SUBMERGED MEMBRANE BIOREACTOR AND REVERSE OSMOSIS TECHNOLOGY FOR TANNERY EFFLUENT RECYCLING

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Abstract: Treatment of tannery effluent is already very well known using a combination of physical, chemical and biological treatment. Recycling has been used in tanneries around the world but is limited to some specific steps such as liming or tanning. The objective of this project is to increase the recycling rate in order to reduce water consumption and pollution load and to keep on processing good quality leather. Membrane bioreactors (MBRs) combine an activated sludge process with membrane ultra-filtration to facilitate complete retention of the biomass. This combination results in high biomass concentrations leading to increased levels of COD and BOD removal efficiency with low waste sludge volumes. The removal of all particle size above 0.1-0.2µm thanks to the ultra-filtration guaranties the quality of the permeat with solid free effluent and low bacterial contamination. This technology will reduce both organic and inorganic materials. The implementation of that technology in order to recycle the floats requires a specific organization in the process floats. As salts, sulphides, chromium, biocides,…. will generate troubleshooting, type of floats treated has to be taken into account. The success of the recycle depends also on the step in which the permeat is recycled for leather processing. This organization of the waste steams will reduce water consumption in the tannery and therefore the water consumption per square meter of leather which is now a market demand. The trials showed excellent results without causing any detrimental effects on leather quality. Trials have been carried out on pilots plants in tanneries and at CTC on a pilot tannery plant.
Key words: membrane bioreactor (MBR); tannery effluent; recycle

1 Introduction

Treatment of tannery effluent is already very well known using a combination of physical, chemical and biological treatment. Recycling has been used in tanneries around the world but is limited to some specific steps such as liming or tanning. The objective of this project is to increase the recycling rate in order to reduce water consumption and pollution load. The objective is also to keep on processing good quality leather.

2 Principle and methodology

Membrane bioreactors (MBRs) combine an activated sludge process with membrane ultra-filtration to facilitate complete retention of the biomass. This combination results in high biomass concentrations leading to increased levels of COD and BOD removal efficiency with low waste sludge volumes. The removal of all particle size above 0.1-0.2µm thanks to the ultra-filtration guaranties the quality of the permeat with solid free effluent and low bacterial contamination. This technology will reduce both organic and inorganic materials.

When recycling, there are 3 major aspects to be controled:

- Origin of the effluent
- Type and performance of the treatment
- Step of the process where the treated effluent is recycled.

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The first step of the membrane bioreactor is a biological treatment. Therefore, effluents to be treated have to be compatible to bacteriological activity. Chlorides, biocides and sulphides might have a negative impact on bacterial growth. Chromium will lead to chromium sludge. Therefore, for that set of experiment, it was chosen to treat de-liming and bating floats that is to say about 20% of the total tannery floats.

Tab. 1 Main disturbing parameters for a biological treatment

	Disturbing parameters for a biological treatment
Soaking	Chlorides / biocides
Liming	Sulphides / biocides
Deliming	
Bating	
Pickling	Chlorides / pH
Tanning	Chromium / pH
Dyeing	Low BOD / Chromium
Retanning	COD
Finishing	

The membrane bioreactor generates permeate. The objective is to reuse that permeate. The less critical steps have to be identified. First step of the beamhouse processes were chosen to reduce any impact of that permeate on the quality of leather.

- Deliming and bating floats are treated in the MBR. Some tannery effluents that have been partially treated (sulphide oxidation + chromium precipitation) were added to dilute the pollution load.

- The permeate is reused for soaking, liming, deliming and bating

Trials were organised in a pilot scale tannery plateform. Two calf skins were tanned per week in order to produce effluents and to tanned leather.
The pilot has a capacity of 5 to 7 liters par hour (1 m^2 of membranes) . The bioreactor has a capacity of 900 litres. Membranes are hollow fibres, spagnetti types with a threshold cut-off of 0.1 µm.

3 Results

After 8 weeks of continuous work, the pilot has given the following resultants.

Tab. 2 Average reduction of pollution for COD, BOD and nitrogen

		Bioreactor inlet	Permeates	Reduction
Average COD	mg/l	4660	300	94%
Average BOD	mg/l	2210	30	99%
Average Nitrogen	mg/l	360	90	75%

These are average results. The evolution of the concentration versus time is as important as the average reduction.

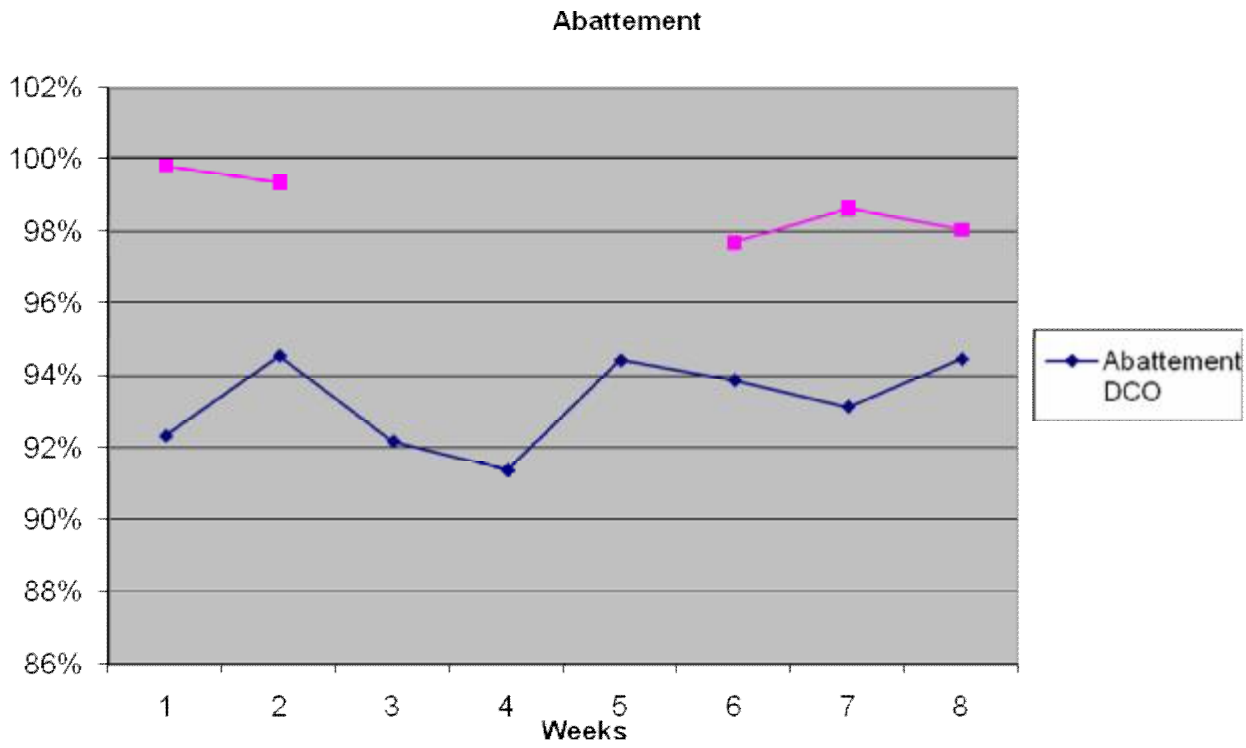

Fig. 1 Reduction of the pollution load for COD and BOD

These results on 8 weeks show that there is no significant evolution of the capacity of the MBR to treat the de-liming and bating floats.

Before recycling, the first priority of the tanner is to produce leather and more specifically good quality leather. The hides that had been processed with permeates (soaking, liming, deliming, bating,) have been tanned and the leather obtained has been tested (physical tests).

Tear strength and strength tests have been performed on leather that have been processed with permeates. Results do not give any significant differences to the standard. 1

4 Conclusion

This pilot scale operation has been successful showing that recycling of tannery floats is technically feasible both for the treatment side and for the recycling side. Economical aspects have to be optimised and parameters are being modified to make in simpler and chipper.