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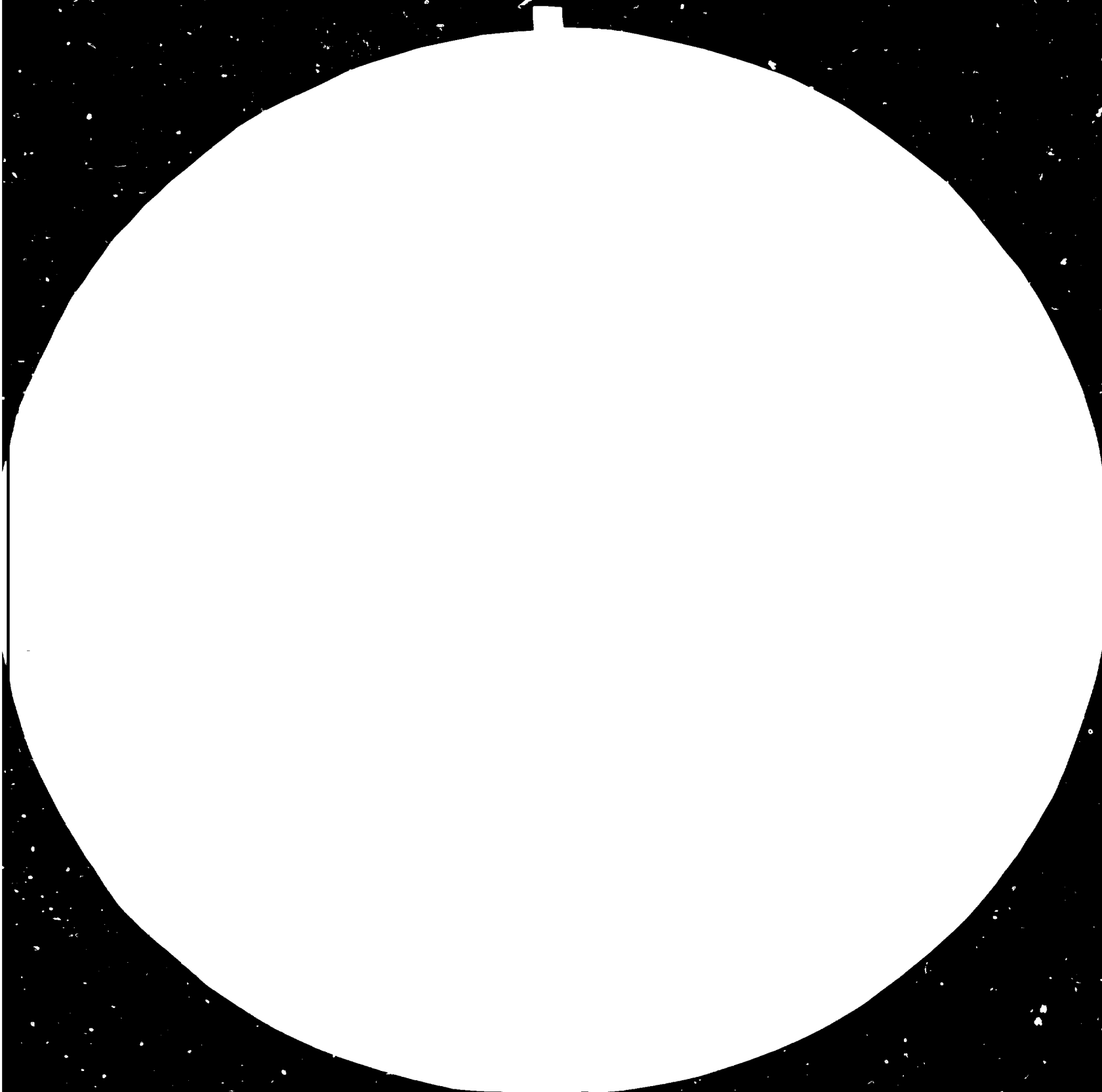
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MAI 1983

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ASSISTANCE IN TANNERY EFFLUENT TREATMENT AND
PLANT INSTALLATION AT ESTANCIA VELHA, R.S.

US/BRA/80/166 BRAZIL

MISSION REPORT

MICHEL ALOY

CONSULTANT/EXPERT IN THE TREATMENT
OF TANNERY EFFLUENTS

1186

The report has not been
cleared by UNIDO who do
not necessarily share
the views presented.

I - S U M A R Y -

During the three week-assignment of the consultant and mainly during the twelve days spent in Estancia Velha, Rio Grande do Sul, Brasil, the consultant payed ten visits to different tanneries in Rio Grande do Sul in order to evaluate the efficiency of the existing waste water treatment plants.

He had also several meetings with local authorities in Estancia Velha and in Porto Alegre.

During two working sessions with the leather technicians of the school of tannery in Estancia Velha he gave informations about the different technics that could be applied in tannery waste water treatment.

The consultant gave also a two hour and half lecture in the Tannery School for local authorities, tanneries managers and students from the school.

The consultant examined the working conditions of the pilot demonstration plant with the contractor's team member, Dr. Nini, who arrived the 9th of May 1983 and with the counterpart personnel, engineers Hugo Springer and Luiz Ruppenthal.

Some equipments in bad working conditions, delayed the starting of the biological treatment but it seems that a continuous study could be started within two or three weeks.

II - I N T R O D U C T I O N -

A- B A C K G R O U N D -

Based on the findings of a previous mission a UNIDO tannery effluent adviser reported on the situation in RIO GRANDE do SUL regarding tannery pollution.

In order to allow tanners to install plants that meet the norms proposed by the programme instituted by the State Secretary of Healter, a pilot demonstration plant was installed in

the Tanning School of Estancia Velha. It is considered that such a pilot plant can serve as a regional demonstration plant for whole of the region.

During previous preparatory missions, C.T.A. David Winters worked out a detailed work plan and a list of basic equipment required for the secondary treatment.

B- CURRENT MISSION -

Attached to the tannery School SENAI at Estancia Velha, the consultant, Michel ALOY, was expected to :

- 1- Evaluate briefly the environmental nuisance created by Brazilian tanneries in the local of the duty station,
- 2- Review the regulations being imposed by the Rio Grande do Sul authorities to mitigate such nuisance,
- 3- Assist the project and counterpart personnel in the commissioning of the secondary treatment units,
- 4- Advise interested Brazilian authorities/industrialists regarding the most suitable tannery effluent treatment systems applicable to local circumstances.

The consultant started his mission with a two days briefing in UNIDO Vienna and in UNDP Office in RIO - From 12th to 24th Mai he was at the duty station and returned to home through a two days debriefing in Vienna.

III - FINDINGS -

- 1- The consultant payed seven tannery visits in the locale of the duty station and three other visits in LAJEADO, TAQUARI and SADUCAIA Do Sul.

All the tanneries were equiped with primary treatment but most of these treatments, seven out of ten, were not working correctly. In some cases the project was undersized and in most of the cases,

the main characteristics of tannery effluent were not taken into consideration (Settleability, mixing effect, sulfide removal, fine screening).

However, it is possible with some improvements to obtain a good primary treatment necessary for the efficiency of a biological treatment.

In the locale of Estancia Velha, a mixed treatment of primary treated tannery effluent, and domestic sewage could be achieved with a successful decrease of investment and running cost.

A 200 ha area is kept free of inhabitants in order to build a 100.000 population equivalent treatment (90% of the organic load coming from the tanneries and 10% from the population).

A very rough estimation of this treatment plant leads to an investment cost of 3 to 3,5 millions US \$.

One can notice that in most of the cases, a chrom recycling is achieved in each tannery and liming float recycling could be effective in 20 to 30% of the factories.

Then to have more precise datas on quality and quantities of tannery waste water, it seems necessary to perform an enquiry in each tannery with flow metering and proportional sample collecting. This work could be made under the control of the Tannery School.

— 2- The State Secretary of Health and Environment imposed the following regulations :

- 14th March 1981 : running of primary treatment with screening, mixing equalizing, settling and sludge removal,

- 14th March 1984 : running of the secondary treatment,
aerobic biological type giving the following results :

sulfide S^{--} \leq 1 mg/l
 BOD_5 \leq 60 mg/l
Chromium \leq 1 mg/l
Oil and Grease \leq 20 mg/l

If sulfide, chromium and Oil and Grease values can be reached in normal conditions, BOD_5 regulation needs to be proved achievable in pilot plant treatment in the tannery working conditions. As it is necessary to perform a complete study on lagooning and activated sludge process (oxidation ditch type and extended aeration type) including a summer period, it will be not possible to obtain complete datas on biological treatment before 14th March 1984. Then it will be impossible to design and to build a treatment running at this date.

It seems then necessary that the Brazilian authorities delay for a year to impose the final regulations.

A particular contract could be established with the city of Estancia Velha in order to help the local tanning industry to plan and to build a mixed treatment plant that could give better results than several small treatment plants and will be safer and more economic.

--- 3- As soon as the primary treatment will be ready to treat all day long 50 m3 of tannery effluent coming from curtume Leuck Mathes and from the school workshops, then it will be possible to test in real conditions three types of biological treatment.

--- 3-1- The facultative aerated lagoon (300m3) can treat a maximum of 24kg BOD_5 /day that is brought through a 2m3/day effluent coming from Leuck Mathes at a constant

flow rate of 0,89 m³/h. It seems also necessary to stop one of the two floating surface aerators, to have a correct value of 3,7 w/m³ mixing power and to create a sedimentation zone in the lagoon.

- 3-2- The 60 m³ oxidation ditch is connected with a 1,22m² sedimentation tank accepting a maximum flow rate of 0,67m³/h (16,1m³/d) for a maximum organic load of 18kg BOD₅/day - volumetric maximum load would be then 0,3 kg BOD₅/m³/d and massic load 0,08kg BOD₅/kg MLVSS/day. In these conditions, the aeration to be provided is 30,6 kg/O₂/j, corresponding to 40% of the maximum input of the aeration rotor.

- 3-3- The 50m³ tank used as activated sludge process is connected with a 1,65m² sedimentation tank accepting a maximum flow rate of 0,91 m³/h (21,8m³/j) for a maximum organic load of 24,6 kg/j. Volumetric maximum load would be then 0,49kg BOD₅/m³/d and massic load 0,1kg BOD₅/kg MLVSS/d. The aeration equipment (floating aerator) in these conditions will necessarily be running 20,5 hours per day.

- 3-4- Due to the high cost of plastic packing in the trickling filter, it could be necessary to find another packing material. If strong enough supports can be placed in the trickling filter, hollow bricks could replace the plastic media. Because of the type of feeding of the trickling filter giving a constant delivery on all the surface, it could be difficult to use stone packing in half of the trickling filter and another type of packing in the second half, as this second type necessitates a higher flow rate.

Nevertheless, the trickling filter can be used as a pretreatment of another biological process, because the efficiency of a plastic and brick packing, will never exceed 50 to 55% and a stone packing, more effective, will be clogged rapidly with tannery effluents.

In order to know precisely the volume and the organic load applied to each type of treatment, it is necessary to set on each feeding channel a weir, V type for example, that could be realised very easily.

Due to the large number of datas to collect and specially on the BOD_5 value going in and out of the different biological treatments, it seems to be necessary to buy some respirometric equipments (2 x 5 posts HACH system) that could give safer results than the classical BOD_5 determination.

- 4 - After several visits in the locale of the duty station, it seems that the most suitable tannery effluent could be established as follows.

When the tannery is isolated and when its capacity of processing does not exceed 800 raw hides per day, the best and safer biological treatment will be a facultative aerated lagooning. This type of treatment may not give the higher quality of treatment as most of the time, the final BOD_5 cannot be under 100mg/l. Due to the large availability of ground, the low investment and running cost, this treatment, that necessitates no regular chemical analysis, will finally give the best results.

When it is possible to have a mixed treatment, with domestic effluents, the best available solution for large treatment is the extended aeration process, activated sludge type, that will give a final effluent

with a BOD_5 value under 30 to 50 mg/l according to the domestic effluent quantity. This type of treatment is also well adapted for large tanneries as for example BENDER SCHUCK in Estancia Velha who can perform good analysis and control of the treatment. In these cases, the equipment will be a surface aeration equipment fixed type (rotor or propeller). The air diffuser systems are very difficult to maintain in good running with tannery effluents and will not be used.

IV - RECOMMENDATIONS -

- 1- According to the pilot study being fully operational by June 1983, it is recommended that the timetable is scheduled by the D.M.A. in Rio Grande do Sul for operation of secondary treatment plans in March 1984 to reexamine the scheduling relating to implementation of stages of treatment. This will give time to have the complete results of the biological pilot waste water treatment before planning industrial equipment.
- 2- The regulation being imposed on the BOD_5 after biological treatment seems to be rather low. This is due to the water savings in factory that increase the concentration of organic contents. It is recommended to apply a regulation on the efficiency of biological treatment (for example 85 to 90%) or a regulation in kg of BOD_5 per kg of raw hide processed.
- 3- In order to help the Brazilian counterpart, it is recommended to purchase two respirometric five posts HACH equipments for a safe and easy mesurment of the BOD_5 at each stage of biological treatment.
- 4- Priority should be given, to obtain complete datas on activated sludge process and on facultative aerated lagooning that seems the best available biological treatment for small and isolated tanneries.

5- A complete study on the quality and quantity of effluent in tannery after primary treatment, should be undertaken. This study could be financed by each tanner with the technical help of the tannery school. This study is essential for the evaluation of the pollution in Estancia Velha.

ANNEX I - VISIT REPORTS -

BENDER SCHUCK
ESTANCIA VELHA (RS)

Located at a short distance from the school, this tannery processes 50 tons per day of cow hides of 29 kg each.

The process is classical with the following steps :

- Soaking in a continuous way in a 12 m long drum
- Flesching after soaking (Recovery of greases from fleshings)
- Liming in drum with 300 % water
- Splitting after liming.
- Hides are then processed through deliming, bating, pickling and chrom tanning.
- Splits are tanned with vegetable extracts as waste in drums and pits.
- Neutralization, retanning, dyeing and fatliquoring are processed in drum.

The used chrom liquors are recovered and treated with soda ash solution. The sludge is dewatered in a filter press and used again to prepare new chrom liquors. 20 to 25 % of the initial chrom input is saved through this process.

A waste water treatment process was established on the following datas :

- 50 tons of raw hides input
- 2100 m³/day
- 5140 kg of BOD₅/day (that seems rather high)
- 4500 kg of SS/day (rather low)
- (3250 kg BOD₅/ d and 7000 kg SS/d would be more correct)

The treatment is established with the following steps :

- Recovery of liming floats (175 m³/d) in a 120 m³ storage and pumping tank
- After sedimentation the clarified effluent can be stored in a holding tank for recycling, or directed to a 223 m³ aeration tank for catalised oxidation of sulphides.

It seems that the aeration provided in the first 120 m³ tank will also oxidise partially the sulfide. This will give improper results for recycling.

Due to the low volume of the mixing tank for the effluents coming from the rest of the factory, 472 m³ for a total delivery of 2100 m³/d, the storage tank of the settled liming floats could be used to deliver a constant flow to the mixing tank. The aeration equipment is largely undersized in the equalization tank. The primary sedimentation is well sized although the lack of a thickening tank will necessitate a 24 hours running of the filter press. It is also possible to treat the total effluent within 10-12 hours. Due to the rather optimistic elimination rate of BOD₅ with primary sedimentation (60 % instead of a more realistic 35 % the quantity of BOD₅ provided to the second biological stage seems correct (2060 kg BOD₅ for 50 tons gives 40 kg per ton)

If the aeration rate seems correct, the size of the aeration tank is certainly too low and the values adopted for massic and volumetric load applied are too high for a good result in tannery effluent biological treatment. Instead of $\bar{C}_m = 0,18 \text{ kg DBO}_5/\text{kg VSM/d}$ it could be applied $0,08 \text{ kg/VSM/d}$ giving a volumetric load of :

$$C_v = 0,320 \text{ kg DBO}_5/\text{m}^3/\text{day}$$

for a mixed liquor containing 4 g/l of volatile suspended matters.

It could be achieved a 95 % elimination of BOD₅ with these values giving an effluent under the limit of 60 mg/l.

The area occupied with sand drying beds (560 m²) seems to be very low giving a drying capacity for only seven days with biological sludges.

If the primary treatment can give good results although type of screening, pumping and aeration equipment are not well adapted, the secondary biological treatment must be recalculated after a running of six to twelve months of the primary treatment, in order to be effective.

CURTUME VACCHI

SAPUCAIA DO SUL (R.S.)

This tannery processed 2 500 hides per day in the wet blue stage - Each hide weights 12 to 15 kg.

For the complete process of these hides including :

- neutralization
- retanning (mainly with chromium)
- dyeing
- fatliquoring
- finishing
- treatment of shavings

the total water consumption is 900 m³/j.

These effluents are recovered after a manual screening in a 250 m³ mixing tank equipped with a propeller mixer of 15 HP.

Two raising pumps drive the effluent on two gravity sieves to take of fine particles and buffing dust from the water.

In the effluent is then added calcium hydroxide, aluminium sulfate and an anionic polyelectrolyte.

The sludge are recovered in several vertical rectangular shaped settling tanks. It seems that 15 to 20 m³ of sludges are sent every day to drying beds.

The final effluent that is delivered to the river has the following analytical values :

BOD₅ ≠ 120 mg/l

MES ≠ 50 mg/l

It is yet slightly brown coloured but the result seems to be good enough for a physico chemical treatment. A complementary biological treatment seems not to be viable according to the high DCO/DBO₅ ratio.

KERN MATTES LY DA

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PORTAO - (RS)

Each day, 600 raw hides of 27 kg (16 T/d) are processed.

This process is more or less classical.

We can only notice the use of enzymes in the liming process and a low amount of sulphide (1,8 %). Chromium exhaustion seems to be high as is used a new technology with BAYCHROM 9000.

The effluents from liming are then mixed with ferrous sulphate (20 kg/d). After a first sedimentation, these liming floats are mixed with total effluent from the factory (more or less 500 m³/d).

After several settling tanks, the effluent goes through several lagoons (2000 m² of total area) and then to the river.

In spite the recovery of 6000 to 8000 l /d of sludge used as a fertilizer, the quality of the treatment can be improved.

As the tannery is located at 900 m from the place of the future treatment plant of ESTANCIA VELHA, the final solution will be a mixed treatment (biological type).

If this solution is not viable, the treatment can be locally improved by replacing the several lagoons with a 6000 to 8000 m³ aerated facultative lagoon with a settling zone and equiped with 6 x 4 kw floating aerators. Area of the lagoons can be limited to 3500 m².

A. BUHLER S.A.

IVOTI (RS)

This tannery processed 1300 à 1700 hides per day. The raw hide input is nearly 36 to 40 T/d.

The process of the hides is classical but in the tannery exists a recycling of liming float and of tanning floats. 50 % of the waste lime liquor is reused after grease élimination and sedimentation of sludges.

Chrom tanning floats (20 g/l Cr_2O_3) are recovered separately and processed through a gravity sieve (Johnson type). After acidification the chrom liquor is reused in complement with new chrom salts (7 % on the limed weight).

The rest of the effluent (700 - 800 m³/d) arrives in a tank with several baffles for grease recovery. Then takes place a first sedimentation and the settled effluent goes in a mixing tank (350 m³) equipped with a floating surface aérateur.

At the bottom of the tank the effluent is pumped and aluminium sulfate (250 kg/d) plus polyelectrolyte (4 ppm) are added.

Then a second sedimentation takes place and the settled effluent is sent to river.

Each day eight trucks are loaded with a total amount of 10 m³ of greases and 30 m³ of sludges.

Although a modification of the addition of flocculant could give better results for the thickness of the sludge, the quality of the treatment would be difficult to improve in the physico chemical way. If the biological treatment is adapted (It exist a 2000 m³ tank close to the treatment plant) it should be perhaps necessary to diminish or to stop the chemical addition in primary treatment to get a good COD/BOD₅ ratio. Nevertheless a volume of 2000 m³ appears to be rather short for the biological treatment.

CURTUME RIMUS S.A.
ESTANCIA VELHA (RS)

This tannery processed 500 hides per day, of 25 kg each, through a complete process using 350 - 400 m³/d.

The effluent coming from the beamhouse goes through a 35 m³ settling tank (16 m² area). Grease is also recovered in this tank.

After going through the factory and being mixed with the rest of the effluent of the tannery (vegetable tanning represents 80 % of the production), the water passes through a manual cleaned screening.

After mixing in a 75 m³ tank aerated with a surface aerator the effluent is pumped to a sedimentation tank (16 m²) and the clarified water goes to the river. 10 to 15 m³/day of sludges are recovered and put in discharge.

The treatment seems to be overloaded and the equipment used not really adapted to the process. It will be necessary to make some changes in the primary process before a collective municipal biological treatment.

CURTUME BERGHAN LT DA

ESTANCIA VELHA (RS)

In this factory are processed 600 hides/day in semi tanned state

45 % wet blue

45 % chrom semi tanned

10 % crust (vegetable semi-tanned)

The process used (retanning, dyeing, fatliquoring and finishing) requires 90 m³/day.

A pump (Moyno type) sends the effluent on a gravity sieve (0,5 mm) and the filtrate is admitted in a 340 m³ tank equiped with two mixers.

Then takes place a sedimentation in two 16 m² area sedimentation tanks.

The sludge recovered represents one truck (5 m³) for two weeks.

According to the large size of the equipment, the result of the treatment seems quite good and the final effluent can join the municipal treatment without any problem. If a more efficient treatment was necessary in the factory, a chemical addition (Aluminium sulphate mainly) could give satisfactory results.

CALCADOS HEEMANN

LAJEADO (RS)

This small tannery processed 120 hides per day (20-25 kg) in a classical chrom tannage. After recycling of chromium float, the effluent (110 m³/d) goes through a short sedimentation tank and is raised to a 360 m³ mixing tank. The mixed effluent goes through a large 15 HP pump and is mixed with flue gaz provided by the local boiler. After a slow sedimentation in two separate tanks, the effluent goes to the river.

It seems possible to complete this treatment largely sized with a facultative lagooning (1200 m³, average depth = 2 m) equiped with a 3 HP floating aerator that will provide a good BOD elimination. Sludges coming from the primary treatment are sent to a drying pond and are used as a fertilizer.

CURTUME KERN WIENAMOTS et CIA

TAQUARI (RS)

This medium size tannery can process a maximum of 280 hides per day (7 tons). After direct recycling of chrom float, the total effluent (300 m³/d) passes through a rough mechanical screening and goes in a 10-m diamètre and 4 deep circular tank.

The equipment that provides the mixing is not well adapted and would be advantageously replaced by a 10 HP floating aérateur; sulphide oxydation could be carried out with this equipment.

As the rectangular settling tank seems to be rather short, it could be replaced by a cylindric vertical sedimentation tank ($\varnothing = 4\text{m}$, height = 1,5 + 3 m) Then the sludge would be stored in the existing settling tank.

This sludge is actually pumped and spread in a forest as a fertilizer.

The next step of the water treatment could be a facultative lagooning of nearly 4000 m³ (35 x 57 m) equiped with four 5 HP floating aerators.

F.G. SCHMIDT S.A.

SAO LEOPOLDO (R.S.)

Through a mainly vegetable (80 %) process, this tannery (100 hides per day) uses 90 m³ per day.

After mixing in a 100 m³ tank aerates with a floating 7,5 HP equipment, takes place a sedimentation in a 9 m² (3 x 3) settling tank. Sludges are removed and sent to two drying beds (3 x 8 m each).

This primary treatment not yet running could be completed with a facultative aerated lagoon of 1500 m³ equiped with two 3 HP floating aerators.

If necessary, a light chemical treatment ($Al_2(SO_4)_3$) could give a good colour removal in the primary treatment.

CURTUME BIER, SCHARLAU et CIA - LT DA

NOVO HAMBURGO (R.S.)

This tannery processed 400 hides/day (10 T raw hides) in a 60 % vegetable tanning and 40 % chrom tanning mainly for splits.

Direct chrom recycling exists in the factory and lime recycling could be soon in operation.

This tannery processed also the fleshings through a steam heating and manual grease recovery.

The effluent of this treatment brings most of the grease that troubles the waste water plant.

After two poorly sized gravity screens, the effluent is sent to a mixing tank 300 m³ with two floating aerators (each 3 HP).

Then takes place through a constant pumping a sedimentation in a rectangular 3,7 x 7,4 m area tank.

Sludges are removed once a day and directed to sand drying beds.

The primary treatment works with difficulties due, first, to the high quantity of greases brought by the fleshing treatment. The two surface aerators provides a too weak mixing effect and cannot prevent sludge settling in the mixing tank. They could be advantageously replaced with two 7,5 HP equipments.

The existing aerators will be possibly used for an aerated facultative lagooning that can complete the treatment when primary will be quite safe.

It will be also necessary to collect separately the effluents from the fleshing process and to store these effluents for 24 hours in a tank equipped with a grease removal system (with baffles). Then the effluent could be mixed with the rest of waste waters.

