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ASSISTANCE IN THE DEVELOPMENT OF NEW ACTIVITIES AT THE  
INSTITUTE FOR RESEARCH AND DEVELOPMENT OF  
LEATHER AND ALLIED INDUSTRIES

DP/INS/85/016/11-03

INDONESIA

Technical report: Treatment of effluents emanating from small-scale  
tanneries in the Magetan and Garut clusters

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

Based on the work of Giuseppe Cloafaro,  
expert in tannery waste-water treatment

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Explanatory notes

IRDLAI	Institute for Research and Development of Leather and Allied Industries
COD	Chemical oxygen demand
BOD <sub>5</sub>	Biochemical oxygen demand
DO	Dissolved oxygen
NPD	National Project Director
CTA	Chief Technical Adviser

All prices of equipment are given in United States dollars.

## ABSTRACT

As part of the project "Assistance in the development of new activities at the Institute for Research and Development of Leather and Allied Industries" (DP/INS/85/016), an expert in the treatment of tannery effluents was sent on a two-month mission, July and August 1987.

In accordance with his job description and with the immediate project objective of establishing a core capability at IRLAI for the design of waste treatment plants suitable for application in the small-scale sector, the expert trained his counterparts at IRLAI, at the same time recommending steps that should be taken to upgrade their knowledge and experience; proposed, at the request of IRLAI, a programme for the fellowship abroad planned for an IRLAI counterpart; assessed the capabilities of the IRLAI laboratory for analysis of tannery effluents; visited the small-scale Gambiran tannery owned and operated by IRLAI, advising that a simple treatment plant be installed there that would also serve as a training facility and preparing a design, including a list of essential treatment and laboratory control equipment, for the suggested plant; and visited numerous small, independent tanneries clustered at Magetan and Garut, recommending for the former site several temporary interventions to reduce pollution and proposing a waste treatment plant for the site. The situation at Garut was too complex to admit an easy solution, and the expert advised that a more detailed study would have to be undertaken.

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## INTRODUCTION

### A. Summary of activities

This report describes the most significant activities of Giuseppe Clonfero, UNIDO expert in tannery effluent treatment, during his two-month mission in Indonesia during July and August 1987. Because it was his first mission to that country, the expert needed to quickly immerse himself in the local situation, in particular:

To ascertain the level of technical knowledge on the subject of tannery effluent pollution and treatment;

To become familiar with existing legislation and standards for industrial effluents;

To visit as many tanneries as possible, especially the small-scale tanneries clustered at Magetan and Garut, to gain a first-hand knowledge of their problems and needs.

The expert also began training his counterparts at IRLAI in tannery effluent treatment and in treatment plant design and installation.

### B. Conclusions

At the end of his mission, the expert reached the following conclusions:

1. Indonesia suffers a lack of expertise in the treatment of industrial effluents, in particular those of the leather industry. Most of the tanneries visited (small- and medium-scale) have no kind of treatment. Moreover, the few treatment plants that do exist, or are being installed, are poorly designed and primitive.
2. Existing effluent standards are too strict to be attained all at one time. The technical and economic difficulties of meeting these standards (coming, as they do, in addition to the difficulties mentioned in item 1), are, in the expert's opinion, too great for the local tanning industries, especially the small-scale ones.
3. Conditions in the Magetan area are much different from conditions in the Garut area. The tanneries at Magetan are concentrated in a well-defined industrial area; those at Garut are spread throughout the urban tissue. The environmental problems at Magetan are directly related to tannery effluents, and the airborne pollution there can be reduced to a level acceptable to the community. The difficulties at Garut are much more complex and will only be resolved after there has been a more detailed study of the industrial and public uses of that area.
4. The small-scale leather industry is very frequently treated as a homogeneous whole. This, in the expert's opinion, is a mistake: the present and future problems of tanneries differ greatly from the problems of goods manufacturers. 1/

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1/ For example, if leathergoods manufacturers were to avail themselves of the large quantities of leather now exported as wet-blue that is available to them, they would be able to grow in terms of both quality and quantity; by contrast, most small-scale tanneries will only be able to improve quantitatively.

5. The technical competence at IRDLAI is not sufficiently high, mainly because of a lack of practical experience. The expert does not believe that IRDLAI personnel will be able, at least in the near future, to design proper tannery effluent treatment plants. Although the situation will have improved once the IRDLAI candidate has completed his fellowship in Europe and once a second expert mission to Indonesia has taken place, the Indonesian team must nonetheless make every effort to extend its knowledge and practical experience. In particular, it must improve its liaison with regional environmental institutes and with outside (i.e. non-IRDLAI) tanneries, no matter what their size (many problems are the same whether the tanneries are large or small). In the expert's opinion, IRDLAI is living in somewhat of an "ivory tower", removed as it is from the real needs and problems of the country's industries. This situation can and must be changed. If existing facilities (laboratory, pilot plant etc.) are just slightly improved and governmental economic support is forthcoming, and if the counterparts are allowed more initiative and movement, IRDLAI could in the coming years play an essential role in helping the tanning industry treat its effluents.

6. The project's aims are very ambitious relative to its means (five man-months for an expert in the field, six man-months for a fellowship and four persons assigned as counterparts in effluents treatment), but it is to be hoped that when this project expires, new initiatives will take place.

#### C. Background information

Since 1975 the Indonesian Republic has been promoting environmental protection by means of laws that regulate both urban and industrial effluents. These laws, directives and standards were promulgated by the Health Ministry (only recently has an Environmental Ministry been instituted) and give priority to the interest and safety of the country's citizens. (Rivers are an important element in the life of the Indonesian people. Their waters are used both for sanitary purposes, such as bathing and washing clothes, and for agriculture - i.e. irrigation, watering stock etc.) A law that also addresses the problems and needs of industry has been drafted by the Industry Ministry, but it is still under governmental review. Thus, the environmental legislation now in effect sets standards for the final quality of effluents as well as penalties for transgressors, but it does not allow time for compliance nor does it envisage sources of the financial support necessary for meeting these standards.

One purpose of the project DP/TNS/85/016/11-03 is to create, within IRDLAI, a unit that is able to design waste-treatment plants for small-scale tanneries. The project aims to assist these small industries by suggesting, in line with their technical and economic resources, measures they can take inside and outside the factories to mitigate environmental threats to the rest of the population.

The tanneries and leather manufacturers that are clustered at Magetan and Garut were taken as test cases to determine if it would be possible to create, within existing governmental technical bodies, units that could help various small industries (not only the leather industry) to overcome their environmental problems. The existing legislation, in particular the very strict standards, has remarkably increased the difficulties in this project: to mitigate tannery pollution is one thing, to meet these stringent standards for effluent quality is quite another!

#### RECOMMENDATIONS

1. The theoretical knowledge of IRDLAI personnel working on tannery effluents treatment must be upgraded. At the same time, and even more important, their practical experience must be extended. The counterparts at IRDLAI must get out in the field; they should visit the tannery effluent treatment plants that are being installed in the Yogyakarta area to gain first-hand knowledge of their operation and problems. The most advanced of these plants is the one at Budi Makmur.
2. Meeting Indonesia's strict effluent standards poses a technical and economic problem for tanneries, especially the small ones. The Indonesian Government should realize that, at least at present, these standards are unrealistic.
3. To improve the environment at the Magetan cluster, some short-term, relatively straightforward steps can be taken. Next, the Government should install a more efficient treatment plant, for which a detailed study will be needed.
4. The complex situation at Garut cannot be easily solved. While he suggests a number of alternative solutions, the expert insists there must be a special mission to this area to study the many interrelated problems.
5. A simple water-treatment plant should be installed at the small Gambiran tannery owned by IRDLAI. It could serve to train IRDLAI staff and could also become a demonstration unit for outside tanners. At the same time it would reduce the pollutants released to the environment by the Gambiran facility.
6. IRDLAI must improve its existing effluents analysis laboratory by purchasing additional equipment.
7. The problems of the manufacturers are very different from the problems of the tanners and should be addressed separately.
8. A search must be made to find out which pieces of effluent treatment equipment can be obtained locally.
9. The Indonesian Government must deal with environmental problems step by step, allowing time for the industries, the engineers and the equipment suppliers to improve their knowledge and experience. It must ask the local authorities to prepare studies showing potential sites for residual sludge disposal.
10. IRDLAI must have better contact with regional environmental organizations and must improve its liaison with outside tanneries.



## I. ACTIVITIES IN-HOUSE AT IRDLAI

### A. Training

Four IRDLAI staff members are involved as counterparts in tannery effluents treatment: Mrs. Sri Mulati, Mr. Sunaryo, Mrs. Pudji Ediari, all three biologists, and Mrs. Sri Sutiya-smi, an industrial chemist. The level of knowledge of this team was not entirely satisfactory nor was it uniform. The expert believes it will be necessary to establish a strong theoretical base before these counterparts can embark on the design of effluent treatment plants.

In the short time available, it was impossible to systematically train these staff members in every aspect of tannery effluent pollution. The following topics were covered briefly (the remaining topics will have to be covered by the next mission):

(a) Characteristics of the different tannery effluents, which vary according to type of production, materials processed and chemicals employed;

(b) Primary treatment: screening, equalization, sulphides oxidation and/or precipitation, chemical flocculation (with alum, iron salts, lime and polyelectrolytes) and sedimentation;

(c) Secondary treatment: aerobic biological treatment (compact vs. extended units) and oxygen requirement calculations;

(d) Sludge production and final disposal;

(e) Expected efficiency of the primary and secondary treatments and the difficulty of obtaining a final effluent that meets the legislated environmental quality standards;

(f) Standard methods of analysing the pollutants that are commonly found in tannery wastes;

(g) Equipment suitable for treating tannery effluents: screens, pumps, blowers, diffusers, surface aerators, clarifiers, thickeners and sludge-dewatering devices. Technical pamphlets on treatment equipment available from various European suppliers were examined in an effort to search for similar equipment available locally. The pamphlets can also be used for theoretical training.

The expert gave his Indonesian counterparts three technical papers:

(a) "Techno-economic study on measures to mitigate the environmental impact of the leather industry, particularly in developing countries" (April 1984), by David Winters, UNIDO consultant. A complete and detailed survey of tannery wastes pollution, this paper contains descriptions of treatment technologies and should be very useful, in the expert's opinion, for upgrading the Indonesian team's theoretical background;

(b) "Assistance in the establishment and operation of a pilot and demonstration plant for tannery effluents treatment at Estancia Velha - R.S. - Brazil." (first phase July 1984 and second phase March 1987), by Giuseppe Clonfero, UNIDO consultant. These reports which contain information and data on the tests and results of UNIDO project US/BRA/80/166 in Brazil, should prove useful for improving the counterparts' knowledge of tannery wastes treatment.

It is expected that these papers will also help prepare the Indonesian team for the next mission of an expert on effluents.

#### B. Fellowship

Jack Theeuwes, Chief Technical Advisor (CTA), requested the expert's assistance in preparing a programme for a fellowship in tannery effluent treatment. The project foresees a fellowship of 6 man-months, all of it abroad, and IRDLAI has selected Mr. Sunaryo as the candidate. The expert's proposal for a fellowship programme and his rationale therefor are reported in annex I. The fellowship programme was described at a meeting held on 8 August 1987 at IRDLAI. Attending the meeting were:

Mr. Koentoro Soebijarso, National Project Director  
Mr. J.F.M. Theeuwes, CTA  
Mr. Koesnan, Project Manager  
Mrs. Suliestyah, Project Officer  
Mr. G. Clonfero, UNIDO expert

In general, the proposal was accepted by those present, who said they preferred that the fellowship consist of 1.5 months at the Centre technique de cuir (Lyon, France), 1.5 months at TNO (Waalwijk, Netherlands) and a one-month study tour in Italy.

It was also agreed that any surplus fellowship funds be spent to send the candidate on a short (roughly one week) visit to Japan to visit a fair that will feature equipment for waste-water treatment. (The date of this fair will be provided by the Japanese Embassy in Jakarta.) Japan was chosen not only because the technical level of its equipment for treating effluents is high, but also because the equipment is marketed throughout the world, including to Indonesia.

At the end of the meeting it was agreed that IRDLAI would submit a request for such a fellowship to the Government and to UNDP. UNIDO will have to decide whether it can be realized and will have to spell out details of the programme.

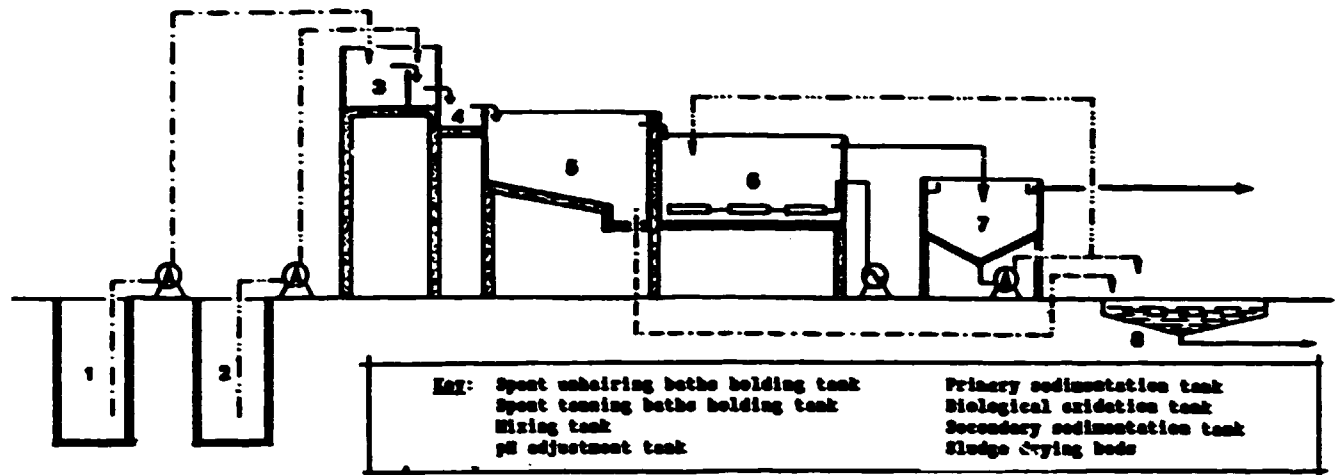
#### C. Effluent analysis laboratory

At the existing IRDLAI effluents laboratory, the expert and his counterparts analyzed some waste-water samples from outside tanneries, specifically those at Magetan. The aim of this exercise was to verify the counterparts' familiarity with effluent analysis and the ability of the laboratory to undertake such analysis. With respect to the latter, it was noted that the equipment was poor and that some important capabilities (such as apparatus for COD, BOD<sub>5</sub> and greases determination) were lacking. A list of the equipment needed to minimally upgrade the laboratory's efficiency was then prepared and submitted to the National Project Director (NPD) (see annex II). These improvements must be made as soon as possible, for analytical control will be the most important activity of the IRDLAI team in the next few months. It is to be hoped that UNIDO will use part of the remaining budget for the purchase of essential equipment that is not available locally.

#### D. Pilot- and laboratory-scale effluent treatment plants

At IRDLAI there are several laboratory-scale effluent treatment plants as well as a pilot plant with a capacity of 2-3 cubic metres per day of waste water. A flow diagram of this pilot plant is presented in figure I.

Figure I. Flow diagram of the IRLAI pilot plant



These plants were installed several years ago. Some tests of treated tannery effluents have already been carried out, but with uncertain results. In the expert's opinion, this uncertainty is due more to a lack of expertise on the part of the Indonesian team than to poor plant design or equipment. He judges that it is unnecessary to install further pilot or laboratory plants. Once the level of expertise has risen, the existing facilities will prove useful for demonstration and experimental purposes.

The aeration devices used in the biological treatment are very primitive (they are simply perforated pipes), but they may be easily replaced by diffusers with better oxygen transfer efficiency (for example, polyethylene discs, 21 cm in diameter, MKL or HKL 215, made by Nokia and costing \$20 each, can be imported).

#### E. Gambiran tannery

This tannery, which is owned by IRLAI, is located at Yogyakarta. IRLAI uses it for making the leather that will be finished at its institute and also for tanning skins and hides from outside tanneries in the course of providing assistance with new processes and/or improving old ones.

If a simple waste-water treatment plant were to be installed at Gambiran, it might, in the expert's opinion, serve as a training base and as a demonstration unit for other tanners. At the same time, it would mitigate the environmental impact of this factory. Concurring in this opinion, the participants in the 8 August meeting at IRLAI agreed it would be better to have a treatment plant at Gambiran than to install a new pilot plant or improve the existing one. The expert has prepared a design for the proposed simple primary treatment plant. The equipment to be imported and approximate costs are listed in annex III.

#### F. Meeting at IRLAI

A meeting was held on 31 August and 1 September 1987 at IRLAI. About 40 persons, including various authorities of the administrative and industrial sectors of the Indonesian Republic, took part (see the list of participants, annex IV). The expert took part in this meeting by delivering a lecture (see annex V).

## II. OTHER ACTIVITIES

### A. Magetan cluster

The expert, together with the CIA and with his IRDLAI counterparts, visited the small-scale tanneries and leathers goods manufacturers at Magetan. They investigated the environmental problems and collected waste-water samples from the tanneries and samples from the Gandang River. The results of the analyses, carried out at the IRDLAI laboratory, are reported in the table below.

On that first visit it was thought useful to plan a meeting with the tanners of the area. This meeting, which took place at Magetan on 24 and 25 August, was attended by about 30 persons of the cluster. At the meeting the expert described some possible interventions to overcome the airborne nuisance (the most urgent complaint of the neighbourhood) and proposed that a common plant be installed to treat the cluster's effluents. The flow diagram of the proposed treatment plant is shown in figure II.

The suggested treatment is very simple: screening → spontaneous sedimentation → sulphide oxidation with an  $Mn^{+2}$  catalyst → biological treatment. For further details of the proposed intervention, see annex V, item on the Magetan cluster.

During the same meeting, two members of the IRDLAI effluents team gave lectures: Mr. Sunaryo, "Effluents, governmental laws and the tanning industry", and Mrs. Pudji Ediari, "The impact of pollution from the tanning industry on the River Gandong".

### B. Garut cluster

The situation at Garut is completely different from that at Magetan. At Garut, the various small industries (many of which are cottage industries or are seasonal in nature) are spread throughout the urban tissue in such a way that it is impossible to demarcate the industrial and the residential areas. The liquid (and sometimes the solid) wastes are disposed of together with the urban wastes in two open channels that also receive clean superficial waters and rain water. The total flow in the two channels is too great to allow all these waters to be treated in one plant, so a new canalization for the industrial effluents might be the only solution. Even if the existing channels were used for the industrial effluents, pipeline installation costs would be very high. The technical and economic ramifications of the alternative solutions should be studied by a hydraulic engineer.

The expert feels, however, that neither of these solutions will be satisfactory in the long run (see annex V) and that tanners will probably have to be relocated. He suggests some interim measures, the first of which is to install drums and paddles in the common service facility and ask the tanners to do the liming and unhairing of their hides and skins there. This would concentrate an important part of the tannery pollution at a single point: 40-50% of the total  $BOD_5$  and COD, 50-60% of the total suspended solids and about 90% of the total sulphides.

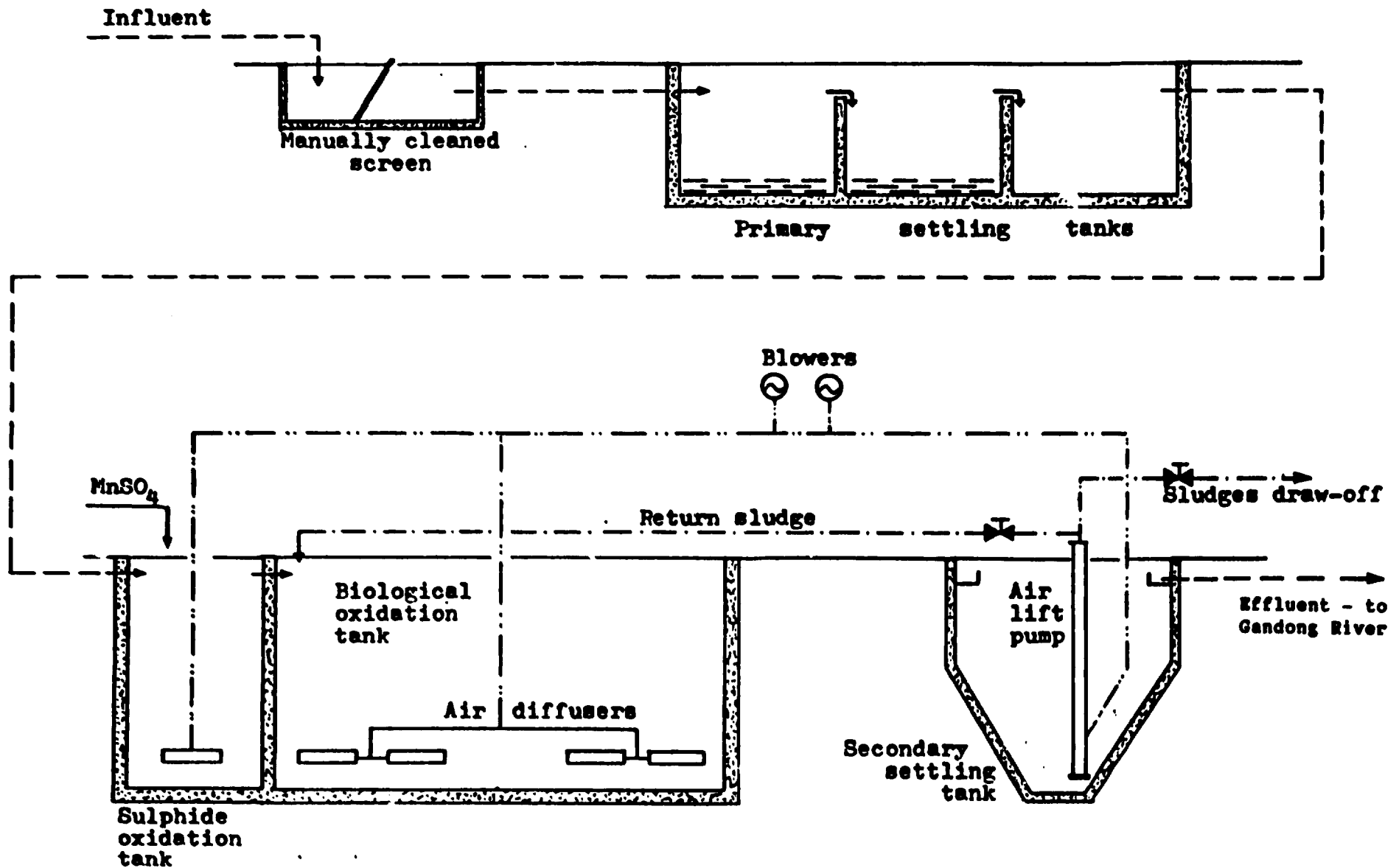
Simultaneously, the tanners should be asked to install a few very simple facilities, such as manual screens and chrome precipitation or recycle, that would further improve the quality of their effluents.

**Analysis of tanneries waste-water at Magetan and of water from the Gandong River**

Samples <u>a/</u>	Parameters							
	BOD <sub>5</sub> (mg/l)	DO (mg/l)	COD (mg/l)	Cl <sup>-</sup> (mg/l)	Settleable material (mg/l)	Suspended solids (mg/l)	Total solids (mg/l)	Fixed residue at 550 °C (mg/l)
<b>B<sub>1</sub></b>								
Unfiltered	-	-	2 890	-	38	1 436	5 100	1 830
Filtered	-	-	1 283	772	-	-	3 604	1 328
<b>B<sub>2</sub></b>								
Unfiltered	-	-	829	-	10	968	3 550	1 480
Filtered	-	-	480	551	-	-	2 582	842
River (1)	5.4	5.9	13	19.7	-	-	2 140	-
River (2)	50.8	2.2	89.6	118.2	-	-	5 760	-
River (3)	38.8	2.3	49	169.4	-	-	6 570	-

a/ B<sub>1</sub> = Magetan cluster effluent (after existing treatment) at 9 a.m.  
 B<sub>2</sub> = Magetan cluster effluent (after existing treatment) at 11 a.m.  
 River (1) = Gandong River above the Magetan cluster  
 River (2) = Gandong River below the Magetan cluster  
 River (3) = Gandong River below the Kepala unit (chrome tannery)

Figure II. Flow diagram of a proposed effluent treatment plant at Nagetan



### III. RECOMMENDED WORK PROGRAMME FOR IRDLAI

The expert cannot foresee when the next effluents treatment expert mission will be scheduled by UNIDO. Nevertheless, the national team must carry on the project activities. It is the expert's opinion that, at the very least, the following programme must be carried out by the counterparts, and he hopes that the NPD and the CTA will periodically review their progress and problems.

It is essential that what has been gained in these two months, whether it is a little or a lot, not be lost. Furthermore, the project has reached a kind of understanding with the tanners at Magetan and Garut, and this understanding must be respected.

(a) The effluents' laboratory must become fully operational: the locally available and imported equipment must be installed as soon as possible. Nevertheless the counterparts must in the meantime work with the existing one, improving their ability (theoretical and practical) to carry out effluent sampling and analysis. They can make use of samples from the Gambiran and Budi Makmur tanneries or other tanneries in the Yogyakarta region;

(b) The expert suggests utilizing the existing tannery at Budi Makmur as a "field experience" for the counterpart team. The counterpart team (members) must follow the plant's day-to-day operations, the performance of each stage of treatment, the existing or emerging problems and so on, and it must try to interpret them by means of laboratory analyses;

(c) At the same time, they must continue their theoretical training by studying the technical papers given them by the expert;

(d) The counterparts must try by all means to find out what equipment for treating wastes is available in Indonesia (commercial listings in the telephone directory, engineering companies and environmental institutes are some suggested sources of information). It is impossible for them or for foreign experts to plan any projects or give any technical suggestions without knowing whether equipment is available locally. It is also necessary to improve the liaison between the project and other Yogyakarta institutions that are involved in environmental affairs. This can be done through meetings, the exchange of technical information and reciprocal help (for instance, IRDLAI can ask them to carry out analyses that require sophisticated equipment, such as an atomic absorption spectrophotometer);

(e) The counterparts must keep in touch with the tanneries at Magetan and Garut and occasionally visit them to learn of new developments. In particular, they must solicit the tanners' reactions to the suggestion made at the IRDLAI meeting on 31 August and 1 September. From Garut they must obtain a complete map of the cluster, including the two channels, the area proposed for relocation and the area available for the plant installation. From Magetan they must obtain an answer as to the possibility of undertaking a joint treatment plant together with the Kepala Unit tannery and also obtain a map of the area together with other information such as the predominant direction of the winds and the shape and features of the land surface.

Annex I

PROPOSED PROGRAMME FOR TANNERY EFFLUENTS TREATMENT FELLOWSHIP

Official candidate: Mr. Suwaryo

A. Fellowship programme

1. Training at two of the following European leather institutes: a/

Centre technique du cuir, Lyon, France

TNO, Waalwijk, Holland

Stazione sperimentale Pelli, Napoli, Italy

British Leather Manufacturers Research Association, Egham, United Kingdom

Westdeutsche Gerberschule Reutlingen (Tanning School), Federal Republic of Germany

Subjects to be covered/activities to be carried out:

- (a) Analytical methods for tannery effluents and solid wastes;
- (b) Tannery effluent characteristics;
- (c) Techniques for reducing pollution from tannery processes;
- (d) Survey of environmental legislation;
- (e) Visits to industrial-scale treatment plants.

2. A study tour in Italy, accompanied by a local tannery effluents expert. b/  
The tour would include a two-week stay in the Pisa area to study an industrial treatment plant (laboratory, plant operation and maintenance), to be selected from among the following:

Cuioidepur Spa, Ponte a Egola, a plant that treats 4,000 cubic metres per day of effluents from 150 tanneries as well as 1, 000 cubic metres per day of urban effluents

Societa Recupero Cromo Spa, S. Croce s. Arno, a centralized treatment plant that recovers 2,000 kilograms per day of Cr<sub>2</sub>O<sub>3</sub> from about 200 tanneries

The centralized plant at S. Croce s. Arno, a plant that treats the effluents of 400 tanneries as well as municipal effluents

The centralized plant at Ponte a Cappiano, a joint treatment plant serving 15 tanneries

as well as two weeks spent visiting various treatment plants for tannery effluents and solid wastes throughout Italy.

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a/ This listing reflects the expert's ranking with respect to overall suitability. When the institutes are being chosen, this ranking should be taken into account.

b/ The expert would be available, as a short-term consultant, to assist the candidate during his study tour of Italy. If the Indonesian Government and UNDP agree, a Government nomination of the expert may be useful.



3. A 2-4 day visit to a fair devoted to equipment for treating effluents and solid wastes; to be scheduled after ascertaining the date of a suitable fair.

B. Basis for the proposal

1. The expert does not believe that regular courses of six months' duration are available, as had been foreseen in the original programme; in any case, six months would be too long a time for a specialized course and too short for a course at the graduate (post-university) level. So we must look for a suitable course at a European leather institute that can provide training in the treatment of tannery effluents. It would be preferable, for several reasons, to split the fellowship into several short periods at different institutes. First, because it would be an extra course, it is unlikely that an expert in this area would be able to devote six months to it. Secondly, the candidate's interest would probably decline after a time. Lastly, each institute has its own approach to and experience in effluents treatment, and it would be best for the candidate to become acquainted with more than one of them. This would sharpen his critical facilities and would be especially useful if his knowledge is to be applied in Indonesia and adapted to the country's needs.

2. In the expert's opinion, the study tour in Italy would be an essential part of the training of the candidate and must be carried out after the training at the leather institutes. Having gained theoretical knowledge, the candidate will then need practical experience. This can be acquired by visiting some industrial plants, both large and small, to see equipment being installed, to learn about the day-to-day operation and maintenance of the systems and to gain first-hand information about their performance and their problems. Such practical knowledge would be difficult to obtain in institutes, which have only pilot and laboratory plants. (Even these are sometimes not in operation, because the treatment of effluents is declining in Europe.)

It is proposed that the tour take place in Italy because that is the country with the most advanced leather industry. The candidate would come across a wide variety of interesting effluents and solid wastes and would be able to observe the treatment and recovery of other by-products. He would also see (even if on a different scale) some situations similar to those existing at Magetan and Garut. (Years ago, the conditions at Santa Croce were probably very similar to the present-day conditions at Garut.)

If a study tour of Italy is considered worthwhile and agreed to, the organizers must, in the opinion of the expert, go a step further and arrange for a local expert to accompany the candidate during his stay in Italy. It is hard to imagine that a candidate alone in a foreign country and without contacts could benefit fully from this opportunity.

Annex II

**SUGGESTED LIST OF EQUIPMENT TO BE IMPORTED FOR  
THE EFFLUENTS ANALYSIS LABORATORY**

2 COD reflux apparatuses, each consisting of:

- 1 six-burner heating mantle
- 6 reflux apparatuses (250 ml Erlenmeyer flasks  
with ground-glass 24/40 necks and 300 mm Liebig jackets)

spare parts:

- 2 reflux apparatuses (glass)
- 10 Erlenmeyer flasks, 250 ml
- 10 Erlenmeyer flasks, 500 ml

Approximate total price: \$3,000

2 BOD<sub>5</sub> respirometric apparatuses, each consisting of:

- 1 six-place stirring device
- 6 BOD<sub>5</sub> bottles with caps, mercury tubes, LiOH/silicone containers  
and stirring anchors
- 6 sets of interchangeable scales for direct reading of BOD<sub>5</sub> values

spare parts:

- 20 BOD<sub>5</sub> bottles
- 4 sets of rubber drive belts
- 1 refill supply of chemicals (nutrient, checked BOD<sub>5</sub> pills, LiOH)

Approximate total price: \$1,500

1 distillation apparatus for NH<sub>3</sub> and phenols, consisting of:

- 1 heating mantle for 500- and 1,000-ml flasks (ground-glass 24/40 neck)
- 1 500-ml flask, 24/40 neck
- 1 1,000-ml flask, 24/40 neck
- 1 condenser, 24/40 neck (see EPHA Standard Methods of Water Analysis,  
cited below)

spare parts:

- 2 500-ml flasks, 24/40 neck
- 2 1,000-ml flasks, 24/40 neck

Approximate total price: \$600

2 magnetic stirrer and stirring anchor sets

Approximate total price: \$300

2 magnetic stirrers with heating plate

Approximate total price: \$450

3 solvent-extraction apparatuses (Soxhlet glassware), each consisting of:

- 1 reflux apparatus, large-neck, 250 ml capacity
- 1 500-ml Pyrex balloon, 24/40 neck

Approximate total price: \$500

A Standard Methods for the Examination of Water and Wastewater, published by American Public Health Association (APHA), latest edition

Approximate price: \$100

1 apparatus for collecting composite samples, battery-operated, including battery charger and accessories

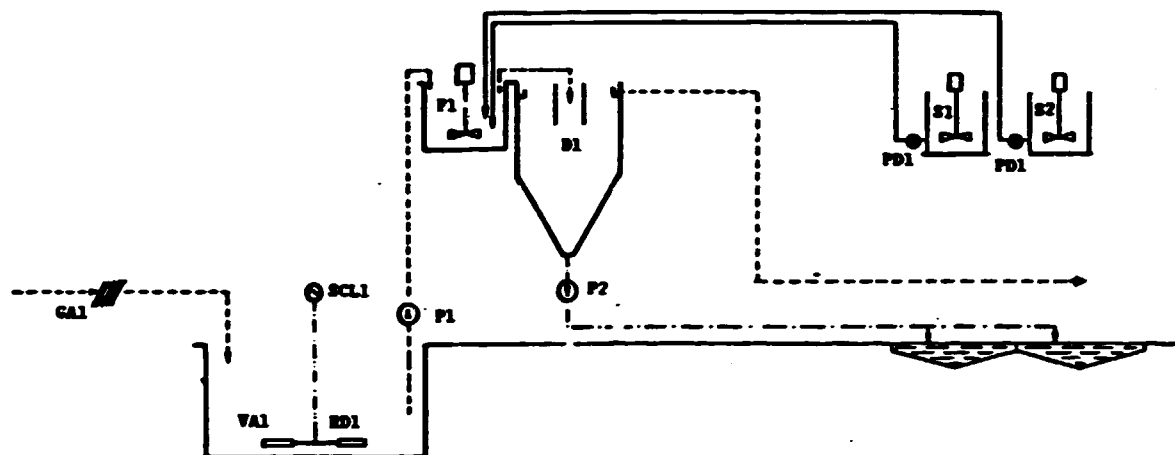
Approximate total price: \$1,500

Annex III

**EQUIPMENT FOR THE PROPOSED PRIMARY TREATMENT PLANT AT  
THE GAMBIRAN TANNERY**

The following list of equipment is based on a maximum daily effluent volume of 50 cubic metres and a five-step treatment scheme (figure III): screening; equalization and sulphide oxidation; chemical flocculation; primary sedimentation; and sludge dewatering. The starred items (\*) are expected to be obtainable locally.

Figure III. Proposed primary treatment for effluents of the tannery at Gambiran



Screening

(GA1) 1 bar screen (to be manually cleaned) 50 cm wide and with bar openings of 0.5-1.0 cm\*

or, alternatively,

1 self-cleaning brushed screen (Parkwood type) with a capacity of 20 cubic metres per hour and 1 mm openings

Possible suppliers: Italprogetti Engineering, Via Gramsci, Ponte a Egola, Pisa, Italy, or Longwood Engineering, Huddersfield, U.K.

Approximate price: \$6,000

Equalization and sulphide oxidation

(VA1) 1 reinforced concrete tank, 6 x 3 x 3(h) metres, with a capacity of 54 cubic metres\*

(SCL1) 1 centrifugal blower with a capacity of 80-100 Nm<sup>3</sup>/h at 2.5 m H<sub>2</sub>O

Possible suppliers: FPS, Concorezzo, Milan, Italy (Model 30/22) or Siemens Elettra, Via F. Filzi 29, Milan, Italy

Approximate price: \$1,500

(RD1) 8 polyurethane foam air diffusers

Possible supplier: Flygt, Box 1309, S-171 2S Solna, Sweden (Model 4702)

Approximate total price: \$250

(P1) 1 eccentric screw pump (Mohno type) with a capacity of 10 cubic metres per hour

Possible suppliers: Ercole Marelli, Via 24 Maggio 10, Sesto San Giovanni, Milan, Italy (Model D60); Allweiler Seeberg Pumpen, Postfach 1220, D-4272 Kirchhellen, Federal Republic of Germany (Model SEP200); or Netzsch-Mohno Pumpen, Liebigstrasse 28, D-8264 Waldkraiburg, Federal Republic of Germany (Model M40)

Approximate price: \$1,600

#### Chemical flocculation

(F1) 1 concrete tank, 1 x 1 x 1.5(h) metres\*

(S1, S2) 2 vessels of glass fiber (or other acid-resistant material), each equipped with a 5-horsepower electrostirrer and each having a capacity of 500 liters\*

(PD1, PD2) 2 metering pumps, each with a capacity of 0-30 liters per hour

Possible suppliers: Officine Meccaniche Gallaratesi, Via C. Tenca 1, Milan, Italy (Model DOKAM 15 x 25) or Dosapro Milton Roy, Piazza IV Novembre 4, Milan, Italy (Model MILROYAL A 11,11)

Approximate price: \$500 (each)

#### Primary sedimentation

(D1) 1 reinforced concrete tank with pyramidal bottom (slope 60°) with central cylindrical baffle and outlet weir, a total volume of 10 cubic metres and a surface of 4 square metres\* (2 x 2 metres)

(P2) 1 eccentric screw pump (Mohno type) having the same specifications and suppliers as P1

#### Sludge dewatering

4 drying beds for sludge dewatering: 2 x 5 x 0.5-0.7 metres\*

Annex IV

LIST OF PARTICIPANTS AT THE IRDLAI MEETING ON 31 AUGUST-1 SEPTEMBER 1987

Mr. Garjito P.S., Agency for Industrial Research and Development  
Mr. Syahwir Syarif, Directorate General for Multivarious Industries  
Mr. Abdul Aziz, Directorate General for Small-Scale Industries  
Mr. S. Syahrier, Directorate General for Small-Scale Industries  
Mr. Kukuh, Provincial Office of the Ministry of Industry, East Java  
Mr. S. Naryo, Provincial Office of the Ministry of Industry, Yogyakarta  
Mr. Sosrin, Mini Industrial Estate, Magetan (LIK)  
Mr. Semsuhadi, P.T. Aneka Charma, Magetan  
Mr. Santoso, P.D. Aneka Usaha, Magetan  
Mr. Endang Daryanti, P.D. Aneka Usaha, Magetan  
Mr. Chafid Sundli, Institute for Environmental Research  
Mr. Sigit Hernowo, Institute for Technical Environmental Health  
Mr. Jack F.M. Theeuwes, UNIDO expert in finishing hides; CIA  
Mr. Guisepe Clonfero, UNIDO expert in waste-water treatment  
Mr. Hasan Basalamah, Counterpart of hides project  
Mr. Mughtar Lutfie, Counterpart of hides project  
Mrs. Widari, Counterpart of hides project  
Mrs. Meiyanti, Counterpart of hides project  
Mr. Koentoro, IRDLAI  
Mr. Koesnan, IRDLAI  
Mr. Sunaryo, Counterpart of waste-water treatment project  
Mrs. Mulati, Counterpart of waste-water treatment project  
Mrs. Ediari, Counterpart of waste-water treatment project  
Mrs. Suti Yasmi, Counterpart of waste-water treatment project  
Mr. Bambang Suroto, Counterpart of leathergoods project  
Mrs. T.H. Widiarti, Counterpart of leathergoods project  
Mr. Tjahyo Wartono, Counterpart of leathergoods project  
Mr. Soepranoto, IRDLAI  
Mrs. Endang Sinungsih, IRDLAI  
Mr. Sucipto, IRDLAI  
Mr. Jayusman, IRDLAI  
Mr. Bambang Utoyo, IRDLAI  
Mr. Sunarso, IRDLAI  
Mrs. Dewi Rustiningsih, IRDLAI  
Miss Ratnawati, IRDLAI  
Mr. Bambang Tunasmoyo, IRDLAI  
Mrs. Susilowati, IRDLAI  
Mr. Kcmijo, IRDLAI

Annex V

COMMUNICATION OF G. CLOWERO AT THE 1 SEPTEMBER 1987 MEETING

The time of my stay in your country has been too short for me to gain full knowledge of local conditions; therefore, I apologize for any error I may commit in this speech and ask you to correct me as necessary. I shall also like to thank the IRLAI Director, Mr. Koentoro, for this initiative which gave me the opportunity to stay with various authorities of the administrative and industrial sectors of the country so as to obtain a more complete view of all sides of Indonesia related to water-treatment.

In these days, according to a not secondary aim of this project, and as a UNIDO expert in tannery effluents treatment, I have visited together with IRLAI counterparts, many tanneries and spoken with several people at your University and environmental institutes. Today I will present my first impressions of these visits and furthermore, as dictated by my project duties, I will try to offer some suggestions and recommendations. Before this, however, I wish to give you some general information which I consider very important to a proper understanding of the following speech.

I don't want to spend time describing the nature of pollution caused by the tanning industry (Indonesia's of course is the same as every country's). On the other hand I do want to remind you that, in my opinion, this industry (which utilizes a sub-product of the most important alimentary one) has a bad environmental reputation more for its nuisance (especially the bad smell) than for its real danger to health (no particular professional diseases are reported for the tannery workers). Furthermore, I want to underline that tannery effluents treatment is not very easy or without problems; also to point out that tanneries located in more developed countries are a long way from having resolved their problems.

These difficulties derive from various causes:

(a) The lack of technological treatments able to assure at acceptable costs a final effluent with the characteristics generally requested by environmental legislations (in particular COD, ammonia nitrogen and chlorides). This difficulty, of course, could be resolved if the tannery effluents, after a suitable pre-treatment, were to be treated in a joint plant together with a reasonable amount of urban sewage (unfortunately, this possibility very seldom occurs: in general, the municipalities are the last to install treatment plants);

(b) The large quantity of residual sludges: 100-150 g of sludge (as dry material) which are produced after complete treatment - primary + secondary - of the liquid wastes from 1 kg of hide (i.e. 2-3 liters of liquid sludge at 5% of dry material). The final disposal of these sludges (both liquid and dewatered) constitutes a major problem; at the moment no alternative to landfilling is available. Some studies have been undertaken to evaluate their possible utilization in agriculture, but practical results are not available;

(c) The installation of a tannery effluent treatment plant may (especially in particular local conditions) increase the environmental airborne nuisance. Therefore more sophisticated and expensive technologies are sometimes requested.

With regards to the Indonesian situation I consider the following:

1. Environmental legislation. The industrial effluents quality standards requested by your law No. 173/MenKes/Per/VII/77 tahun 1977 may be reached only with great difficulty by the tanning industry; furthermore they appear too strict even if compared with the legislation of other more-developed countries. As an example I have copied here the limits imposed by the Italian law for the most significant pollutants frequent in the tannery effluents:

<u>Parameter</u>	<u>Indonesian legislation</u>	<u>Italian legislation</u>
Coarse material	0 (3 mm)	0 (10 mm)
Settleable solids	1 mg/l (weight)	0.5 ml/l (volume-Imhoff cone 2 h)
BOD <sub>5</sub>	20 (max 30) mg/l	40 mg/l
COD	50 (max 80) mg/l	160 mg/l
Sulphide	0.1 mg/l	1 mg/l
NH <sub>3</sub> (total)	0.1 mg/l	15 mg/l
Cr <sup>+6</sup> <u>a/</u>	0.1 mg/l	0.2 mg/l
Cr <sup>+3</sup>	-	2 mg/l
Phenols	0.1 mg/l	1 mg/l
pH	6.5-7.5	5.5-9.5

a/ Normally only Cr<sup>+3</sup> is present in the tannery waste. I have copied the limit of Cr<sup>+6</sup> because there is no indication in Indonesian law for Cr<sup>+3</sup>.

2. Local experience in industrial treatment plant installation. In my opinion, Indonesia at the moment lacks local expertise in industrial effluent treatment and particularly in the industrial tannery sector. Both the industrial and the consulting engineers (governmental and private) are without any practical experience in this field.

3. Equipment. Furthermore, a wide choice of suitable equipment is not available in the Indonesian market. The only tannery treatment plant I visited whose equipment was technically acceptable had totally imported both know-how and equipment from Japan. The other plant projects were poorly designed and their attempts at treatment were destined to failure.



After this introduction, I will speak on the clusters of small-scale tanneries at Magetan and Garut. I was expected to elaborate two common treatment plants for these industrial areas (as reported in my job description, although I cannot understand how, without a preliminary technical and economic study, anyone could think this possible or suitable).

The two industrial clusters are characterized by different conditions and problems.

(a) Magetan cluster

Twenty-nine small-scale tanneries (220 persons) and 9 leathergoods manufacturers (30 persons). The actual daily production capacity is 200 skins of sheep and goats (dried, 2-3 kg each) and 80 bovine hides (dried, 6 kg, or, rarely, wet salted, 15 kg each).

The maximal capacity in the existing structures is about twice the actual one. All these industries are located in the restricted area of the cluster and are utilizing the same waste-waters collector designed for receiving only the industrial effluents. At the end of this pipeline a sedimentation tank is installed to detain the heavier solids before the final discharge of wastes into the Gandong River. The present average daily volume of the waste waters is 15 m<sup>3</sup>. Since the volume of the cluster effluents is small and the working process is not highly pollutant,\* there is no present injury or large danger to the environment.

Nevertheless the nuisance caused by the cluster activity to the people living in the surroundings must be resolved. To improve the situation I suggest the following short-term interventions:

1. Install a manually cleaned screen (openings 1-2 cm) at the exit of each tannery to avoid the pipeline clogging.
2. Install at the head of the two principal lines of waste-waters collector two pits of 2,000 liters each, filled with clean water, to be used at the end of the day for cleaning (washing off) the pipeline. If, even after these interventions, the clogging continues, it will be necessary to study a radical modification of the existing pipeline.
3. Install a suitable pump for a more frequent and easy draw-off of the sludges from the sedimentation tank.
4. Add lime periodically to the residual sludge during its dewatering time.
5. Stop burning all the solid wastes inside the cluster area indiscriminately. The organic materials (trimmings, fleshing, shavings etc.) and the spent mimosa bark must be disposed of in a sanitary landfill if they are not otherwise utilized (agriculture). In my opinion, the present system of burning is mainly responsible for the bad smell. These are the first steps to take against the bad smell; the second step is to install a more efficient treatment plant. No other alternatives are possible to the adoption of a common treatment plant.

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\*Liming in pits reusing several times the same bath, vegetal tanning with mimosa bark instead of extract and limited utilization of other chemicals.

No major problems exist in the plant dimensioning. Nevertheless before beginning work, a detailed project will be necessary in order to:

- define the area available for the plant installation and its suitability as regards possible airborne nuisances;
- find an area destined to receive the residual sludges and the other solid wastes. It is unrealistic to begin a policy of effluent treatment without having found a solution for the residual sludges;
- decide if this common service may be utilized also by other industries of Magetan; for instance, the unit Carma Yasa.

There are no large cost differences when the plants have these small dimensions; moreover to concentrate the treatment in the same area may be helpful in overcoming future nuisance problems.

The costs for plant installation, in my opinion, must be assumed by the Government; the utilizers (the tanners) will pay the operational and maintenance costs in relation to the quantity and quality of their effluents. Once the plant is installed, we may realistically expect an average reduction of near 100% for  $\text{Cr}^{+3}$  and sulphide, near 80-90% for COD and BOD and 90-95% for suspended solids but, as aforesaid, we must not claim to reach the quality standards requested by the present legislation without a final dilution.

(b) Garut cluster

Two hundred and thirty-seven small-scale tanneries (1,260 persons) and 78 small-scale leathergoods manufacturers (1,757 persons). The total tannery production is about 300 bovine hides (7,000 kg) and 300 skins (500 kg) per day.

The Garut cluster situation is completely different from Magetan's: the various small industries (many are home and seasonal industries) are spread through the urban tissue of Garut in such a way that it is impossible to distinguish between the industrial and the residential areas.

The liquid and sometimes the solid wastes are disposed together with the urban ones in two open channels which also receive clean superficial waters and rain water. The total flow in the two channels is too great for hoping to treat all these waters in one plant. For this reason, the installation of a new canalization for the industrial effluents seems to be the only suitable solution.

Of course if one is also thinking to utilize the existing channels for the industrial effluents, pipeline installation costs will be very high. The technical and economic aspects of this solution should be studied by a hydraulic engineer. I'm very reluctant to accept this apparently necessary solution for the following reasons. Environmental problems never are coming singly; in Indonesia you are now starting to face industrial effluents pollution but in the next years you will be asked to resolve as well the problem of air pollution and the health of the workers inside the factories. This process has happened in the history of other countries and will occur also in Indonesia, in time. As well as for the benefits coming from the industrialization of the country, the people will also ask for a qualitatively better life. To say today to the tanners in Garut, "install a treatment plant and your problems are finished", would be an irresponsible lie.

I cannot believe that the present situation can be sustained for a long time: the number and the variety of problems will reach an unbearable point in the future; what is true for this issue was true for yesterday's. It would be a mistake, in my opinion, to try to establish a common destiny for the leathergoods manufacturers and the tanneries. The latter have doubtless different problems; I don't see any alternative for them but relocation. This process of moving of course must be realized progressively so as not to lose or damage an industry so important for many people and their families. It will be not a painless operation, but to wait would be worse. Returning to the treatment plant, I cannot possibly tell you now what, in my opinion, is the best solution. However, I shall try to suggest some solutions which must be evaluated in the next months.

The first solution may be to install, in the common service facility, some drums and paddles and ask the tanners to do the liming and unhairing operations of their hides and skins there. Such method would concentrate in the same point an important part of the total tannery pollution:

40-50% of the total BOD<sub>5</sub> and COD;  
50-60% of the total suspended solids;  
about 90% of the total sulphide.

It will be simpler to install a treatment plant there for these effluents; the relocation may be programmed over a longer period of time.

Simultaneously the tanners should be asked to install a few, very simple facilities (like manual screens and chrome precipitation or recycle) in such way to improve even further the quality of their effluents. If the installation of an industrial pipeline must be undertaken, it is arguable that the treatment plant be installed in a suitable area and in such a way that the plant can be gradually linked to new or relocated industries (this means in an area near future industrial clusters).

I will suggest that UNIDO spend part of the short-term expert's time for a mission specifically destined to study the Garut problems because I think they are too complex for resolution in a three days' visit.

#### Recommendations

In my opinion, the existing legislation is too strict for the present capacity of the Indonesian industry (especially small-scale). If the Government wants to support the industry growth they must understand that such limitations are unrealistic: as regards the present local situation, they must begin an environmental step-by-step policy which gives time to the industries, engineers, and equipment suppliers to improve their knowledge in this area. Furthermore the Government must press the local administrations to prepare studies of the territory indicating the areas available for the disposal of the residual sludges.

IRDLAI must improve the capacity of the existing effluents laboratory: this is an essential instrument for good understanding of the pollution problems and for helping the tanners to solve them. My counterpart must be a more active presence in the field: there are several tannery effluents treatment plants in course of installation in the Yogyakarta region. To follow the performances, problems and results of an industrial-scale plant in person will be a very useful experience; as well as serving the function of carrying out indispensable service of analytical controls. I'm thinking particularly of the Budi Makmur tannery, the only one visited in which we have found a complete treatment (primary + secondary) plant projected in accordance with technical criteria suitable to tannery effluents treatment.

The director of this tannery, located in Yogyakarta, has declared his interest in being assisted by IRDLAI/UNIDO experts to overcome several problems.

As regards the practical experience of the IRDLAI team, I will suggest that UNIDO (if funds are available) install a treatment plant at the IRDLAI small-scale tannery of Gambiran. That, in my opinion, will prove more useful than a pilot plant (at the Institute, 2-3 laboratory plants already exist but their utility is doubtful, due to the difficulty of feeding the plants: the waste waters must be transported from an external tannery).