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United Nations Industrial Development Organization

Assistance in Pollution Control and Treatment of Tannery Effluent in Two Selected Areas of Indonesia

UNIDO PROJECT
US/INS/92/120

FINAL REPORT

Based on the work of M. van Vliet - Team Leader/Environmental Specialist,
F. Turan - Effluent Treatment Technologist/Process Engineer
D. Cruickshank - Senior Leather Technologist, and
P. Mitchell - Senior Civil Engineer, representing
BLC, Leather Technology Centre

This document follows the previous field mission and commissioning reports for the UNIDO contract with BLC, Leather Technology Centre under Contract No. 95/187.

Backstopping Officer : J. Buljan, Agro-Based Industries Branch

This document has been edited and cleared by UNIDO.

BLC Leather Technology Centre

October 1998

FINAL REPORT

for

Assistance in Pollution Control and Treatment of Tannery Effluent in Two Selected Areas of Indonesia

UNIDO Project US/INS/92/120
UNIDO Contract No. 95/187
BLC Contract No. RC95-6-002

This final report provides a summary of the overall project activities and information on the project status of the Gambiran Tannery and ETP in Yogyakarta. The report also updates on the progress achieved since the commissioning field mission of May-June 1997 and, in particular, details of the missions of 1998 to complete the ETP equipment installation, commissioning and training and cleaner technology demonstrations.

.....

Martin van Vliet
(Project Team Leader)

.....

Farid Turan
(Effluent Treatment Specialist)

for

BLC Leather Technology Centre
Northampton
United Kingdom

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LIST OF ABBREVIATIONS

APKI	Association of Leather Industries in Yogyakarta
BLC	The Leather Technology Centre, UK
IRDLAI	Institute for Research and Development of Leather and Allied Industries, Yogyakarta, Indonesia
RePO	Regional Programme Office (UNIDO), Chennai, India.
UNIDO	United Nations Industrial Development Organisation
Alum	Aluminium sulphate
BOD_5	Biochemical Oxygen Demand (5 day)
COD	Chemical Oxygen Demand
Cr^{3+}	Chromium (trivalent)
DS	Dry Solids
d	Day(s)
ETP	Effluent Treatment Plant
h	Hour(s)
kg/d	Kilograms per day
kW	Kilo Watts
mm	Millimetres
m^3	Cubic Metres
Rp	Indonesian Rupees
SS	Suspended Solids
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
y	Year(s)

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1. Introduction

This final report for the project presents a summary of all the previous reports from the various field missions by the UNIDO Consultants to Yogyakarta (Indonesia) and the debriefing missions to Jakarta and Chennai (India). The consultancy was undertaken as part of the project US/INS/92/120: "Assistance in Pollution Control and Treatment of Tannery Effluent in Two Selected Areas of Indonesia". The BLC terms of reference for the UNIDO Contract No. 95/187 is included in Appendix I.

The main objectives accomplished during this consultancy project are;

- Review of the considerable amount of technical reports, studies and the various consultant papers dealing with matters of relevance to the project.
- Assessment and recommendations on appropriate low waste processing methods to be applied to reduce pollution load from Gambiran & Budi Makmur Tanneries.
- Re-assessment of the Gambiran ETP design and the already initiated civil works.
- Providing of detailed design and updated information including drawings, flow sketches, and diagrams for civil works, mechanical and electrical installations.
- Provision of detailed design information on mechanical and electrical equipment, installation and operation including costs for chemicals, power, labour, etc.
- Progress assessment and verification of the preparatory work - civil construction and infrastructure- to be in-line with the original specifications and requirements.
- Preparation of detailed tentative specifications and cost estimates for tannery machinery and ETP equipment, suppliers and assistance with the technical evaluation of equipment quotations to be procured for the project.
- Assistance with the supply, mechanical and electrical installation and test run of the ETP equipment, upto the commissioning and staff training for the first phase operation of the primary treatment and sludge dewatering facilities.
- Repeat field missions to assess and provide support during first phase operation of ETP. Assistance with practical recommendations to increase production from Gambiran Tannery and operate with ETP as a commercially viable enterprise.
- Close collaboration with UNIDO Jakarta and RePO in Chennai (India) including regular debriefing missions to update on progress and provide support with regard

to technical and commercial matters associated with Gambiran Tannery operation and ETP installation, commissioning and maintenance for a successful project.

- Return field missions to assess the operation of the primary treatment to ensure equipment and processes perform as expected and designed. Finalise commissioning of the second phase biological treatment process and optimise primary treatment operations in preparation to the official inauguration ceremony.
- On-site practical training of operators to independently operate equipment and ETP processes. Technical training lectures and practical demonstration of ETP technologies provided to local staff and other tannery personal based at IRDLAI.
- Official hand-over of the plant to RDLAI. Due to political problems in Indonesia the inauguration ceremony was cancelled.

In the latest field mission it was noted that a relatively good level of primary treatment was achieved by the counterparts when relatively 'fresh' wastewater was being treated. However, the main issue was that of providing regularly and sufficient supply of wastewater from Gambiran Tannery prior to the biological process being commissioned for effective long term operation of the complete treatment facilities. The UNIDO Consultant was involved in arranging negotiations between IRDLAI and the local tanners to start regular processing at Gambiran during the mission and thus enable the complete operation of the ETP facilities including the biological stage.

The Consultant noted that the biological process had been successfully commissioned and prior to departure from the field all the ETP equipment was fully installed, refurbished and operational and further practical and technical training of the local personnel was provided with detailed instructions to operate and maintain the equipment and to further optimise the treatment performance. A formal confirmation by IRDLAI of the successful installation and commissioning of the Gambiran ETP equipment and training of local counterparts is included in Appendix II.

2. Project overview

The first field mission to Yogyakarta by the UNIDO Subcontractor's team was made during the period 19 February to 2 March 1996 following a prior debriefing mission to Vienna and the evaluation of the existing reports and technical data on the project. The specific objectives of the two week first field mission was to primarily collect updated information and to re-assess the existing designs and facilities for the implementation of cleaner technologies and effluent treatment plant at Gambiran. The scope of the mission also included technical support to Budi Makmur Tannery, in particular, identification of suitable low waste technologies and analysis of the main deficiencies with their existing ETP in order to improve its operational performance.

A very detailed first field mission report (March 1996) was provided from the Subcontractors' comprehensive field study including the revised and updated information, design evaluation with relevant process drawings, sketches and an indication of the new equipment specifications together with new investment and operation cost estimates as specifically requested by the contract. Important design information was provided for Gambiran ETP, in particular, to incorporate essential changes and strengthening of the civil works since the civil construction of the first phase facilities was already mostly established and the second phase about to start. Detailed design drawings was also provided for the civil construction of the second phase mainly sludge dewatering and chrome recycling facilities.

Appropriate changes to the ETP process design were also included based on updated information, in particular with regard the envisaged quality and quantity of waste water to be produced on a regular daily basis. The process design changes were based on the detailed assessment of the existing facilities and on discussions with the local counterparts concerning the operation of the facilities at Gambiran. The Tannery and ETP is intended to be used as demonstration site for pollution control and cleaner technologies for small and medium sized tanneries of Indonesia.

In addition to the Gambiran site, the first mission also investigated the application of suitable cleaner processing options for Budi Makmur Tannery and provided detailed process evaluation and advice to improve the performance of the existing ETP.

A second field mission was made by the Subcontractor's team leader during 6-8 May 1996. The main objectives of the two day field mission were to:
- assess the progress made with regard to ETP civil works and Gambiran Tannery,
- identify the progress with regard to implementation of recommended improvements of the ETP at Budi Makmur Tannery and recommendations for cleaner technologies,
- discuss any comments by IRDLAI on the report, design information and recommendations from the first field mission,
- agree with IRDLAI on a timetable for the phase II of the civil works and the implementation of cleaner technologies, and to revise the project time schedule.

The progress report of June 1996 provides updated information and details from the findings of the second mission including progress on the civil works, new drawings and sketches and additional information on the new equipment specifications together with new investment and operation cost estimates. Also, a draft business plan was provided (as prepared by IRDLAI) for the Gambiran Tannery and ETP. The business plan was requested by the Subcontractor to enable the long term commercial operation of the Gambiran Tannery to enable future funding of the necessary costs of operating and maintaining the ETP facilities.

The third field mission by the Subcontractor's was during the period of 5 May to 2 June 1997. The specific objectives achieved during the 'commissioning' mission was:
- verification that the preparatory work- civil constructions and infrastructure - was in line with the original specifications and design requirements,
- installation, test run and commissioning of all machines and equipment delivered,
- ensuring the ETP equipment and processes perform as expected and designed,
- training of local staff to independently operate installed machines and equipment.

The original project time schedule had to be extended and a two stage approach to the commissioning of the ETP was undertaken due to the inadequate and irregular supply of tannery wastewater for effective biological treatment. Initially, only the primary physical-chemical and sludge treatment operations was commissioned prior to the secondary biological treatment process when adequate staff experience had been gained and sufficient tannery wastewater was to be provided regularly.

A further (fourth) field mission to Yogyakarta was made by the Subcontractor's team leader, during the period 21 to 27 September 1997. The main objectives of the visit to the Gambiran Tannery and ETP was to:

- assess the actual operation of the ETP,
- agree on the programme and time scale for the final commissioning of the ETP,
- agree on a programme to demonstrate cleaner technologies in the tannery.

During the fourth mission it was noted that the production from Gambiran Tannery was extremely low (estimated at 3-5 m^3/day of effluent discharged to the ETP) and a substantial increase in production could not be foreseen at that time. Effluent treatment was only practised when a sufficient volume of effluent was collected in the first compartment of the equalisation tank. As a result ETP equipment was switched off most of the time and odour problems occurred from time to time. However, when the primary treatment facilities were operated by the local counterparts a very good quality of treatment was achieved with substantial reductions in effluent pollution. A number of minor problems with some of the ETP equipment was also noted and corrective measures were taken and suggested.

The Subcontractor's team attended a debriefing mission to UNIDO RePO in Chennai (India) during the period 11 to 24 October 1997 for the UNIDO Workshop associated with the overall project. The up-to-date report on the operation and performance of the Gambiran ETP was presented at the Workshop by IRDLAI staff. A group meeting was held with the UNIDO project co-ordinators to solve the main issues of increasing tannery production, UNIDO assistance to cover operational costs during the three months trial to finalise the ETP commissioning and staff training, and to alleviate the operational problems of odour from the ETP. One particular suggestion, as proposed by the local counterparts, was to arrange for tanker supply of wastewater from the local tanneries to supplement the daily volume from Gambiran.

In preparation to the final commissioning mission by the Subcontractor's team a number of prior actions was requested from the local counterparts to enable the optimisation of the ETP and rapid start-up of the secondary biological process. It was requested to provide a minimum regular supply of wastewater, essential stock of chemicals, fill the biological aeration tank and initial supply of active biomass.

The fifth field mission by the UNIDO Consultant (Farid Turan) was during 1-14 February 1998 with a return visit on 1-7 March 1998. The specific aim was to ensure the successful commissioning and operation of the comprehensive ETP facilities at Gambiran and further training of local operators and staff. Furthermore, the complete Gambiran Tannery and ETP facilities had to be fully operational in preparations to the official inauguration ceremony which was proposed during 17 February 1998.

During the initial two week period of this field mission the Consultant was involved in the servicing of existing and the installation of remaining ETP equipment. Much time was also taken to re-establish the primary and sludge treatment operations following almost a weeks' shut-down of the ETP during the national holidays just prior to the mission. However, the main problem to overcome was still that of providing sufficient and regular supply of wastewater for the biological process to be commissioned. By the end of the second week, an agreement was reached with the local tanners (see Appendix III) to contract process at Gambiran and thus provide the required supply of tannery effluent to initiate the biological activated sludge process.

On the return mission, the Consultant witnessed that a relatively good level of biological treatment had been established during the short period although further optimisation of the process was expected. Prior to departure from the field suitable measures were taken to alleviate some of the operational problems identified and provide advice to the local counterparts to ensure effective long term operation.

All the ETP equipment (see Appendix V) had been fully installed and refurbished and further practical and technical training of the local staff was provided by the Subcontractor. Detailed instructions to operate and maintain the equipment was provided with three copies of complete operating and maintenance (O & M) manuals. Additional specific operating instructions and recommendations (included in Appendix IV) were also provided with extensive practical demonstrations to optimise the treatment performance.

Performance of primary treatment was considered to be satisfactory producing a relatively clear effluent with adequate dose of the coagulant (alum) and polymer flocculant. The biological process had been successfully commissioned achieving a relatively good level of secondary treatment as confirmed in the effluent analysis.

The local counterparts were advised to regularly (daily) monitor and control the operation and performance of the activated sludge process. The important issue of odour and effective ETP operation, sludge dewatering and management was extensively demonstrated by the Consultant. There was no foul odour from the main ETP operations during the mission except for the remaining sludge collected in the tanks from before the mission.

The two new machines (fleshing and sam/setting machine), provided with UNIDO support in the framework of this project, was checked to be operational and used regularly. The benefits of the two new machines was appreciated by the local tanners which had encouraged the increase of contract processing at Gambiran Tannery and hence the more regular supply of effluent to be treated in the ETP. The new drum, also supplied under the project, had been installed and was being made operational during the mission. It's full operation, however, was not witnessed by the Consultant.

The programme for the demonstration of cleaner technologies has been somewhat limited due to the deviation from the original scope of supply of tannery equipment, together with the lack of regular bovine processing (for hair-save trials) or chrome tanning at Gambiran Tannery for demonstration of chrome recycling and recovery. However, during the course of the project, extensive technical information and training on practical cleaner technologies was provided by the Subcontractor to both the local counterparts at IRDLAI and Budi Makmur Tannery.

The facilities for chrome recycling (and recovery using the filter press) has been put in place and staff made aware of the principles of the process for future application. Furthermore, trials were undertaken at Gambiran to develop an equivalent 'hair-save' liming process for sheep and goat skins by reducing the sulphide offer and change of process to reduce the extend of hair burn. Dramatic improvements were noted by the Consultant with reduction of sulphide load to the ETP and ease of removal of the mostly intact hairs from the brush screen unit. In addition, potential savings on sulphide chemicals were estimated by 50%.

The practice of some cleaner technologies, such as low salt preservation, CO_2 deliming, high exhaustion chrome tanning, low VOC finishing were considered to be inappropriate (unfeasible) for the requirements of the small scale tanners processing at Gambiran. More practical and relevant advice was provided (including to Budi Makmur) on water usage, materials handling and better house keeping.

The final mission was undertaken by the Subcontractor from 4 to 16 May, just prior to the revised inauguration ceremony, planned during May 1998. The specific aim was to evaluate the progress by the local counterparts and provide, if necessary, further assistance to compliment the practical experience gained from the actual operation of the comprehensive ETP facilities.

The ETP has been operated by IRDLAI staff since the final commissioning by BLC in February/March. During the period March to May several complaints were received from local residents concerning obnoxious smell from the ETP. During the first part of the mission the operational problems were resolved and the process was optimised in order to meet discharge standards. The cause and sources of smell were investigated and action was taken to minimise the generation of hydrogen sulphide.

By that time (student) protests commenced in various places in the country and one protest, involving residents of Gambiran and non-residents, prevented further operation of the Tannery and ETP.
During two meetings with local residents it became clear that it had become a political issue and there was no opportunity to discuss the substance. It became apparent that a (temporary) shut-down could not be avoided.

As a result the opening ceremony had to be cancelled and the ETP was cleaned and partly de-commissioned. All parties involved agreed that due to the volatile situation it would be better to cease operation for an indefinite period.

3. Other Business

3.1. Budi Makmur Tannery

The technical assistance provided to Budi Makmur Tannery during the initial mission of the project involved assessment of the application of cleaner processing methods, in particular the setting up of a housekeeping programme to improve the cleanliness of the factory and to ensure that water consumption in the tannery will be reduced. However, due to the reduced production levels during the initial part of the project and the factory set-up being widely spread the immediate uptake of some of the cleaner technologies of interest, such as chrome recycling and recovery, could not be easily or immediately adopted.

A list of recommendations and action plans was proposed to revise the Tannery production scheme to gradually implement the most appropriate cleaner technologies. Support was offered in terms of overall better process monitoring, better housekeeping, water management and replacement of some of the potentially hazardous process chemicals. Furthermore, the performance of the existing, but not optimally functioning, effluent treatment plant at the Budi Makmur Tannery was evaluated to identify the main deficiencies and suitable options were proposed by the UNIDO Consultants to improve the ETP operations.

Budi Makmur has been particularly supportive of the activities at Gambiran, in particular, during the latest mission to ensure that contract processing is established at the Tannery. The Company has provided assistance for the ETP commissioning, in terms of chemicals and biomass to seed the activated sludge process and technically with regard to the Tannery machinery refurbishment.

During the latest mission, the Consultant was in discussions with the Tannery management with regard to the demonstration of a chrome recovery system to be installed at the Budi Makmur Tannery. The re-arrangement of the tanning drums (which is to be undertaken by the Tannery) and the design of the proposed chrome recovery system was discussed and was considered to be viable by the Consultant.

Although the option to practice chrome recovery has been provided at Gambiran, it is believed that the technology will be more effectively demonstrated at a technical scale at Budi Makmur. The Consultant recommends the request for a simple chrome recovery process, achieved with a nominal capital investment, since there is a regular production of chrome tanned leathers at the Tannery. The environmental benefits from such a chrome recovery process would minimise the potential future problems of ETP sludge which is disposed to the Tannery's own land fill site.

3.2. Training Presentations on ETP and Cleaner Technologies

A one day lecture was presented by the UNIDO Consultants during the third (commissioning) field mission of May 1997 to the students and staff at the Academy of Leather Technology on the subject of Cleaner Technologies and Pollution Prevention from the Leather Industry. The course was well attended and received.

A further one day technical presentation was provided by the Consultant at IRDLAI during the latest mission specifically on tannery effluent treatment technologies. A total of 35 delegates attended (details as presented in Appendix VI), which included staff from IRDLAI and representatives from local tanneries as well as tanneries from as far-a-field as East Java. The technical presentation was accompanied by a detailed tour of the ETP facilities at Gambiran to demonstrate the treatment technologies in operation - as shown in the pictures from the mission (Appendix IV).

APPENDICES

APPENDIX I - Subcontractor' Terms of Reference

1.1. During a three day briefing at UNIDO Headquarters, Vienna, of the Team Leader and possibly the key experts, and at home base prior to departure to the Project Area, the subcontractor's team will thoroughly review a considerable amount of technical reports, studies and various papers produced so far and available in the Leather Unit, ISED/AGRO; dealing with matters of interest to the project.

1.2. Subsequently, during a three to four week field mission collect, in close co-operation with national counterparts, up-to-date information and carry out the following work:

1.2.1. Assess the leather processing technology applied; agree on low waste leather processing methods to be introduced in the Gambiran Tannery to reduce the pollution load generated by the presently applied conventional processes. The methods to be considered could be;

- overall better process monitoring, water management and housekeeping
- manual and/or mechanical desalting
- hair-save liming
- ammonium-free deliming
- improved chrome tanning/chrome management (e.g. direct recycling, high exhaustion, chrome recovery)
- avoidance of harmful biocides, dyestuffs, surfactants etc.
- water-based finishing

The selection of methods to be introduced will be based on careful consideration of the local conditions and cost implications.

1.2.2. (Re)assess, in detail, the design of the tannery effluent treatment plant to be established at the Gambiran tannery, including costs of civil works within the area now available for the ETP, and costs of drainage, construction materials, labour, power, chemicals required, etc.

1.2.3. Check, in particular, existing standards for effluent discharge into the water recipient available as well as for tannery sludge disposal. Assess possible locations for the safe disposal of the sludge resulting from the ETP, including cost estimates covering also transport of the sludge to disposal site.

1.2.4. For the Budi Makmur Tannery in Yogyakarta assess in detail the application of cleaner processing methods, including setting up better housekeeping programme to improve the cleanliness of the factory and to ensure that the water consumption in the tannery will be substantially reduced.

1.2.5. Scrutinise the existing, but not optimally functioning, effluent treatment plant at Budi Makmur Tannery and identify the main deficiencies and possible areas of intervention.

1.2.6. Revise and/or prepare the tentative specifications of machines and equipment needed for the introduction of cleaner technology and setting up of the ETP at the Gambiran Tannery to be provided by recipients and by UNIDO; also, indicate the civil works, staffing and training requirements.

1.3. At home base, based on the up-to-date specific data and information collected during the first field mission, the subcontractor's team will elaborate the study which will, in particular, comprise and/or elaborate:

1.3.1. Detailed design, drawings, sketches, flow diagrams, equipment specifications, investment and operation cost estimates to be used by UNIDO and recipients to requisition the equipment needed and to carry out the construction works as required.

1.3.2. Prepare a realistic work plan for the implementation of the activities.

1.4. Copies of the elaborated comprehensive study will be forwarded to UNIDO Headquarters and to the counterpart organisations directly involved in the project, and within a period not exceeding one month from receipt, the study will be reviewed with the recipient parties concerned in the field.

1.5. Subsequently, the Subcontractor will assist in the technical evaluation of equipment quotations to be procured for project needs both by recipients and UNIDO as applicable.

1.6. Finally, the subcontractor will provide the following services;

1.6.1. Verify that the preparatory work - civil construction and infrastructure - are in line with original specification and requirements.

1.6.2. Assist in the installation, test run and commissioning of all machines and equipment delivered.

1.6.3. Ensure that the demonstration units, ETP and processes perform as expected/designed.

1.6.4. Train local staff to independently operate machines and equipment.

Appendix II

Confirmation of ETP Installation and Commissioning

DEPARTEMEN PERINDUSTRIAN DAN PERDAGANGAN
BADAN PENELITIAN DAN PENGEMBANGAN INDUSTRI DAN PERDAGANGAN
BALAI BESAR PENELITIAN DAN PENGEMBANGAN INDUSTRI BARANG KULIT, KARET DAN PLASTIK

INSTITUTE FOR RESEARCH AND DEVELOPMENT OF LEATHER AND ALLIED INDUSTRIES
Jalan Sokonandi No. 9 - Telp. 563655 & 563939, 512929 Fax. : (62) (0274) 563655
Y O G Y A K A R T A - 55166
INDONESIA

Facsimile to	:	**Mr. A. Sahasranaman** **Programme Coordinator** **RePO Madras**	From	:	**Drs. Marsam Kardi, Bk.Teks** National Project Director
Date	:	March 6, 1998	Nr of pages	:	1
Fax number	:	91-44-235 3156			

Dear Mr. A. Sahasranaman,

This is to inform you that the final commissioning of the Gambiran ETP facilities has now been completed with the operation of the complete, physical, chemical, biological and sludge treatment stages.

All the ETP equipment provided under the UNIDO project and supplied by latham Engineering Services (LES) has been installed and tested by BLC (May 1997) and formally commissioned in two phases :
i. Primary and sludge treatment (May 1997)
ii. Biological tretament (March 1998)

In addition to the mechanical and electrical installation, testing and commissioning of the specific ETP equipment, BLC also provided comprehensive training of the principles and practical operation & maintenance of the effluent treatment technologies as provided under the UNIDO Project and IRDLAI Project.

With regards,

Yours truly,

YOGYAKARTA

Drs. Marsam Kardi, Bk.Teks
National Project Director

CC:
1. AITRD
2. UCD Jakarta
3. BLC
4. Project Manajer PPTIKKP
5. File

Lies (file:sahas/swasta/surat8)

Appendix III -

IRDLAI & APKI Agreement for Wastewater Supply to Gambiran ETP

LETTER OF AGREEMENT

We, the following Leather Tanners, are willing to supply, each of us, a minimum of tannery effluent as indicated below, transported by IRDLAI's truck for commissioning the Gambiran ETP, every day (Monday-Saturday). Transport cost will be determined at a later stage, upon amount of service charge agreable by both parties.

No.	Company Name	Minimum Supply	Signature
1.	PT. Budi Makmur	25 m^3	
2.	PT. Budi Progo	15 m^3	
3.	PT. Bromo Sakti & PT. ASA	5 m^3	
4.	PT. Bintang Alam	3 m^3	
5.	CV. Sapta Tunggal	4 m^3	
6.	PT. Sinar Obor	5 m^3	
7.	PK. Fajar Makmur	3 m^3	
8.	PT. Dian Mandala	2 m^3	
9.	PK. Harapan Baru	3 m^3	
10.	IRDLAI	5 m^3	
	Total	70 m^3	
11.	PK SAMPURNA	2 m^3	

Yogyakarta, 2 December 1997

Director of IRDLAI

Drs. MARSAM KARDI, Bk.Teks

Chairman of APKI

Diyono Heningsasmito,B.Sc.

Appendix IV -

Gambiran ETP Process Description

&

Recommended Process Operating Instructions

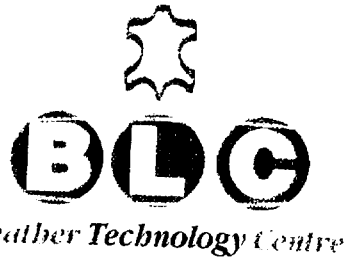
GAMBIRAN EFFLUENT TREATMENT PLANT (ETP)

PROCESS DESCRIPTION AND FLOW DIAGRAM

BLC Contract: RC95-6-002

UNIDO PROJECT
US/INS/92/120

Assistance in Pollution Control and Treatment of Tannery Effluent in Two Selected Areas of Indonesia



March 1998

PROCESS DESCRIPTION OF GAMBIRAN ETP

General Description

The Gambiran effluent treatment plant is designed for 100 m^3/d of wastewater based on typical tannery production of 2.5 tonne/day of bovine and goat/sheep skins.

The comprehensive ETP at Gambiran includes the following main unit operations:

Primary Treatment	- Screening (coarse bar & automatic fine brush screens)
	- Equalisation and sulphide oxidation
	- Pumping and flow control
	- Neutralisation, coagulation & flocculation
	- Primary sedimentation (settling)
Secondary Treatment	- Biological oxidation
	- Secondary clarification (settling)
Tertiary Treatment	- Slow sand/media filtration
Sludge Dewatering	- Sludge holding tank
	- Mechanical filter press unit
	- Sludge drying beds
Chrome Recycling	- Holding tank and return transfer pump
Process Instrumentation	- pH meter and flow meter display
and Control	- pH setpoint, low level and timer controls

The process scheme for the ETP is shown in the Plant Layout & Schematic drawing. Further information on the ETP operation, maintenance, drawings and detailed product literature for the equipment is included in the Operating and Maintenance (O & M) instructions manual - three copies were provided during the commissioning. The ETP supervisors were trained and should be fully familiar with the main unit operations and the O & M instructions for the ETP equipment. The information provided in this document is proposed to further assist the local counterparts with the operation and maintenance of the ETP to achieve the desired treatment results.

DESCRIPTION OF THE ETP UNIT OPERATIONS

i - Primary Treatment Processes

- Wastewater from the tannery flows under gravity through an inclined bar screen (in the factory outlet channel) manually cleaned to remove the coarse solids.
- The wastewater then flows directly into the mechanically cleaned 'brush' screen and into the channel feeding the sulphide oxidation and equalisation tanks.
- Mixing and aeration for both equalisation and sulphide oxidation is provided by two submersible centrifugal aerators located in the centre of each compartment.
- The homogenised effluent is pumped by a single submersible centrifugal 'feed' pump up to the neutralisation/coagulation tank at the top of the ETP. The transfer pump is protected under automatic low level control by float switch.
- The feed flowrate into the neutralisation tank is controlled by an overflow pipe arrangement with the excess flow (prior to any chemical treatment) returned back into the equalisation tank.
- For effluent neutralisation, either diluted sulphuric acid or lime-milk can be dosed from the dosing tankset -either manually or under automatic setpoint pH control. The same tankset can also be used for dosing of polyelectrolyte for enhanced primary treatment.
- For coagulation, aluminium sulphate (alum) is dosed from the packaged tankset. For pH control sulphuric acid can also be added for dosage together with alum.
- Mixing for neutralisation and coagulation is provided by a high speed mechanical agitator in the tank. A dip style pH probe is installed in the neutralisation tank with the pH meter display controller located in the main control building.
- The chemical treated effluent flows directly into the centre of the primary settling tank for solids separation. The wastewater supernatant from the primary tank is discharged directly into the biological aeration tank. Alternatively, primary overflow can be diverted directly to sand filters (as operated in the initial phase).
- The settled primary sludge is discharged under gravity with manual valve control either into the sludge holding tank (for filter press dewatering) or into drying beds.

ii - Secondary Treatment Processes

- Primary effluent is further treated by the biological activated sludge process. The aeration for the aerobic biological process is provided by a submersible centrifugal aerator with self-entraining air inlet pipe located in the centre of the tank. Aeration tank capacity provides a nominal of three days hydraulic retention.
- Mixed activated sludge liquor overflows into the centre of the secondary settling tank for the gravity separation of the biological (biomass) sludge from the treated wastewater. Treated effluent overflows for tertiary treatment by sand filtration.
- The settled biological sludge is continuously recycled using a submersible pump (similar to the feed pump) back into the biological aeration tank. Pump operation can also be controlled under automatic timer control. Periodically, all or part of the return sludge flow can be diverted back into the secondary settling tank to manually dislodge any settled sludge from around the tank corners.
- The excess 'surplus' activated sludge is pumped, with manual valve control, either to the individual drying beds or to the sludge holding tank for mixing with the primary sludge for mechanical dewatering using the filter press.
- The option to discharge the full contents of the biological aeration tank (and the primary settling) is provided by low level manual isolation valve for the controlled 'emergency' drain of the tank contents (preferably through the drying beds).

iii- Tertiary Treatment Process

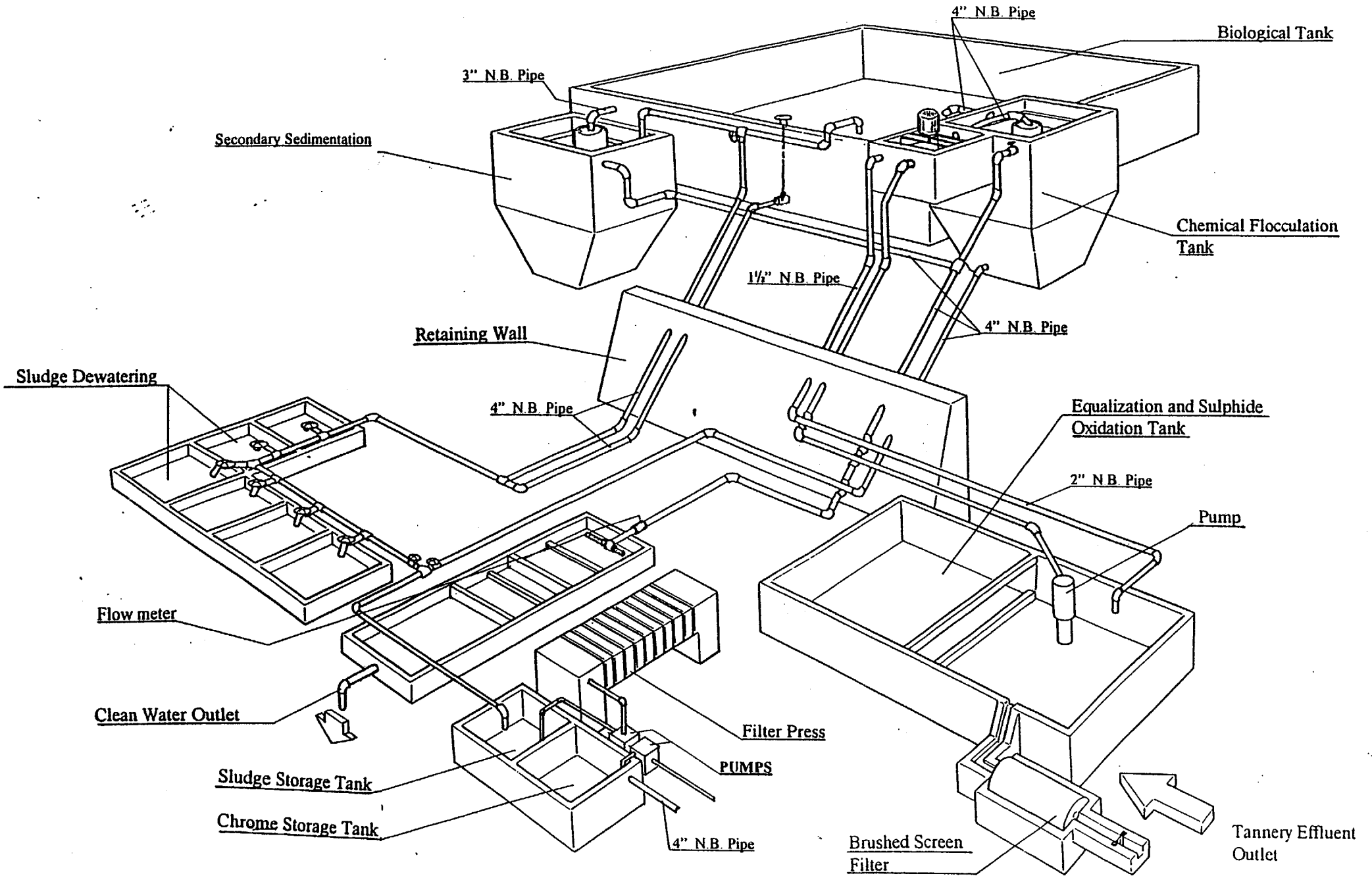
- Biologically treated wastewater from the secondary settling tank flows under gravity to the tertiary sand/media filters for additional solids & biomass separation. The tertiary filters, constructed from the existing simple settling pits, includes a number of concrete baffles to extend the path of flow thus increasing the contact surface area.
- Prior to being discharged into the sand filters the effluent flowrate is measured using an electromagnetic flowmeter with total flow also logged in the display unit.
- The tertiary treated wastewater flows out from the tertiary filter stage and the plant boundary for discharge by open drainage channel into the receiving river.

iv - Chrome Recycling Process

- The spent chrome liquors flows under gravity along a dedicated pipe and channel outlet from the tannery into the chrome holding tank located alongside the sludge holding tank in the mechanical dewatering area.
- The discharged chrome liquors will be screened to remove any large leather solids using a manually cleaned inclined bar screen located inside the tannery.
- The stored chrome liquors will be returned back into the tannery using a submersible transfer pump, controlled from an isolating switch from inside the tannery or from the filter press panel. The rate and volume of returned chrome liquor can be monitored using the in-line electromagnetic flowmeter.
- If required, the exiting facilities can be relatively easily adapted to provide recovery (or safer disposal) of spent chrome liquors following chemical precipitation and sludge dewatering using the filter press unit.

v - Sludge Handling and Dewatering Processes

- The settled primary sludge is periodically discharged into the sludge holding tank. Sludge flow is under gravity and controlled using a set of manual isolation valves.
- Primary sludge can also be discharged to any of the drying beds as well as the option to discharge secondary biological sludge into the sludge holding tank.
- The sludge holding tank incorporates a vertical shaft slow speed (geared) mixer for maintaining the sludge in suspension and agitation during chemical additions. To protect against low level the mixer operation is controlled using a float switch.
- An air operated double diaphragm pump is used to feed the sludge from the holding tank into the filter press unit. Pump air supply is provided using a highly efficient automatic screw compressor unit. Compressed air is supplied to a large reservoir vessel and is lubricated, pressure regulated and the flow adjusted using manual valves for sludge pump speed and pressure controls.
- A semi-automatic filter press unit with 50 chamber plates of 800 mm is provided for dewatering the primary sludge and possibly for the precipitated chrome sludge from the proposed recycling/recovery process. The filter press unit includes a local control panel to operate the hydraulic opening and closing gear and local isolation switches for the associated air compressor unit, sludge mixer and chrome pump.
- A total of six drying beds is provided to be mainly used for the separate natural dewatering of the biological settled sludge. On exceeding the capacity of the drying beds (possibly during the rainy season) the biological and primary sludges can be mixed for combined mechanical sludge dewatering using the filter press.



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SCHEMATIC OF EFFLUENT TREATMENT PLANT

GAMBIRAN

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Kings Park Road Moulton Park
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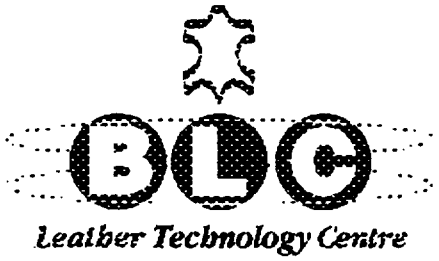
RECOMMENDED PROCESS OPERATING INSTRUCTIONS FOR GAMBIRAN ETP

BLC Contract: RC95-6-002

UNIDO PROJECT
US/INS/92/120

Assistance in Pollution Control and Treatment of Tannery Effluent in Two Selected Areas of Indonesia



March 1998

RECOMMENDED OPERATION CHECK LIST FOR GAMBIRAN ETP

I - General Operation of the ETP

The operation and performance of the ETP is directly related to the amount and quality of wastewater production from Gambiran Tannery and the overall efficiency of the key unit operations of the ETP. In particular, it is essential to provide:

- a regular wastewater supply of minimum 6 days per week
- adequate effluent supply of minimum 50 m^3 (nominal 100 m^3) per day
- wastewater quality in line with the design average influent characteristics
- frequent maintenance and supervision of the essential ETP equipment
- extended operation of the primary treatment stage (minimum 12 hour period)
- continuous operation of the sulphide oxidation and biological aeration stage
- regular removal of sludge from the system and immediate sludge dewatering

To achieve the designed plant performance and meet the required wastewater discharge quality standards it is necessary to provide both consistent and efficient primary (physico-chemical) treatment with effective chemical dosing, sludge removal and optimum control of the biological oxidation process.

Regular influent and effluent analysis and data recording is necessary to determine wastewater characteristics and operating efficiencies, especially from changes in daily and extended operation profile of the ETP. Without proper operation of the key stages and equipment and inadequate monitoring, control and supervision of the treatment performance the final effluent quality will be adversely affected. Operational problems could also result including: poor sludge dewaterability, foul odour and high labour, maintenance, energy and chemical costs.

It is necessary to avoid problem conditions, such as long periods without wastewater influent or insufficient sludge removal, and any chemicals which can be detrimental to the aerobic biological process, such as highly toxic compounds, solvents and oils. It is strongly recommended to maintain regular monitoring of the ETP, based on actual observations and effluent sample analysis, with a daily log of the main plant parameters to achieve and maintain optimum treatment performance.

ii - Primary Treatment Processes

- Ensure the manual bar screen is regularly kept clean of gross solids.
- Ensure the mechanical brush screen is not allowed to block with solids, especially due to part dissolved hair, fibres and fats from liming and fleshing operations. Use brush or jet spray to regularly keep clean the small perforation holes of screen.
- Do not allow the solids to build-up in the equalisation tank (check weekly) or allow any material which could damage the submersible aerator and pump units.
- To prevent motor overheating, do not allow the liquid level in the equalisation tank to drop less than set low level (1 m) when operating either the aerator or pump.
- Do not start/stop pumps and other motors too frequently to prevent overheating.
- Regularly check condition of the feed pump for any blockages with fibres/rags.
- Do not pull on the submersible pumps using the electrical cable. (Ensure cable is not damaged in raising the various pumps out of the tank).
- Run aerator in the equalisation tank for 24 hours every day for sulphide oxidation.
- Operate primary treatment over minimum 10-12 hours, 6 days per week.
- Adjust rate of feed flow into the neutralisation tank to match the daily treatment capacity and alum dosage, typically at 300-500 mg/l. Determine optimum dosage by regular jar tests (amount required depends on volume, pH & SS concentration).
- Ensure wastewater is at optimum pH range for coagulation with alum (pH 8-10). If required, add lime milk (into equalisation tank) or sulphuric acid with the alum.
- Dosing of polyelectrolyte is considered to be optional (typically at 2-5 mg/l) and only recommended if primary effluent quality needs to be further improved. Polymer make-up should be regular, every 2-3 days, and at correct concentration of 0.5-1 %. Do not store prepared polymer solution for more than 2-3 days.
- The overall performance of the primary treatment should be regularly checked by monitoring quality and analysis of both the equalised and primary treated effluent.
- Sludge should be removed from the primary settling tank regularly (at least twice per day) and dewatered using filter press unit. Excessive storage of sludge in the primary tank (more than 1 day) will result in anaerobic conditions, rising sludge, odour and difficulty of dewatering.
- Use sludge drying beds if there is inadequate capacity in the sludge holding tank.

- Periodically (weekly) remove any sludge build-up in the corners of the primary settling tank by using mechanical and/or pumped wastewater as demonstrated.

iii - Secondary Biological Treatment Process

- The activated sludge process requires a continuous supply of oxygen and the return of settled sludge from the secondary settling tank. Ensure biological aerator is always operational (24 hours per day, 7 days per week) and a dissolved oxygen (DO) level of 1 to 3 mg/l is usually maintained.
- Regular and adequate supply of primary treated effluent (with at least 50 m3/day) is needed for the effective biological treatment of tannery wastewaters.
- Discharge of problem and inhibitory (toxic) compounds from the tannery should be avoided. Some scum and foam on the surface of the aeration tank is quite normal due to oils & grease, foaming agents (surfactants) and biodegraded by-products.
- The active biomass concentration, determined by the mixed liquor suspended solids (MLSS) level, must be maintained in the normal range of 4000-8000 mg/l. Biomass activity can be checked under microscope for types of bacterial cultures.
- To maintain the desired MLSS level, periodically the settled 'surplus' activated sludge needs to be disposed of or 'wasted' - preferably to the drying beds.
- Remove sludge from the drying beds on a weekly basis or sooner if possible.
- Biological processes for tannery effluents often requires the supplement of phosphorous (to maintain nutrient balance). It is recommended to dose either phosphoric acid or a suitable phosphate rich fertiliser such as 'TripleSuper Phosphate' (TSP), typically at 5-10 kg/day directly into the aeration tank.
- It is essential that all the settled biomass is continuously returned by pumping the activated sludge from the secondary clarifier back into the aeration tank.
- Periodically (on a daily basis), remove any sludge build-up from the corners of the secondary settling tank using the new set-up with diverted flow of return sludge.
- Fats and scum, if present, should be removed from the secondary settling tank.
- To anticipate biological performance and sludge separation the settling volume index (SVI) should be checked and recorded (at least on a daily basis). Test details are included in the detailed project O & M manual.
- Operators should be familiar with potential problems of the biological aeration process, such as *rising* and *bulking sludge,* and take effective preliminary actions as appropriate. Further details are provided in the project O & M manual.
- Monitor the performance of the biological performance and maintain daily log.

iv - Sampling and Analysis

It is necessary to monitor and control the performance of the Gambiran ETP based on regular and accurate sampling and analysis of the tannery wastewater. The three main process liquors to be sampled and analysed are:

i- untreated mixed effluent from the equalisation tank
ii- primary treated effluent following chemical addition and settlement
iii- final treated effluent before to discharge (after biological and sand filtration)

The important effluent parameters to be analysed and recorded include: pH, total suspended solids, BOD_5, COD, sulphide, total chromium, oils & fats, ammonia and/or total Kjeldhal nitrogen (TKN). These parameters should be tested preferably every day (or at least twice per week) based on fresh effluent samples taken from:

i - feed flow into the neutralisation tank (before any chemical addition)
ii - weir overflow channel of the primary settling tank
iii -outlet channel or pipe after sand filtration

The biological activated sludge process requires additional specific tests/monitoring to be performed and recorded on a regular basis as follows:

- dissolved oxygen (DO) level in the aeration tank (at least twice per day)
- mixed liquor suspended solids (MLSS) in aeration tank (minimum weekly)
- sludge settlement volume in 30 minutes using Imhoff cone -to determine SVI
- return sludge rate and volume (and % DS) of 'surplus' sludge discharged
- biological treatment efficiency determined from influent and effluent quality

The average hourly and total daily flow rates should also be monitored and logged as well as the number of hours the primary treatment stage is operated. Any operational problems, observation and comments should be recorded in the daily ETP log book including any odour based on H_2S meter readings from the various ETP locations.

The sludge characteristics and dewatering efficiency should be checked including:

- volume of primary and biological sludge discharged per day
- average dry solids content (% DS) of sludge before and after dewatering
- time required and number of plates used to dewater sludge using filter press
- number of re-fills and typical time required for dewatering with drying beds

Notes:

1. Sample should be representative of actual effluent and tested within 1-2 days.
2. BOD_5 test may be performed on a weekly basis due to lengthy time for analysis.
3. The pH meter reading from the neutralisation tank includes the coagulant dose. (The pH of the equalisation and biological aeration tanks should be checked daily)
4. The sludge volume index (SVI) is determined from the value of sludge settlement volume divided by the MLSS level (full details included in the O & M manual).
5. It is also recommended to periodically analyse the raw tannery effluent as discharged during various times of day (from channel before equalisation tank).
6. The biological treatment efficiency should be based on influent from primary stage and effluent (before sand filtration).
7. Based on accurate information and daily records the performance of the ETP can be optimised and any operational problems, especially with biological plant, can be later identified.

Example of results table for daily log book - as proposed by the Sub-contractor

Daily Operation and Analysis Log for Gambiran Effluent Treatment Plant								
Date:	***Flowrate:*** .....m^3/h .....m^3/d .....*h operation of primary stage*			***Tannery Operations:***				
Effluent Parameters	**Effluent Samples** Equalised	Primary	Final	**Biological Plant Parameters**		**Sludge Disposal & Dewatering Parameters**		
pH				pH		***Source***	***Volume (m^3)***	***% Dry Solids***
TSS (mg/l)				MLSS (mg/l)		Primary		
BOD (mg/l)				Sludge Test Volume (ml)		Biological		
COD (mg/l)				SVI		After filter press		
S^{2-} (mg/l)				DO (mg/l)		After drying beds		
Cr^{3+} (mg/l)				Temp. (C)		Hours Press operation		
Oils & Fats (mg/l)								
NH_3 or TKN (mg/l)								
Observations and Comments:								

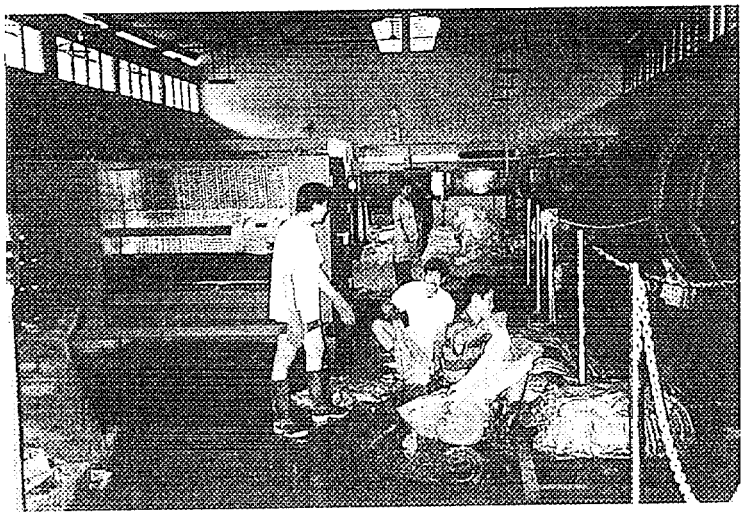
Minimum Recommended Effluent Analysis Schedule:

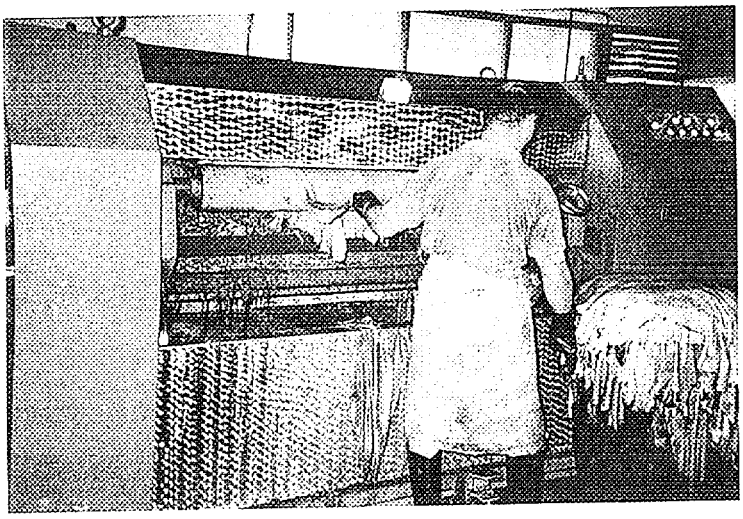
pH	Daily	pH (aeration tank)	Daily
TSS	twice/week	DO (aeration tank)	twice/day (am/pm)
BOD	weekly	Temperature	Daily
COD	twice/week	MLSS	twice/week
S^{2-}	Daily	Sludge Volume (ml)	Daily
Cr^{3+}	twice/week	SVI	twice/week (from MLSS)
Oils & Fats	twice/week	Sludge Volume Discharged	Daily
NH_3 or TKN	twice/week	% DS for Sludge	twice/week (for both wet and dewater sludge)

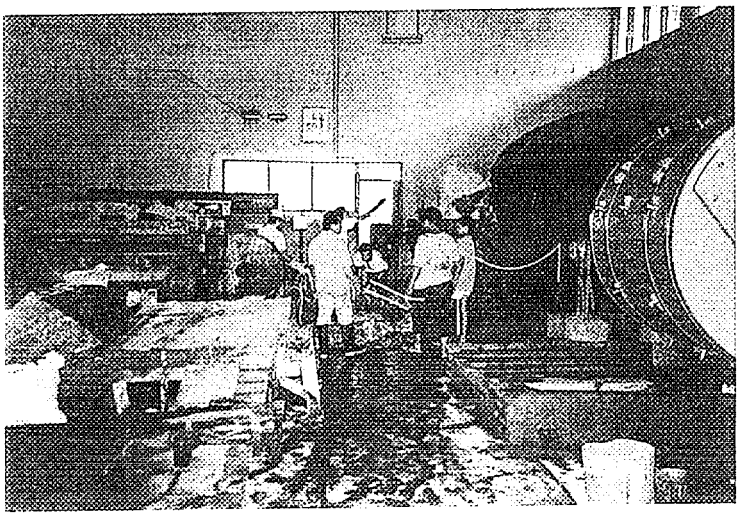
Appendix V -

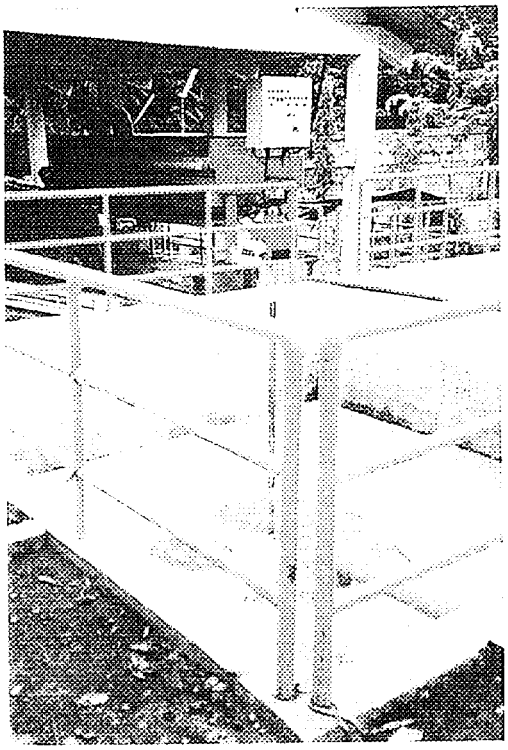
Pictures of Gambiran ETP Installation and Plant Operation

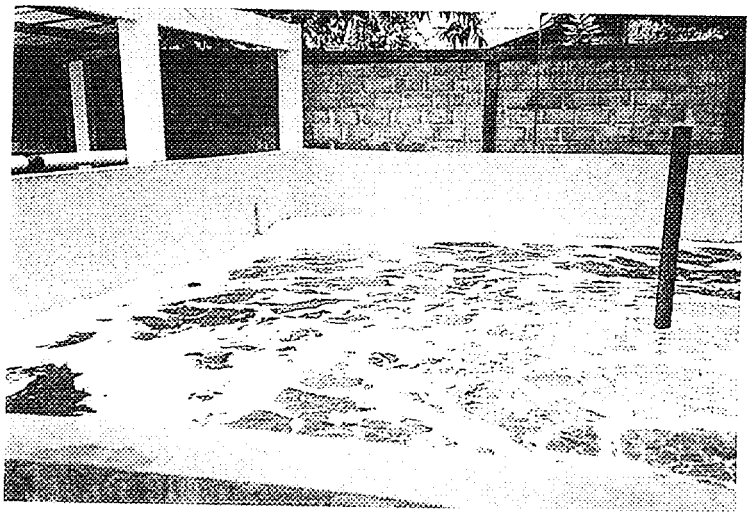
Operation of Gambiran Tannery with New Machinery

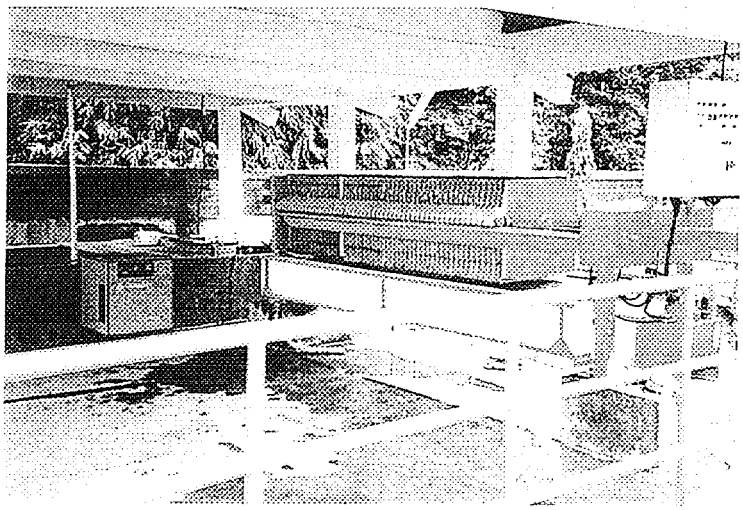




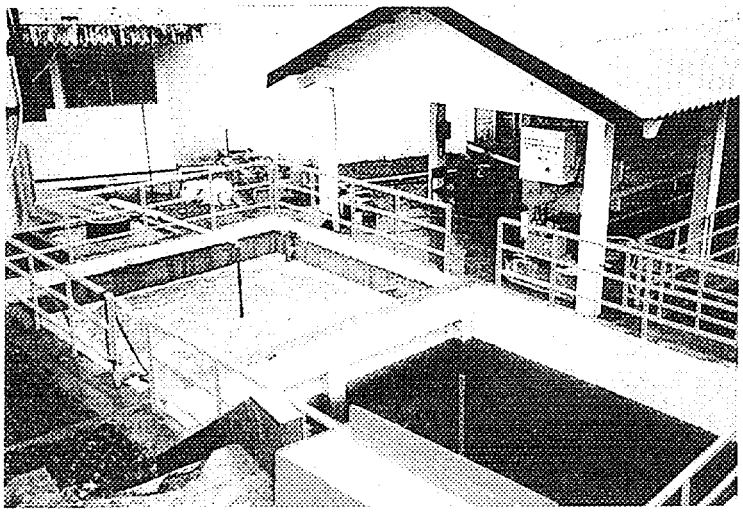


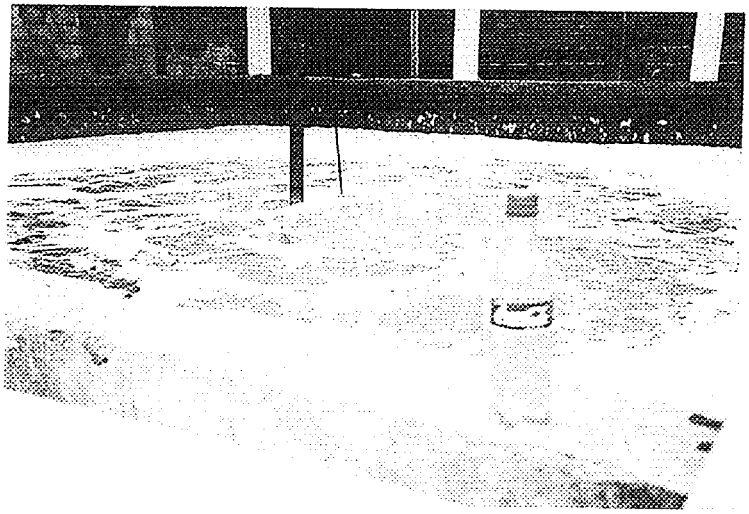


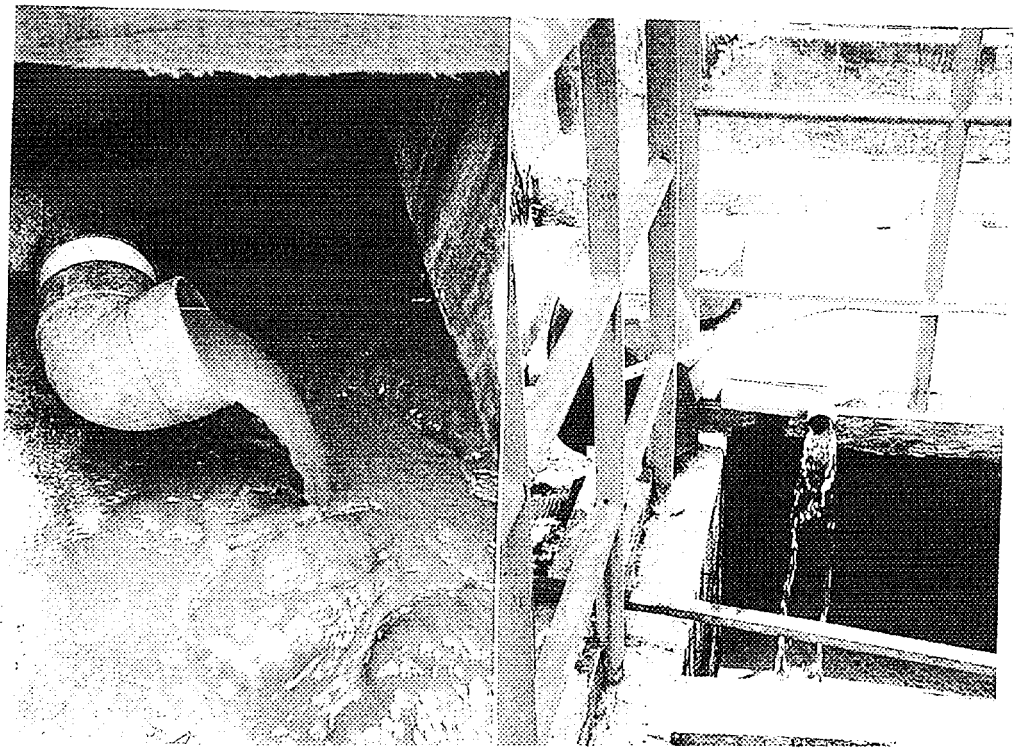




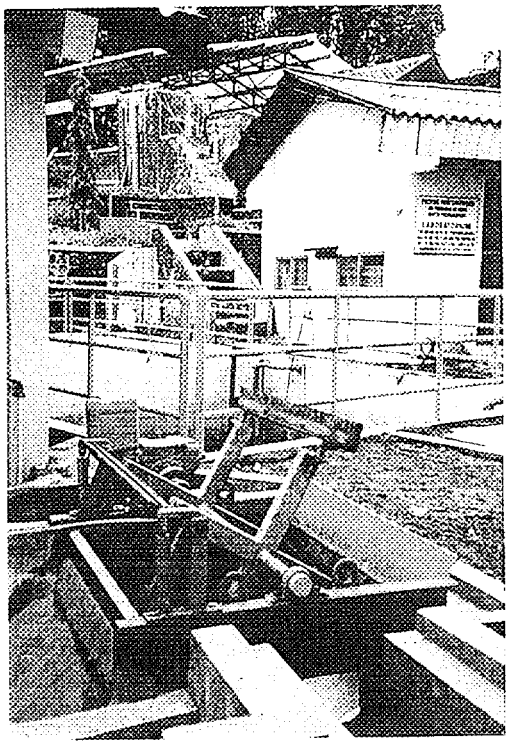
Performance of Biological Treatment from Mixed Untreated Effluent

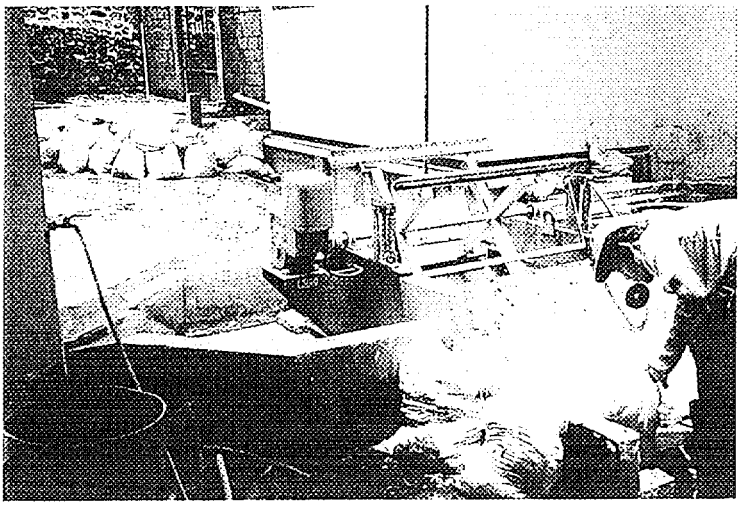


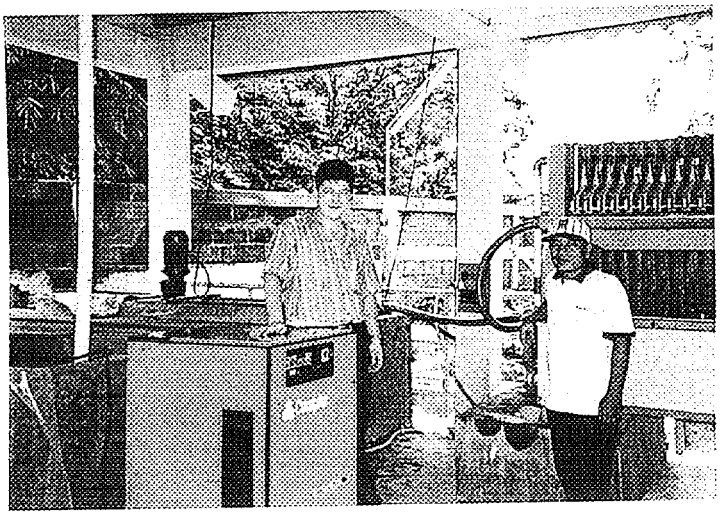




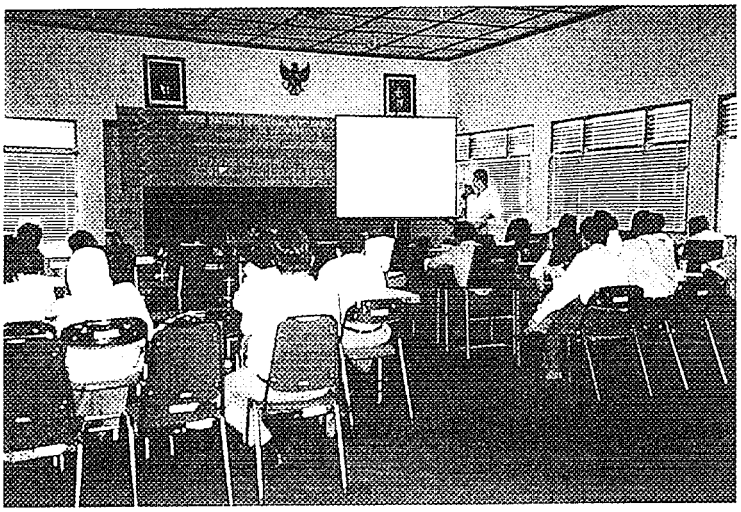
Solids and Sludge Removal Facilities at Gambiran ETP

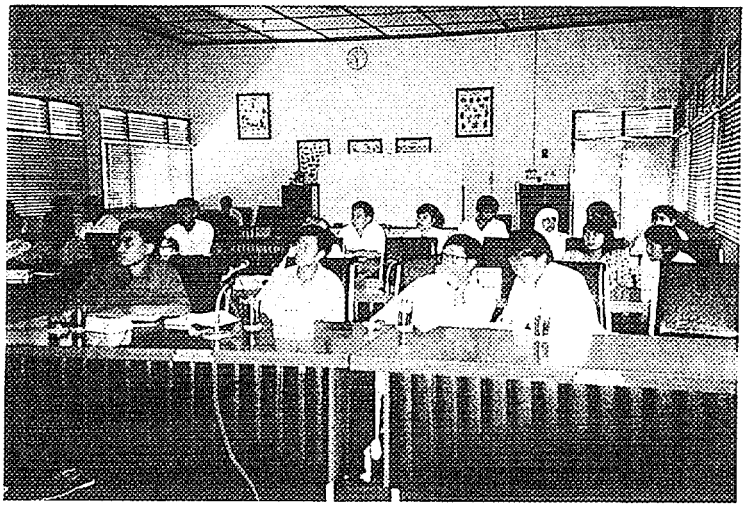


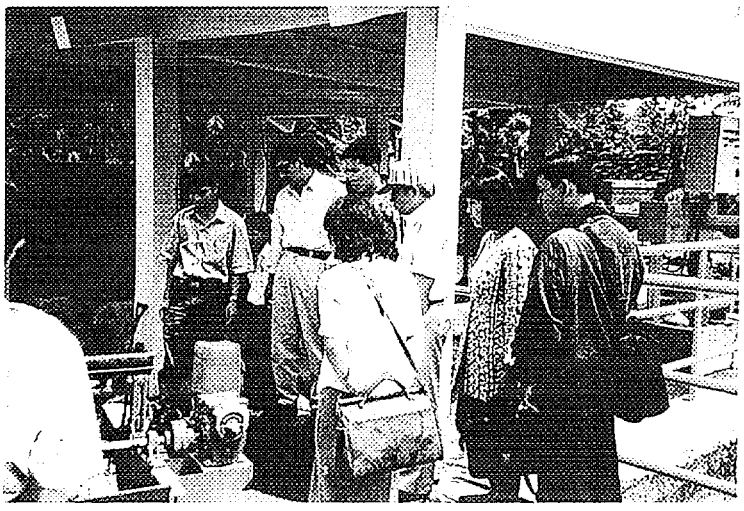




Technical Training and ETP Demonstration at IRDLAI & Gambiran







Appendix VI -

List of Participants of Training Course at IRDLAI

DAFTAR HADIR PESERTA

Hari/Tanggal : .....
Acara : .....
.....

NO.	N A M A	ALAMAT	TANDA-TANGAN	
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5.	Murtijo	PT.Budi Makmur Jayamumi,Yogya	5.	
6.	Agus Muljatim	PT.Usaha Loka, Malang Jatim		6.
7.	Sigit Sugiarto	PT. Usaha Loka, Malang Jatim	7.	
8.	Rudi Krisbiantoro	PT. Usaha Loka, Malang Jatim		8.
9.	Budi Setiawan	PT. Usaha Loka, Malang Jatim	9.	
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11.	Budijono	BBKKP, Yogyakarta	11.	
12.	Widodo, B.Sc.	BBKKP, Yogyakarta		12.
13.	Kasmin Nainggolan,BSc	BBKKP, Yogyakarta	13.	
14.	Muchtar Lutfie, B.Sc.	BBKKP, Yogyakarta		14.
15.	W a h o n o	BBKKP, Yogyakarta	15.	

NO.	NAMA	ALAMAT	TANDA-TANGAN	
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17.	Herryanto, B.Sc.	BBKKP, Yogyakarta		17 .....
18.	Ir. Sri Pertiwi R, MP	BBKKP, Yogyakarta	18.	
19.	Ir. E.Ratna U	BBKKP, Yogyakarta		19. .....
20.	S a i d a	BBKKP, Yogyakarta	20.	
21.	Widodo	BBKKP, Yogyakarta		21. .....
22.	Giyanto	BBKKP, Yogyakarta	22.	
23.	Bambang W, B.Sc.	BBKKP, Yogyakarta		23. .....
24.	Sri Waskito, B.Sc.	BBKKP, Yogyakarta	24.	
25.	Ir. Sotja Prajati	BBKKP, Yogyakarta		25. .....
26.	Sri Sutyasmi	BBKKP, Yogyakarta	26.	
27.	Drs. Ign. Sunaryo	BBKKP, Yogyakarta		27. .....
28.	Ir. Ismiati	BBKKP, Yogyakarta	28.	
29.	M.S.Sandjojo	PT.Bromo Sakti, Yogyakarta		29. .....
30.	Remi Syamsudin	PT. Sinar Obor, Yogyakarta	30.	
31.	S a i d i	PT. Sinar Obor, Yogyakarta		31. .....
32.	Tugiman	BBKK, Yogyakarta	32.	
33.	BASHAR	P.T. ADI SURYA ABADI		33. .....
34.			34.	
35.				35. .....
36.			36.	
37.				37.