

Green Beamhouse – a toolbox for sustainable, high-quality leather

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The arrangement of wastewater treatment plants and the requirements in terms of incoming wastewater vary from country to country and from region to region. This requires tanneries to adjust their processes and to focus on the reduction of certain wastewater components. With “Green Beamhouse”, Lanxess offers a toolbox to independently address all critical wastewater limits, giving tanneries the opportunity to improve sustainability without compromising quality or cost.

Sustainable leather production is becoming increasingly important for tanneries. A key element of this is the careful handling of wastewater. Most tanneries operate their own treatment facility or discharge into a common effluent treatment plant, often referred to as a CEPT. The individual set-ups of these plants lead to facility-specific limits and costs in relation to certain wastewater components. Controlling and potentially reducing these critical components give tanners the opportunity to optimise their capacity and to improve their costs.

Approximately 70% of all tannery wastewater comes from the beamhouse. As a result, the opportunities to reduce critical wastewater components are by far the largest here. One must consider that all the chemicals and products applied during beamhouse operations ultimately end up in the wastewater.

Lanxess has acknowledged this and has developed Green Beamhouse, a technology toolbox that allows for the significant reduction of critical wastewater components without compromising quality or costs.

The origin of all critical components, the strategies to reduce them and the measurable effects achieved in full production are described below.

Critical wastewater components include sulfide (S^{2-}), chemical/biological oxygen demand (COD/BOD), nitrogen/ammonia and common salt (NaCl). The order of importance varies from country to country and from tannery to tannery. Nevertheless, all the components mentioned have been considered critical in most tanneries around the globe.

Sulfide (S^{2-})

Besides very small amounts deriving from the amino acids of hides, the majority of sulfur found in wastewater can be traced back to the reductive auxiliaries added during unhairing. The most common of these materials are Na_2S , $NaHS$ and organic sulfur components such as mercaptans and thioglycolic acid. The aim of these auxiliaries is the cleavage of the sulfur-sulfur bonds of pre-keratin and keratin, which leads to the desired unhairing of the hide. Calculating the volume of reductive auxiliaries required (plus a small surplus) takes into account the total quantity of hair and the thickness of the epidermis.



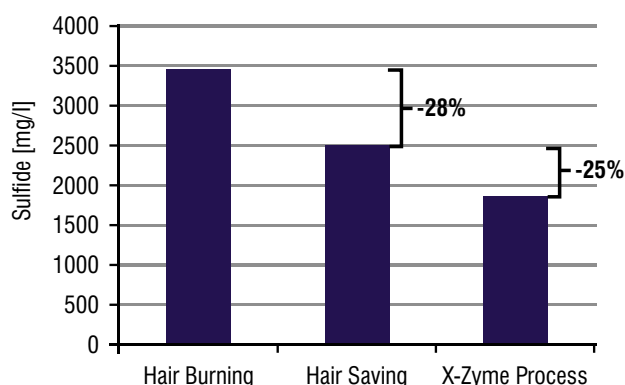
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Changing from a hair-burning to a hair-saving system leads to a significantly lower number of accessible sulfur-sulfur bonds. This means fewer required auxiliaries and less sulfur in the wastewater. A further reduction of sulfides requires an enzymatic cleavage of the pre-keratin.

In collaboration with industrial enzyme producer Novozymes, Lanxess launched its patented X-Zyme technology, which has been successfully implemented in



Figure 1: Sulfide Reduction



tanneries over the past five years. It is based on a pre-keratin-specific enzyme that loosens and avoids immunisation of the hair root in a hair-saving process. The required amount of sulfide can thus be reduced.

Measurements carried out on productions show a sulfide reduction of 45% (vs. hair-burning) and 25% (vs. hair-saving) (Figure 1). This technology also provides a better unhairing result, especially on hides with short hair or from animals slaughtered in winter, leading to better-quality pelts.

Chemical/Biological Oxygen Demand (COD/BOD)

Organic compounds in the wastewater derive not only from degraded hair, other proteins and grease, but also from the auxiliaries applied. In particular, surfactants used for degreasing or emulsifying have a large effect on COD. Strategies for the reduction of COD include reduced introduction of organic matter from the hide (e.g. by hair-saving processes, green fleshing). A reduction of auxiliaries can also be considered, especially surfactants or organic reducing agents.

By using specific enzymes, it is possible to significantly reduce the COD and improve the quality of pelt and wet blue at the same time. The X-Zyme technology, in combination with very effective lipase, is able to replace significant parts of the surfactants and organic sulfur compounds. COD measurements in production of the resulting effluent show a reduction of 65% vs. hair burning and 42% vs. hair saving (Figure 2).

In this process, the glucanases Peltec X-Zyme S and SN enhance the washing out of the non-collagenous byproducts (hyaluronic acid) while the lipase cleaves the remaining fat. Through a combination of these enzymes, the COD in wastewater can be reduced in a cost-effective way.

Lanxess introduced Peltec X-Zyme S, which is active at a pH of around 7, five years ago, and it recently developed Peltec X-Zyme SN in cooperation with Novozymes. This glucanase has the same advantages as Peltec X-Zyme S but reaches maximum effectiveness at pH 9.5, a level commonly used in soaking. This opens up opportunities for tanners to streamline their processes.

Nitrogen

In order to take a holistic approach to reducing nitrogen in the beamhouse, all wastewater streams must be reviewed. Nitrogen originates from the denatured proteins of the hides and liming auxiliaries during the first part of the beamhouse process, while the ammonium salts used in deliming cause

Figure 2: COD Reduction

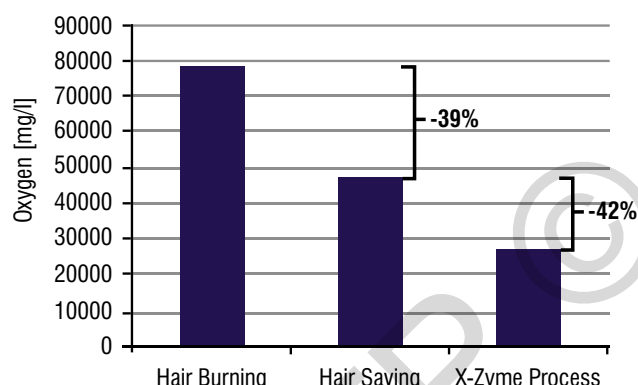
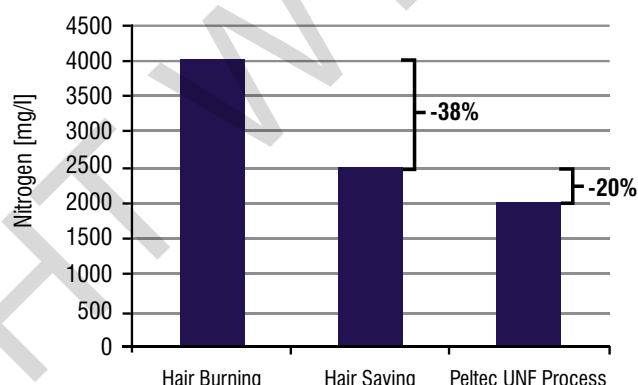


Figure 3: Nitrogen Reduction



most of the nitrogen pollution in the second part.

Strategies for nitrogen reduction include a change from a hair-burning to hair-saving process. Immunising the hair and then filtering it off ensures the hair is not destroyed and so cannot release amino acids into the float. Nitrogen content in the liming float was thus found to be reduced by almost 40% (hair saving vs. hair burning) (Figure 3).

Additionally, replacement of amine-containing swell regulators can lead to further reductions. These swell regulators play an important role in the hide quality in terms of wrinkle-prevention and belly-draw reduction, so a further decrease in nitrogen requires a new technology that offers similar or better performance in this regard. With its Peltec UNF, Lanxess offers a patented, nitrogen-free product that offers slightly improved performance at similar process costs. A further nitrogen reduction of 20% (vs. hair saving) therefore can be achieved (Figure 3).

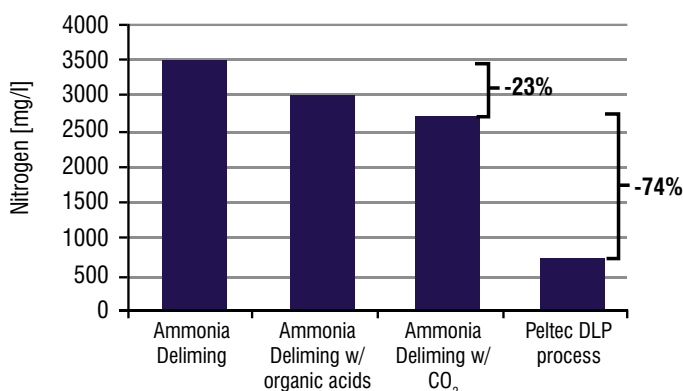
The nitrogen impact in the deliming step is similar to that during soaking/liming. It can be traced almost entirely back to the ammonium salts in the deliming agents. Ammonium salts are the most common base for deliming agents due to their good cost/performance ratio.

Some tanneries are improving the nitrogen content in wastewater by partly replacing ammonium salts with organic acids or carbon dioxide (CO₂). However, this only reduces the nitrogen impact by 20-25%. Other deliming systems that are completely nitrogen-free are based on hazardous chemicals such as boric acid.

During the development of Peltec DLP, Lanxess used a different concept for nitrogen-free deliming. As a result, a



Figure 4: Nitrogen Reduction

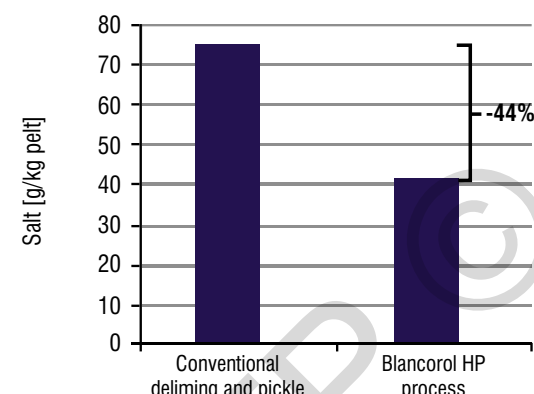


nitrogen reduction of 75% in the wastewater can be achieved at competitive costs and without compromising quality (Figure 4).

Salt (NaCl)

Reduction of salt (NaCl) in the wastewater is also a frequent need in tanneries. Most of the salt is added for the preservation of the raw hides themselves. Salt restrictions in some regions have resulted in the usage of fresh raw material as the most common production method. In this case, most of the salt in the wastewater can be prevented. Further potential for reduction can be seen in pickling, which

Figure 5: Salt Reduction



accounts for the second largest usage of salt.

In the pickle, chrome is allowed to penetrate the hide at low pH prior to fixation at pH 4. The addition of salt counteracts the osmotic pressure and prevents acidic swelling and thus damage to the hide structure. The addition of Blancorol HP helps to speed up the acid penetration, allowing a shorter pickle and a subsequent reduction of salt by almost 45% (Figure 5). Blancorol HP therefore helps to lower the salt load, but also brings benefits to the tanner in terms of the process time. Due to its high masking effect, the chrome tanning salt can be added very early in the process, even when the acid penetration is not complete. 🌱

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