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Research on the Application of a New Multifunctional Swelling Agent in the Leather Industry

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Abstract

This is the research for a new leather chemical, a new multifunctional swelling agent, for industrial application. The main purpose is to use this new multifunctional swelling chemical instead of lime, providing to the collagen the traditional liming effect of opening uniformly collagen fibers, opening wrinkles, having good fullness and softness in wet blue, obtaining clean leather, and improvinge significantly the quality of the finished leather.

On hair saving systems with our multifunctional swelling agent, only a small amount of lime is required to save hair at the end of the liming process. Less lime effluents are produced, reducing the huge amount of lime consumption, reducing sodium sulfide, and reducing the large number of sulfur compounds from the hydrolysis of hair. So, suspended solids (SS) in wastewater, sulfides, COD, and usual amount of water in tanning processes, can significantly be reduced.

Improving the quality of leather, and reducing the treatment costs of wastewater, has a good market prospect, as it improves the economy of tanning companies,

Keywords: multifunction swelling agent, sludge, COD, sulfide

1. Introduction

In light industry, leather industry causes the third largest industrial pollution, following paper and brewing industries. Wastewater pollution is the main source of pollution in the leather tanning industry. Due to the early development of leather industry, there was not enough awareness of environment protection, so groundwater has been seriously polluted under many tanning areas, and groundwater in some areas can not be drinked directly. In the leather industry, solving tanneries pollution has become the primary task in the continuous development and surviving of tanneries [1] .

Tanning procedure has beamhouse section, tanning section and finishing section. Total sewage in beamhouse section is 60~70% of the total volume of the pollution load, a 70% of total effluents. This is the main source of pollution in tannery wastewater. So, to solve tannery pollution, we need to decrease contaminants to the desired level from the beamhouse section. The main problems in

beamhouse section are COD, SS, ammonia, nitrogen and sulfide values, These contaminants are always accumulated during liming/unhairing and deliming/bating processes. Only these two processes produce more than 85% of the emissions from beamhouse section[2], Emphasis to solve pollution from beamhouse section, should focus on liming/unhairing and deliming/bating processes.

The liming process in the beamhouse section produces large amounts of SS, sulfide, and COD. SS go to the wastewater tank, resulting a lot of tannery sludge. The treatment of sludges after the filter press increases the production costs of the tannery. Nowadays, landfill is still used to solve out waste depositions.

In this paper, based on the research of the traditional tanning technology, we develop a new multifunctional swelling agent to replace lime in conventional liming process, through the technology adjustment of the tanning process. We control the amount of pollutants and sewage in the whole liming process. We reduce the source of wastewater and dirt. We reduce the investment of the final pollution treatment facilities, and we reduce the processing costs[3].

2. Experimental

Material and equipments

- Local wet-salted cattle hides from Henan, China
- Sodium sulfide, sodium hydrosulfide, lime: industrial products, Sichuan Xin xing Chemical Co., Ltd
- PRODUCT 1* chemical product, Sichuan Decision Chemical Co., Ltd
- **Multifunctional swelling agent**, 75%, Sichuan Decision Chemical Co., Ltd
- Potassium acid phthalate, 1,10-Phenanthroline monohydrate, potassium bichromate, ferrous ammonia sulfate, silver sulphate, mercury sulfate, analytical pure, SCRC;
- 101 type drier, Beijing Zhonxin Weiye instrument Co, Ltd
- HB-III vacuum pump, Zhenzhou Cheangchen Co, Ltd;
- DF-3000AD leather measuring machine, Guangdon Da Feng machinery equipmet company;
- Drum, diameter = 2 meters, Foushan Guangzhou Nanhai Co, Ltd;

2.1 Experiment

2.1.1 Experimental Procedure

The whole cattle hide is divided in two sides after soaking, each one being used in two comparative experiments. We control the swelling effect, the size of the wet blue, wrinkles, and the following indicators of sewage pollution;

- COD, determination methods by GB11914 - 89 (quality of water, determination of chemical oxygen demand, bichromate method);
- SS, determination methods by GB11901 – 89 (quality of water, determination of suspended solids, weight method),
- Sulfide, determination methods by GB/T 16489-1996.

2.1.2 Steps of experiment

1. Salted hides follow the conventional process: soaking → fleshing → re-soaking. Afterwards, each piece of hide is divided from the spine in two comparative sides. We measure size and weight of each side, and we carry out the trail in two equal drums, comparing the conventional process and the process with less lime, during unhairing/liming and unhairing/swelling.

The process is below：

CONVENTIONAL PROCESS unhairing/liming:

- Water 25ºC 80%
- Liming agent PRODUCT 1* 0.8% run 20min;
- Sodium hydrosulfide 1% run 20/stop 10 min×2;
- Sodium sulfide 0.6%
- Lime 1% run 20/stop 40min, run 5/stop 25min×2;
- Sodium sulfide 0.6% run 40min;
- Lime 1% run 10/stop 20min×8;
- Lime 1.5%
- Water 50% run 10/stop 20min, run 5/stop 25min×3;
- Water 50% run 10/stop 20min, run 2/stop 60min×12, O/N, next day run 10min; drain.
- Splitting 2.0mm, weight, washing×2 times, rinsing 15min, deliming to the required PH;

HAIR-SAVING PROCESS WITH LESS LIME：

- Water 25ºC 80%
- Liming agent PRODUCT 1* 0.8% run 20min;
- Lime 0.8% run 40min
- Sodium hydrosulfide 1% run/stop 30 min; unhairing, filter wool
- Sodium sulfide 0.6% run 20/stop 20min;
- **Multifunctional Swelling Agent 0.5%** run 20/stop 40min×2;
- **Multifunctional Swelling Agent 0.5%** run 10/stop 20min×4;
- **Multifunctional Swelling Agent 1%** run 20/stop 10min×2;
- Water 50% run 10/stop 20min, + run 5/stop 25min×3;
- Water 50% run 10/stop 20min, run 2/stop 60min×12, O/N, next day run 10min;
- Splitting 2.0mm, weight, without washing, deliming to the required PH.

Bating and tanning are done in the same drum, the two comparative sides processed together. After draining and unloading, we horse-up, and measure size. Wet-end is done in the conventional process. We check crust values.

Table 1：Experimental data

	Data	conventional process	Hair-saving process with less lime
Salted hides	Weight	460 Kg	446 Kg
	yield	835.13 sf	811.55 sf
Limed hides	Weight	575.5Kg	608.5Kg
	Comparative weight with salted hides in percentage	25.1%	36.4%
	yield	782.60 sf	754.74 sf
Wet blue	yield	870.32 sf	889.01 sf
	Comparative yield with salted hides in percentage	4.2%	9.5%
	Comparative yield with limed hides in percentage	11.21%	17.79%

Table 2: Key indicators of sewage

Note: wastewater analysis from the drum：

Item	conventional process	Hair-saving process with less lime	Lower rate
COD from wastewater of liming	31,885mg/l	15,018mg/l	52.9%
SS from Wastewater of liming	5,853mg/l	1,276mg/l	78.2%
Sulfide from wastewater of liming	4,520mg/l	1,517.5mg/l	66.5%
Amount of water for beamhouse	□36 kg/kg of raw hides	□ 27 kg/kg of raw hides	□ 25%

3. Results and discussion

3.1 Comparing limed hides weight and salted hides weight, the percentage in the hair-saving process, with less lime, is 11.3% higher than the percentage in the conventional process. So, when using multifunctional agent in liming, there is a better water uptake, with better swelling. Before splitting, obviously thickness of limed hides in the hair-saving with less lime, was higher than in the conventional process.

3.2 Comparing wet-blue yield and salted hides yield, the percentage in the hair-saving process, with less lime, is 5.3% higher than the percentage in the conventional process. Comparing wet-blue yield and limed hides yield, the percentage in the hair-saving process, with less lime, is 6.58% higher than the percentage in the conventional process. It is obvious that the hair-saving process with less lime enlarges yield more than conventional process.

3.3 Using the hair-saving process with less lime, after liming, wrinkles are open, especially neck wrinkles, belly wrinkles and fat wrinkles. Grain is cleaner and clearer, and empty parts of bellies are tighter as well.

3.4 After tanning, wet blue, in the hair-saving process with less lime, has evidently tighter, cleaner and clearer grain.

3.5 Analysing the key indicators of sewage from liming and de-liming process, we find that the hair-saving process with less lime, lowers efficiently the pollution indicators, such as sulfide content, COD, and suspended solids. Suspended solids in tanning sludge are significantly reduced in a 78.2%, alleviating the pressure on tannery sludges treatment.

Moreover, when using hair-saving process with less lime, we can not only decrease the use of sulfide, but we can reduce aswell sulfide from hydrolysis of hair, after filtering. Water consumption is reduced a 25%. So, this process decreases costs of sludge treatment, and save the amount of water consumption.

4. Conclusions

4.1 Traditional clean technology focus more in the process, but does not consider, or weakens, the quality of the final product. Studies of new materials in this paper consider environment-friendly and cleaning technology requirements, but without compromising or lowering the quality of leather. The purpose is to increase the quality of the final product. To solve out the main pollutant from beamhouse processes, and to lower the sulfide use in the tanning industry, provides the basis and reference for the development of clean chemicals for leather processing.

4.2 Clean liming process has a tremendous impact on the traditional process. The new multifunctional swelling agent reduces lime in beamhouse, but it could even replace completely lime, a strong pollutant.

Moreover, this process produces results in limed hides and wet blue leathers that traditional process can not match. It protects loose fiber parts of the hide, and reduces the amount of filling agents required in retanning processes. Tear strength is enhanced, and dry milling is easier.

4.3 The new product in this paper, has a strong marketing sense and prospects. Using the multifunctional swelling agent is very simple, and does not require any replacement of the equipment, Only minor adjustments in the traditional process are done, to meet production needs, and better

quality of finished leather. Leather size is significantly increased, helping tanners to achieve better economic benefits.

4.4 New multifunctional swelling agent is itself an environmentally friendly chemical, that does not produces secondary pollution to the environment. It is easily and fully degraded through the effect of chemical and biological reactions. To promote cleaning technologies for the leather and the tanning industry, and to achieve sustainable development, is an objective and a necessity .

References:

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* PRODUCT 1: DESOAGEN LM-5, buffering lime auxiliary