A way towards sustainable processing

Low-salt process

Leather industry and pollution

The processing of the skin and hides reduces the environmental impact of the meat industry and bails it out of waste disposal problems. However, approximately 25% of the skins or hides by weight are converted into leather and the majority is solid waste or by-products. The chemicals used in the manufacture of the leather contribute to the waste generated after processing. This makes the leather industry one of the highest polluting organisations and requires severe emphasis on the methods of minimizing the pollution through the implementation of cleaner technologies. The concept of cleaner technology is to recycle and replace systems in the effort to reduce the waste generated by the conventional methods. This development of cleaner technology can be divided into two routes that minimize the impact of substances involved in manufacturing that are harmful to the environment. The cleaner technology can be introduced during or after processing to lower the waste by avoiding the harmful chemicals added in processes and the other option would be treating wastewater by incorporating advanced effluent treatment systems.

Pollutants in wastewater

The pollution load can be minimised with a combination of suitable cleaner technologies within processing. The degree to which the pollution load needs to be decreased depends on the concentrations of pollutants that can be legally discharged in effluent. Several parameters have been examined and demonstrated by Directive 2010/75/EU of the European Parliament and Council on industrial emission guidelines for Integrated Pollution Prevention and Control (IPPC) to enable management of industrial emissions. The tannery generates wastewater effluent consisting of high content of inorganic and organic pollutants, which requires lowering/treating before discharging to surface waters. This commonly involves suspended solids (SS), biological oxygen demand (BOD_5), chemical oxygen demand (COD), total kjeldahl nitrogen (TKN), sulfide (S^{2-}), ammoniacal nitrogen, total dissolved solids (TDS), chlorides (Cl^-), sulfates (SO_4^{2-}), chromium (Cr^{3+}) and grease amongst others. There are particular stages of processing leather that require considerable attention for waste minimization, however any alternative technology to reduce the environmental impact is favorable. The beamhouse processes are the highest contributor to pollution of which it accounts to 75% of chemical and biological oxygen demand. About 75% of chromium comes from the tanning stage. The majority source of total kjeldahl nitrogen of 85% is discharged from liming/unhairing process and about 60% of total chlorides come from preservation, whilst pickling generates the

remaining, followed by tanning and dyeing to a lesser extent.

Unlike other pollutants mentioned above, salinity is the most challenging type of pollutant to remove from wastewater because of the high solubility and chemical stability of the sodium chloride in water. The discharging of treated wastewater with high salt content into rivers results in a negative effect on fish and plants. The use of this water for irrigation will increase the soil salinity due time as the water evaporates and subsequently hinders the growth of plants in the area.

Alternative cleaner technologies

Alternative procedures have been implemented to reduce salt before processing, such as processing fresh skin/hides from the abattoir (only economic if abattoir is close to the tannery), and mechanically desalting in perforated drums to reuse the salt for preservation. In processing, recycling pickle liquor is well known. However, further work in the mechanism of swelling has found the development of non-swelling acid (NSA) technology. After processing, solar evaporation has been implemented to reuse the salt for other applications.

Non-swelling acid technology

During processing, the skin is acidified to protonate the carboxyl groups in the pickling stage, the pH of the skin is lowered to modify the collagen structure to have less affinity for the cationic chemicals to prepare the structure for penetration of cationic tanning agents. The salt is essential at this stage only to prevent the swelling of the skin/hide as this is an irreversible structural damage. The mechanism of non-swelling acids predominantly reduces the osmotic effect of swelling, due to the slight increase in collagen stability by interacting strongly with the amino side chains. Therefore, significantly less salt is required to smear repulsive forces of the collagen that cause swelling. This system does not only improve the properties of the skin/hide such as shave-ability and strength, but the exhaustion from the process float.

It is for these advantages that Leder Chimica has developed a modified non-swelling aryl sulfonic acid that can reduce salt by 67% in the pickling stage as seen in Figure 1.1 below. This modified non-swelling aryl sulfonic acid completely replaces mineral acid in the pickling stage, providing better uptake of the tanning agent and less time taken to fix tanning agents. It can be applied at the end of post-tanning stages to enhance fixation of the chemicals, providing a better handle to the leather.

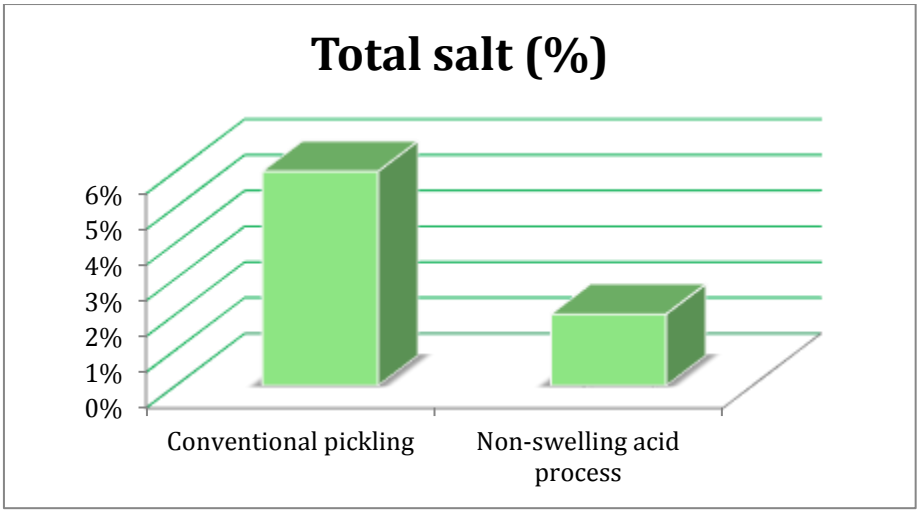

Figure 1.1 Reduction of salt in the pickling stage

Some of the parameters that have been observed whilst implementing the low-salt process in the pickling stage are:

- Reduction of chrome offer by 16%
- Reduction of chrome discharged to effluent
- 67% less salt needed to process
- Reduction of basifying agent by 30%, with less time required to complete process

Conclusion

The effect of cleaner technology is well demonstrated for best available techniques in the Integrated Pollution Prevention and Control (IPPC) reference documents, by complementing different cleaning techniques, cost effective and environmentally friendly processes can be achieved and have significant impact on product quality and the leather produced.

References

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