for the Evaluation of results, Final Project Report and PLAN II Capital intensive recommendations. It is expected to complete this stage in 5 working days.

It is important to stress that, to the extent possible, experts in such disciplines as Water treatment and Boiler/ burner operations should be used in several plant visits during their trip to Chile.

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APPENDIX B

Industry Agreement

CONTRATO DE MUTUA COOPERACION
ENTRE
El Programa EP3 Y (EMPRESA)

Se celebra el presente Contrato con fecha 6 de Dic de 1993, por y entre El Programa de Prevención de Contaminación (en lo sucesivo denominado "El Programa **EP3**") financiado por la Agencia de los Estados Unidos para el Desarrollo Internacional, (en lo sucesivo denominado como "USAID") en Chile, y que cuenta con el respaldo de la Cámara Chilena Norteamericana de Comercio A.G. (en lo sucesivo denominado como "AMCHAM"), y que recibirá asistencia técnica de RCG/Hagler, Bailly, Inc. como Contratista Principal (en lo sucesivo denominado como "**EP3**-HBI"), con sus oficinas situadas en la Cámara Chilena Norteamericana de Comercio A.G., Avenida Américo Vespucio Sur 80, piso 9, Casilla 82, Santiago 34, Chile, por una parte; y por la otra parte Curtidos Bas, (en lo sucesivo denominado "EMPRESA"); domiciliada en Avda.Carlos Valdovinos 101-105, San Joaquín, Santiago, Chile;

Y

POR CUANTO "**EP3**-HBI" ha sido contratado por la Agencia de los Estados Unidos para el Desarrollo Internacional para que le proporcione al Programa **EP3** servicios de administración y apoyo técnico;

Y

POR CUANTO la EMPRESA manifestó su deseo de participar en El Programa **EP3**, de ejecutar un Estudio de Diagnóstico de Prevención de Contaminación y de implementar sus recomendaciones;

LAS PARTES VIENEN, EN VIRTUD DE LO EXPUESTO, A CONVENIR LO SIGUIENTE:

1. <u>RESPONSABILIDADES DEL PROGRAMA EP3</u>

1.1 El Programa **EP3** y EP3-HBI ejecutarán directamente y/o contratarán (sin costo para la EMPRESA) un análisis diagnostico de prevención de contaminación que será hecho por técnicos/expertos Chilenos asistidos por técnicos/expertos extranjeros, cuando sea necesario. Entre la primeras actividades del estudio diagnostico será establecer una base de referencia de las composiciones actuales de los efluentes de la EMPRESA.

1.2 El Programa **EP3** y EP3-HBI le enviarán a la EMPRESA, para su respectiva aprobación y consentimiento, un Alcance de trabajo recomendado para la EMPRESA.

1.3 El Programa **EP3** designa aquí al señor Mauricio Roldán como Coordinador del Proyecto, quien asume una responsabilidad contractual y operativa directa en virtud del presente Contrato.

El señor Roldán será también responsable de verificar el cumplimiento de las condiciones del presente Contrato.

2. RESPONSABILIDADES DE LA EMPRESA

2.1 La EMPRESA cooperará con los técnicos del Programa **EP3**, suministrará las informaciones técnicas, administrativas y contables, relacionadas a los procesos de fabricación necesarias para analizar los sistemas de producción. El objetivo de esto es identificar posibles cambios en ellos, en las materias primas (si es posible), en los productos químicos, en los controles de producción, y en otros variables para reducir la emisión de contaminantes, y que incidirá en el mejoramiento de la productividad y la rentabilidad operacional.

2.2 La EMPRESA también proveerá a los técnicos del Programa **EP3** las informaciones, mediciones o datos relacionados a las actuales composiciones de los efluentes de nuestra EMPRESA y sobre proyectos de mejoramiento ambiental en ejecución o en planificación. En caso que no tengamos datos cuantitativos sobre la composición actual de efluentes, permitiremos que El Programa **EP3** directamente o usando sub-contratistas de USA o Chilenos tome mediciones cuantitativas sobre la composición de los efluentes como parte del estudio diagnostico de prevención de contaminación.

2.3 La EMPRESA requiere que todos los datos confidenciales de procesos de propiedad de la EMPRESA, o datos relacionados a composición de efluentes que suministre, o cualquier información operacional o comercial que obtengan los técnicos del Programa **EP3** en la EMPRESA, serán tratados con **máxima confidencialidad**, y que no serán divulgados a ninguna entidad Publica o Privada sin previa aprobación por escrito por parte de la EMPRESA.

2.4 La EMPRESA tendrá la última decisión y aprobación de cualquiera recomendación que haga el programa **EP3**, y por ende, la EMPRESA releva al Programa **EP3** de toda responsabilidad legal relacionada a la implementación de las recomendaciones del Programa **EP3** o de sus resultados.

2.5 La EMPRESA está de acuerdo con que el Programa **EP3** inicialmente, tratará de identificar modificaciones que no impliquen mayores inversiones o costos.

2.6 La EMPRESA implementará las modificaciones identificadas y recomendadas por El Programa **EP3**, siempre y cuando estas,

según evaluación de la EMPRESA, no sean perjudiciales a los productos, a los sistemas de producción, ni a las prácticas comerciales y de ventas.

2.7 La EMPRESA permitirá que El Programa **EP3** le de publicidad a los resultados de las innovaciones recomendadas por el Programa **EP3**, y permitirá que otras industrias con procesos similares se beneficien de las experiencias de nuestra EMPRESA, siempre y cuando esto no involucre procesos de propiedad de la EMPRESA, y que se puedan transferir a otras industrias del sector. Los resultados no serán divulgados a ninguna entidad Publica o Privada sin previa aprobación por escrito por parte de la EMPRESA. Esta divulgación de resultados se podrá hacer durante los dos (2) primeros años siguientes a la puesta en marcha e iniciación operativa de las modificaciones o aplicaciones, de forma que otras empresas puedan observar las tecnologías en operación. Estas visitas serán aprobadas por el Gerente de Proyecto de la EMPRESA, y se programarán de forma tal de minimizar perturbaciones en las operaciones de la EMPRESA.

2.8 La EMPRESA obtendrá también las licencias, permisos y otros documentos oficiales que puedan requerirse. La EMPRESA se encargará del pago de cargos locales. La EMPRESA será responsable del almacenamiento y de la seguridad de todos los instrumentos y/o equipos de los técnicos del Programa **EP3** desde su llegada a ésta.

2.9 La EMPRESA se compromete a pagar los costos de implementación de la recomendaciones del Programa **EP3** que sean aceptadas por la EMPRESA.

2.10 La EMPRESA accede a proporcionar personal operativo y de mantenimiento que esté capacitado para recibir entrenamiento para la Operación y Mantenimiento de los equipos, instrumentos o recomendaciones operacionales según lo soliciten El Programa **EP3** y EP3-HBI o el consultor/contratista local que contrate El Programa **EP3** para el Programa **EP3**. La EMPRESA también se compromete a promocionar una ética de Prevención de Contaminación que adoptará e implementará la siguiente política ambiental formalizada, que incluirá a todo su personal:

> "Para la EMPRESA, la protección del medio ambiente tendrá máxima prioridad. Nuestro compromiso será eliminar o reducir la utilización de sustancias tóxicas y reducir al mínimo el uso de la energía y la generación de todo tipo de desechos, siempre que sea posible. Preferimos prevenir la contaminación en la fuente que controlarla y/o tratarla al final del proceso industrial. En los casos que no se puede

evitar que haya desechos, trataremos de reciclar, de tratar o eliminar desechos por medios que reduzcan al mínimo los efectos nocivos para la atmósfera, las aguas y la tierra."

2.11 La EMPRESA proporcionará personal con capacidades técnicas suficientes para ejecutar las funciones de verificación o implementación que identifique El Programa **EP3**. Se le proporcionará toda la información disponible a Programa **EP3** que sea necesaria para formular sus recomendaciones.

2.12 Luego de la ejecución del presente Contrato, el personal técnico de la EMPRESA y del Programa **EP3** realizarán conjuntamente el seguimiento de los resultados. Se registrarán toda medida y parámetros necesarios, como ser las emisiones y los efluentes, para verificar la reducción de los efluentes y de las emisiones.

2.13 La EMPRESA designa a Miguel Angel Ponti como su Gerente de Proyecto, quien asumirá las responsabilidades de revisión técnica de la EMPRESA en relación a la implementación del Programa **EP3**. El Gerente de Proyecto actuará también como enlace entre la EMPRESA y El Programa **EP3**/EP3-HBI y/o con los consultores/contratistas extranjeros o Chileno, que contrate El Programa **EP3** para este Proyecto.

2.14 La EMPRESA le proporcionará espacio de trabajo a los representantes del Programa **EP3** cuando éstos se hallen en la EMPRESA durante las fases de medición, implementación de las recomendaciones, y puesta en marcha de operaciones, y también durante el seguimiento de las implementaciones de las recomendaciones y las evaluaciones y/o mediciones de los resultados.

2.15 La EMPRESA conviene en participar, con otras firmas y con El Programa **EP3**, en la promoción de la "aplicación de tecnologías de prevención de contaminación", asistiendo a seminarios y talleres.

2.16 La EMPRESA declara que ni El Programa **EP3** ni USAID ni EP3-HBI ni sus respectivos contratistas y sub-contratistas, serán responsables por ningún daño directo o indirecto, especial o consecuencial; incluyendo, sin que esta enumeración sea limitante, pérdida de energía, costo de reponer energía, imposibilidad de uso o pérdida de ganancias que pudiesen resultar de la implementación de recomendaciones emanadas de los Estudios Diagnósticos de Prevención de Contaminación o de cualesquier otros servicios prestados por El Programa **EP3**, por USAID o por EP3-HBI o por sus respectivos contratistas y sub-contratistas en virtud de este Contrato.

2.17 La EMPRESA declara que ni El Programa **EP3** ni USAID ni EP3-HBI ni sus respectivos contratistas y sub-contratistas, serán responsable por daños personales, pérdidas o daños a la propiedad que pudiesen resultar de la Aplicaciones Técnicas descritas en este documento. La EMPRESA se compromete a indemnizar, a defender y a mantener libre de perjuicio al Programa **EP3**, a USAID y a EP3-HBI y a sus respectivos contratistas y sub-contratista por y ante cualesquier demandas, juicios o procedimientos provocadas por o relacionadas con cualquier acto o emisión en relación con la ejecución de los servicios objeto del presente Contrato.

2.18 Queda convenido que la EMPRESA procurará sus propios seguros como única medida paliativa ante daños personales, pérdidas o daños a la propiedad o ante cualquier otra pérdida o daño resultantes de o relacionados con la prestación de los servicios ejecutados por El Programa **EP3**, por USAID y por EP3-HBI y por sus respectivos contratistas y sub-contratistas en el cumplimiento del presente Contrato. La EMPRESA acepta liberar, por el presente instrumento, al Programa **EP3**, a USAID y a EP3-HBI y a sus respectivos contratistas y sub-contratistas, de responsabilidad por cualesquier pérdidas o daños que pudiese sufrir la EMPRESA por razones de cualquier clase que sean, en este respecto.

2.19 Se espera que la EMPRESA proporcione indemnización o cobertura a su propio sub-contratista, si lo hubiese, sobre cualquier equipo o instalación de instrumentos en el transcurso de sus prácticas normales de contratación, y que tales medidas puedan incluir cualesquier fuerzas mayores, retrasos, daños liquidados o garantías de cumplimiento que la EMPRESA pueda desear, pero se entiende también que tales medidas no involucrarán en forma alguna los resultados de cualesquier actos u omisiones del Programa **EP3** ni de EP3-HBI ni de ninguno de sus contratistas y sub-contratistas.

3. OBLIGACIONES FINANCIERAS DE AMBAS PARTES

3.1 El Programa **EP3**/EP3-HBI o el consultor/contratistas extranjeros o Chilenos contratados por El Programa **EP3** para este Proyecto, no tienen obligación financiera alguna para con la EMPRESA. En igual forma, la EMPRESA no tiene obligación financiera alguna para con el Programa **EP3**/EP3-HBI o el consultor/contratistas extranjeros o Chilenos contratados por El Programa **EP3** para este Proyecto.

4. DURACION DE ESTE CONTRATO

4.1 Este contrato tendrá una duracion suficiente para efectuar los estudios diagnósticos descritos anteriormente, y para implementar las recomendaciones del Programa **EP3**, pero en

ningún caso será mayor de un (1) año a partir de la fecha de la firma de este contrato. El período de duracion solamente podrá ser modificado por medio de un acuerdo formal por escrito, entre las dos partes.

5. DISPOSICIONES GENERALES

5.1 Honorarios Eventuales

A) La EMPRESA garantiza que no ha empleado ni le ha pagado a ninguna persona ni agente de ventas para que solicite u obtenga este Contrato en base a un contrato de entendimiento por comisión, porcentaje, corretaje u honorarios anticipados; a excepción de empleados de buena fe o de agencias comerciales o de venta establecidas que la EMPRESA mantenga para efectos de procurar negocios.

B) En caso de infringimiento o violación del presente Contrato, El Programa **EP3** tendrá el derecho de detener todas las actividades sin contraer responsabilidad por ello.

5.2 Efecto Legal de la Aprobación y Decisión de USAID

Las Partes suscritas manifiestan entender que el presente Contrato reserva ciertos derechos para USAID, tales como (pero no limitándose a): el derecho de aprobar las condiciones del presente Contrato, y también la EMPRESA y cualesquier otras industrias, los informes, las especificaciones, los sub-contratos, los documentos de licitación, los planos u otros documentos relacionados con el presente Contrato, como también el Proyecto del que este Contrato forma parte. Las partes suscritas declaran también entender y aceptar que USAID, al reservarse cualesquiera o todos los derechos de aprobación mencionados, actúa únicamente como una entidad financiera para asegurar el uso adecuado de los fondos del gobierno de los Estados Unidos, y que cualquier decisión que USAID tome de ejercer o de abstenerse de ejercer tales derechos de aprobación, será en cuanto parte financiante en el curso del financiamiento de este Proyecto, no significando que USAID entre a ser una parte del presente Contrato.

Las Partes suscritas declaran entender y aceptar que USAID puede, de vez en cuando, ejercer los derechos de aprobación mencionados, o bien discutir materias relacionadas con tales derechos y con el Proyecto, ya sea con las partes en conjunto o separadamente, sin que por ello incurra en responsabilidad alguna ante las partes, ni en conjunto ni en forma separada. Cualquier aprobación (u omisión de aprobar) por parte de USAID no privará al Programa **EP3** ni a EP3-HBI ni a USAID de ejercer sus derechos, ni liberará a la EMPRESA

de ninguna responsabilidad que ésta pudiese tener, de no haber mediado tal ejercicio, ante El Programa **EP3**, ante EP3-HBI o ante USAID.

5.3 Inspección

La EMPRESA consiente en permitir acceso a los representantes autorizados del Programa **EP3** y de USAID, en cualquier momento razonable, para que inspeccionen las instalaciones, las actividades y el trabajo relacionado con este Contrato, y también para que adopten medidas de trabajo y realicen pruebas durante la vigencia del presente Contrato.

5.4 Notificaciones

Cualquier notificación que entregue al Programa **EP3**/EP3-HBI tendrá validez y efectividad solamente si se emite por escrito y se entrega al coordinador del Programa **EP3** o a la EMPRESA en las direcciones consignadas en este Contrato. Las notificaciones entrarán en vigencia al momento de su entrega o a la fecha consignada como efectiva, lo que ocurra primero.

5.5 Ley que Regirá

El presente Contrato se interpretará de acuerdo con las leyes de la República de Chile, y en caso de litigio, este se tramitará en la ciudad de Santiago.

6. COPIAS DE ESTE CONTRATO

6.1 Este documento se hará en cuatro originales, uno para el Programa **EP3**, uno para la EMPRESA, uno para AMCHAM y uno para EP3-HBI.

Se declara que las partes, por medio de sus representantes debidamente autorizados, están de acuerdo con las cláusulas de este contrato.

Por la EMPRESA	Por el Programa **EP3**
Nombre: Miguel Bas González	Nombre: Eduardo S. Maal
Cargo: Gerente General	Cargo: DEPUTY DIRECTOR
Firma:	Firma:
Fecha: 03 Diciembre 1993	Fecha: 03 Diciembre 1993

FIG. 1: PROCESS FLOW SHEET FOR CATTLE HIDE CHROME TANNING

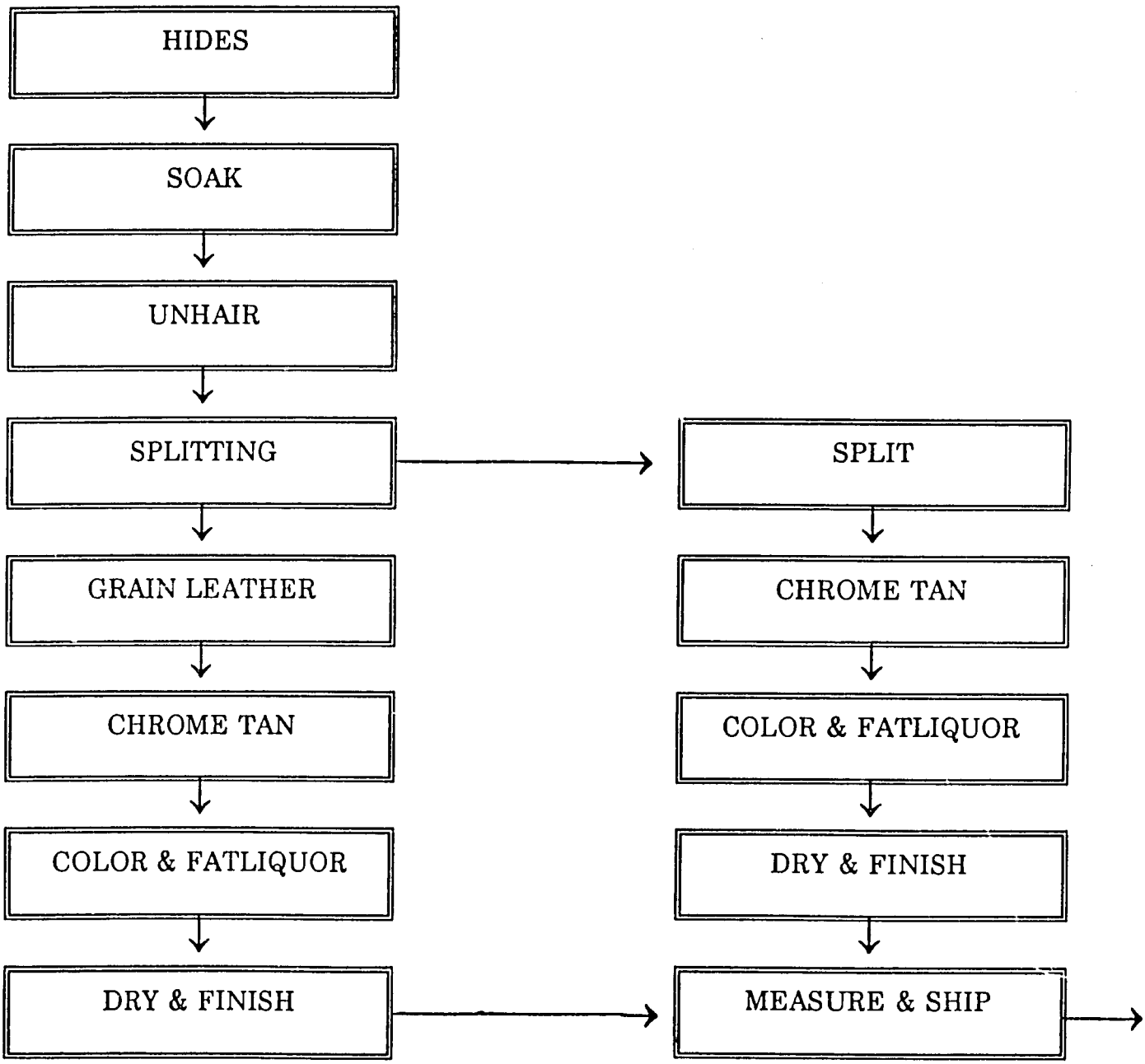


FIG. 2: DATA SUPPLIED BY THE TANNERY OF THE pH

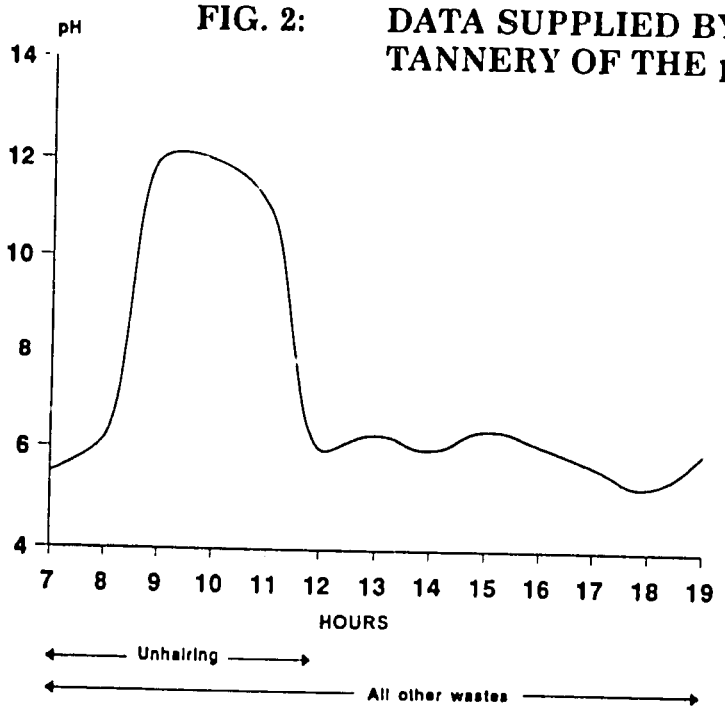
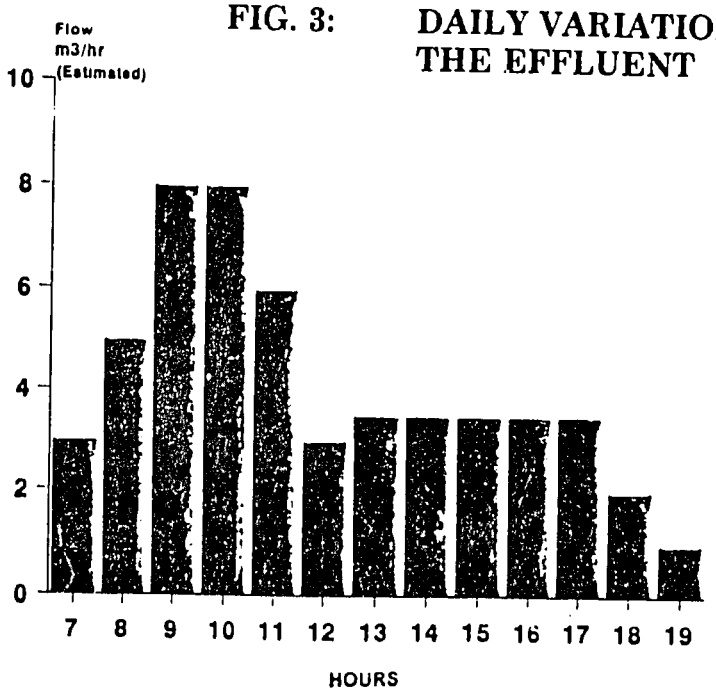


FIG. 3: DAILY VARIATIONS IN THE EFFLUENT



Estimated flow per 1,000 kg Hides

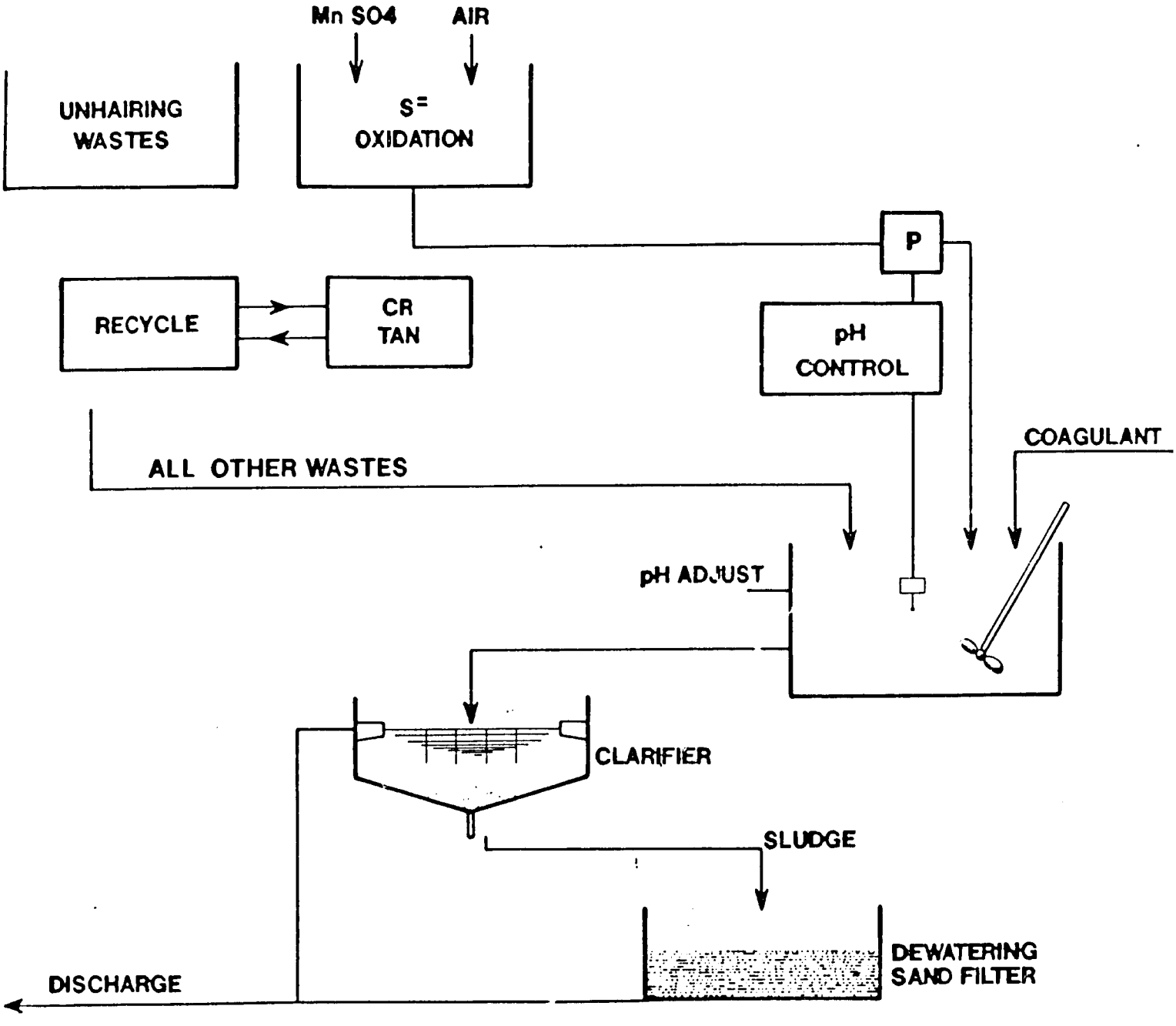



FIG. 4 Primary Treatment Plant