



Reducing the water footprint and pollution load in leather production with DryFast

Nagarathinam Annamalai, BASF India

Dr Winnie Ding, BASF China

Robert Orth, BASF SE

Water is a scarce resource across most industries, and this includes the leather manufacturing sector. At the same time legislation in many countries is becoming stricter with regards to both the volume and parameters for treated wastewater discharge from tanneries. Many tanneries that have not met these new standards for discharge have been forced to shut down their production.

In leather making, wet operations consume large amounts of water and chemicals, and these all contribute to the high effluent discharge. This is of concern to the tanneries as it requires additional investment for effluent treatment plants to meet more stringent legislation.

Accordingly, the minimisation of water consumption coupled with cleaner manufacturing technology has become increasingly important for two reasons:

- To minimise effluent treatment costs.
- Conventional effluent treatment alone is often insufficient to meet requirements for end-of-pipe discharges.

Panel I: Water consumption pattern

Column ref. number	1	2	3	4	5	6
Material	Salted hides			Fresh hides		
Water consumption %	Standard	Standard Optimised	Standard Optimised + Recycle	Standard	Standard Optimised	Standard Optimised + Recycle
Process						
First wash	120					
Dirt soak	100	120	120	100	80	80
Main soak	80	80	80	100	80	80
Wash after soak	80					
Liming HS/HB	120			120	100	Recycle **
First lime wash	100	80	Recycle*	100	80	Recycle **
Second lime wash	100	80	Recycle*	100	80	Recycle **
Fleshing/splitting						
Washing	100	80	Recycle*	100	80	Recycle **
Pre-deliming	100	80	Recycle*	100		
Deliming/bating	80	50	50	80	40	40
First wash	100	80	Recycle*	100	80	Recycle **
Second wash	100	80	Recycle*	100	80	Recycle **
Third wash	100			100		
Pickling	50	50	Recycle**	50	50	Recycle **
Tanning						
Wash after tannage	100	60	60	100	50	Recycle **
Total fresh water	1430	840	500	1250	800	280
Recycle*	50% recycle with addition of 30% fresh water					
Recycle**	40% recycle with addition of 10% fresh water					
Note: all of the values given are based on results obtained. Results may vary depending on tannery conditions, processes and chemicals used, and water conditions etc.						



To address these issues, BASF has developed DryFast – a beamhouse innovation to provide improved efficiency. This follows a more ecological approach by focusing on reductions in three important parameters in the beamhouse process:

- Consumption of water
- Effluent load
- Processing time

Accordingly, a joint collaborative approach was carried out to better understand the benefits of this concept with selected tanneries. This resulted in various bulk production trials being conducted over a period of six months in different parts of the world, the focus being to use specialised auxiliaries to help address these three parameters.

The investigations

The focus of the investigations was in five different areas:

Soaking: The use of effective auxiliaries, surfactants and enzymatic products to eliminate multiple washings. [Legend 1]

Dehairing / Liming: The use of organic sulfur compounds together with enzymatic auxiliaries to facilitate cleaner grain surfaces, hair root removal and reduce sludge in the effluent. [Legend 2]

Deliming: To manage ammonium free deliming processes in order to reduce the nitrogen component load within subsequent effluent treatment. [Legend 3]

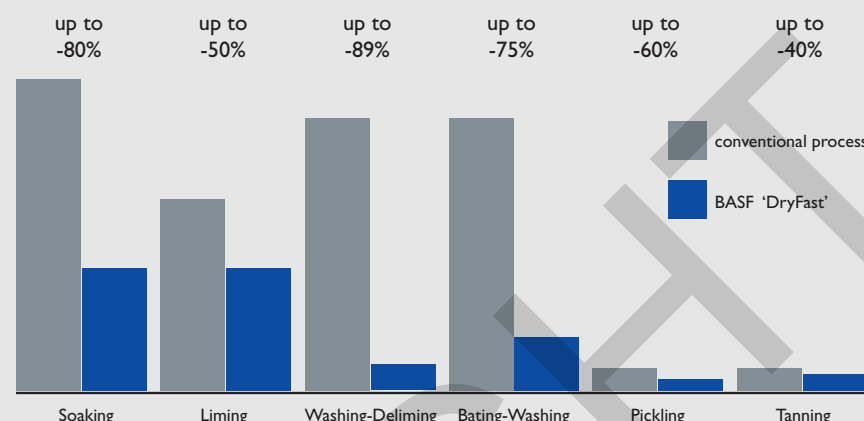
The tanning process: To gain improved chrome uptake within the chrome tanning process, achieve a more even chrome distribution, and to ensure fuller leather. [Legend 4]

Recycling: To apply reuse/recycling of water as appropriate within all stages of the leather production.

Many studies have been undertaken concerning the volume and the quality of water used. The patterns for water consumption of salted and fresh hides at different processing stages are set down in Panel 1. (Reference columns 1 and 4 respectively).

By using specialised auxiliaries at various stages of leather processing, the consumption of water within process of both salted and fresh hides can be optimised as shown (Reference columns 2 and 5 respectively). The used water from

Panel 2: Water reduction pattern within the investigations



Note: all of the values given are based on results obtained. Results may vary depending on tannery conditions, processes and chemicals used, and water conditions etc.

Panel 3: Generation of pollution load. Comparison of hair saving system against hair burn system

	Hair burn process	Hair save process	% Difference
COD mg/l	50,000 to 60,000	20,000 to 25,000	↓ 59
BOD mg/l	Approx. 30,000	10,000 to 12,000	↓ 63
S mg/l	Approx. 4,000	Approx. 2,000	↓ 50
N mg/l	Approx. 5,500	Approx. 3,500	↓ 36
CaO mg/l	Approx. 15,000	Approx. 8,000	↓ 47

Note: all of the values given are based on results obtained. Results may vary depending on tannery conditions, processes and chemicals used, and water conditions, etc.

the different process steps from both salted and fresh hides can then be recycled to create further savings as shown (Reference columns 3 and 6 respectively).

With reference to Panel 1, the study showed that by taking this approach the water consumption for processing salted hides could be reduced from 1430% to 840%. By recycling, however, the consumption of fresh water could be reduced from 1430% to 500%.

Similarly, the water consumption of fresh hides could be reduced from 1250% to 800%. In addition, by recycling the consumption of fresh water could be reduced from 1250% to 280%.

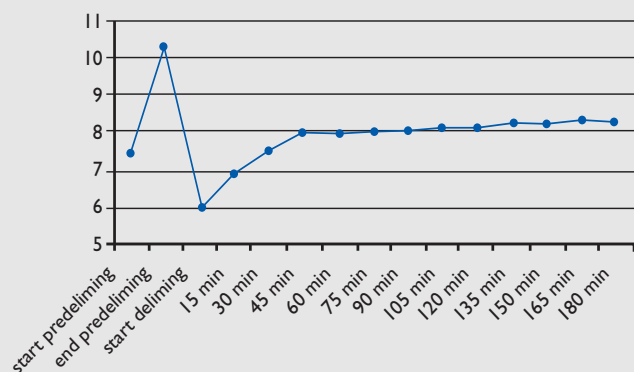
Extending recycling in manufacture

It is known that when water use is not regulated carefully in leather manufacture the use is always higher than necessary. It is also the case that where the fresh water supply is from bore wells or from rivers, that the use can be higher than when the water is from

municipal supply. In both of these situations there is often opportunity for improvement. Also, recycling in practice is often limited to the soaking, liming and unhairing operations, but the techniques used in this study show that reusing and recycling can be extended to other steps of the leather production.

Here, alternatives for water reuse were evaluated in the investigations to estimate the concentration of some contaminant parameters in the different wastewaters. This evaluation was done by the analysis of the various wastewaters from industrial scale trials, being required to ensure the suitability of the water for reuse. In particular, tests were conducted using recycled water in the pre-deliming and deliming stages, with 100% of the recycled water coming from earlier washings after the bating steps collected from previous production process.

It was found that this practice did not present any considerable difference when compared with the conventional process: it demonstrated the viability of reusing

**Panel 4: “pH-development” during deliming process of full substance bovine hides**

water in pre-deliming and deliming stages, thus reducing both water use and the volume of effluent for subsequent treatment.

Together these lower float operations throughout processing from the raw to tanned state, less washings in between process steps and usage of recycled water can reduce the overall water consumption by up to 60%, as illustrated in *Panel 2*.

Reducing the effluent load

Traditionally, in leather processing the hair from the hide is dissolved, generally referred to as the hair burn process. However, this produces a large amount of proteins that are dissolved in the wastewater.

These proteins are treated and settle as a sludge in effluent treatment, but this mix of solids precipitated from solution can only reduce the COD/BOD (Chemical Oxygen Demand/Biochemical Oxygen Demand) to a limited extent as many components remain in solution.

However, the use of specialty soaking auxiliaries facilitates the removal of the hair in a hair saving process, and this hair can be easily recovered from the processing float using a filter system. This approach can reduce the COD/BOD by up to 60%. The percentage of COD/BOD levels, and sulfide and nitrogen content with the hair destroying and hair saving processes is indicated in *Panel 3*.

If the final liming float is filtered, this can then be reused in the next unhairing/liming process together with a reduced offer of fresh water. Moreover, as the recovered hair has not been contaminated within the main effluent treatment plant it can be used as fertiliser, or within bio-gas generation.

Reducing the nitrogen level in effluent treatment

Another way of reducing pollution load in the effluent is to carry out an ammonium free deliming operation. The conventional use of ammonium salts in deliming results in increases of both nitrogen for effluent treatment, and a need to address increases in either sulfates or chloride components.

Carboxylic acid ester, however, has been introduced into the deliming stage and proved to be both effective and more environmentally friendly. The pH development during the deliming process when using Decaltal ES-N liquid is shown in *Panel 4*.

Reduction in processing time

The specialised products and recycling techniques used in these investigations helped to reduce the processing time in each of the soaking, liming, deliming, pickling and tanning stages. This was due to the surfactants, dispersants and exhaustive aids easing the penetration of all basic chemicals uniformly throughout the hides. In this approach there was a reduction of effective processing time by up to 12 hours in total, compared to the standard.

Summary

Industrial scale studies have demonstrated that careful consideration of manufacturing techniques can reduce both the volume of water used for processing and the actual load of the resultant wastewaters. Here, the use of specialised auxiliary products can play an important role in this reduction of effluent strength at source, and an improved use of basic chemicals. In turn, this provides better opportunities for recycling and reuse of floats, and reduces the subsequent load on the effluent treatment plant in terms of COD, BOD, Nitrogen and Sulfide, and ultimately reduced sludge generation.

The DryFast system also has a positive impact on sulfide and lime, as can be seen in *Panel 2*. Discussing that in more detail would have gone beyond the scope of this publication. ☺

Legend

- [1] Eusapon® OC, Eusapon® W, and enzymatic product Basozym® S20.
- [2] Mollescal® HW and enzymatic auxiliaries Basozym® L10.
- [3] Decaltal® ES-N liq.
- [4] Implenal® DC liquid and Neutrigan®

Additional sources of information

Reduction of water demand and treatment cost in tanneries through re-use technique. Year 2008 volume 103 issue 4 Journal of the American leather chemists Association.

Recouping the Wastewater: a way forward for cleaner Leather Processing, Journal of cleaner production. 11, 591-599 Rao, J.R et.al, 2003.

Assessment of waste management in the tanneries: State of Rio Grande do Sul case study.