

The ND Chrome Tanning Technology

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Abstract: This paper introduced the leather tanning machine which was designed specially and the research on the ND(no drum) chrome tanning technology by using the leather tanning machine which was new chrome tanning technology and was different from traditional chrome tanning technology by using drum. It was showed that the leather yield of the ND chrome tanning technology was increased; the leather damages of the ND chrome tanning technology were covered, so the leather surface was beautified, and the leather use ratio was increased; the spent chrome liquid of the ND chrome tanning technology was recycled easily; the energy was saved, energy consumption of tannage was decreased.

Key words: chrome tanning technology; leather tanning machine; increase the leather yield; beautify the leather surface; recycle the spent chrome liquid

1 Preface

Tannage is the key process of the making leather product, in this process the raw skins are made into leather. The chrome tannage is the most mature, popular, steady and cheap. The common equipment of chrome tannage is drum. The skins and chrome liquor are put into the drum together, when the drum run, the mechanical action comes into being through the rolling and throwing of the skins and chrome liquor. The mechanical action makes chrome liquor to penetrate into the inside of skins and accelerates the physical and chemical changes of skins, and then skins are tanned into leather^[1].

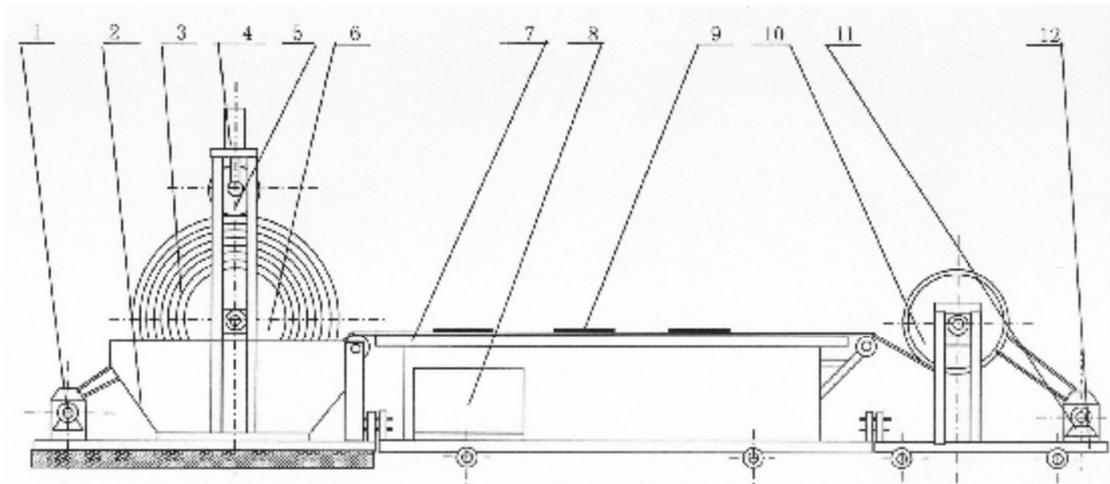
The ND (no drum) chrome tanning technology is new chrome tanning technology which uses the designed specially leather tanning machine instead of drum. The ND chrome tanning technology may tan the pickled skins when the pickled skins are fully stretched and approximately fixed, at the same time the ND chrome tanning technology can exert pressure to the surface of skin in order to increase the yield of leather and beauty the leather surface^[2].

This article introduces the designed specially leather tanning machine, and the experiments and results of the ND chrome tanning technology using this leather tanning machine.

2 The Leather Tanning Machine

According the need of the ND chrome tanning technology, we design a leather tanning machine specially. The leather tanning machine comprises a tanning roller provided with a driving system, a skin loading/unloading roller provided with a driving system, a pressure roller, an operating board, a conveying belt, a tanning tank, an oil cylinder, a hydraulic system, and a main frame. Picture 1 is the basic principle of the leather tanning machine.

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1 driving system of tanning roller 2 tanning tank 3 conveying belt 4 oil cylinder 5 pressure roller 6 tanning roller 7 operating board 8 hydraulic system 9 skins 10 skin loading / unloading roller 11 driving system of skin loading / unloading roller 12 main frame

Picture 1 The basic principle of the leather tanning machine

The operations of using leather tanning machine are: In the beginning of the tanning process, one end of the conveying belt is attached to the skin loading/unloading roller through the operating board. Adjust the tanning roller, the operating board and the skin loading/unloading roller so that their centre lines are aligned to prevent deflection of the conveying belt. Rotate the skin loading/unloading roller counterclockwise to wind the conveying belt round the skin loading/unloading roller. Stop rotating the skin loading/unloading roller and the braking device of the skin loading/unloading roller will strain the conveying belt so that the wound conveying belt exert a pressure to the skins. Slowly rotate the tanning roller clockwise and spread the stretched skins onto the slowly moving conveying belt on the operating board. Continue to spread the skins as the conveying belt winds itself round the roller until all skins are spread on the conveying belt. Remove the conveying belt from the skin loading/unloading roller and attach the conveying belt to the tanning roller. Introduce the prepared tanning liquor into the tanning tank. Rotate the tanning roller and adjust the pressure of the pressure roller to begin the tanning. After tanning reverse the above operations to remove the tanned skins from the conveying belt on the operating board.

3 Experimental

3.1 The comparison of yield of leather

3.1.1 Equipments and materials

The equipment is the leather tanning machine as picture 1, the materials are the salted pig skin and ordinary leather chemicals.

3.1.2 Operations

Presoak the salted pig skins, horse them, measure the area of the skins, then do ordinary soaking, liming, deliming, bating, pickling processes^[3], carry through drum chrome tannage and ND chrome tannage individually, make the blue leather to the finished product, measure their area.

The operations of ND chrome tannage are: spreading the stretched skins by pulling onto the conveying belt of tanning machine, rotating the tanning roller, winding the conveying belt and the pickled skins round the tanning roller. Introduce the prepared tanning liquor into the tanning tank. Rotate the

tanning roller and adjust the pressure of the pressure roller to begin the tanning, until the pickled skins are tanned to leather.

Take the finished product examples of the drum tannage and the ND tannage, measure the area, condition them under the air of room temperature and 100% relative humidity, drying, measure the area again.

3.2 Beautify the grain

3.2.1 Equipments and materials

The equipment is the leather tanning machine as picture 1, the materials are the pickled pig skin and ordinary leather chemicals.

3.2.2 Operations

ND tannage operations are same as 3.1.2; make the blue leather to the finished product.

3.3 The protein content in the spend liquor of chrome tannage

3.3.1 Equipments and materials

The experiment apparatuses are kjeldahl apparatus and general analysis apparatuses, materials are the spend liquors of drum tannage and ND tannage in 3.1.

3.3.2 Methods

The method of determining protein content in spend chrome liquor is kjeldahl method, the method of determining Cr₂O₃ content in spend chrome liquor is iodimetric method ^[4].

4. Results and discussions

4.1 The yield of leather

The results of comparing the yield of drum tannage with the yield of ND tannage are in table 1. Besides the tannage process, the other processes are all same.

Table 1 The leather yield of different tannage method

	area of salted skin Sq. ft	Area of finished leather Sq. ft	Yield of leather %	Average value of yield of leather %
Drum tannage	5.38	6.22	15.6	13.8
	5.50	6.22	13.1	
	4.43	5.14	16.0	
	4.66	5.14	10.3	
ND tannage	4.78	5.98	25.1	25.6
	4.66	5.86	25.8	
	5.02	6.22	23.9	
	4.78	6.10	27.6	
changes				11.8

The results show that yield of ND tannage increases greatly, over 10%. When the pickled skins are tanned by ND chrome tannage, it's fibre is stretched, fibre's weave structure is changed, fibre is fixed by chrome under this situation, the stretching property of the leather is reduced, all directional stretching properties are uniform, so, the leather area is increased.

In order to validate the stability of yield of ND chrome tanning technology, we take the finished leather examples of drum chrome tanning and ND chrome tanning technology individually, condition them under the air of room temperature and 100% relative humidity, dry, measure the area. The results are in table 2.

Table 2 The comparisons of leather area before air-condition with after air-condition

	Leather area before air-condition Sq. ft	Condition 2 days, dry		Condition 6 days, dry	
		Leather area Sq. ft	changes %	Leather area Sq. ft	changes %
Drum chrome tanning	3.2	3.13	-2.2	3.05	-4.7
	3.0	2.93	-2.3	2.85	-5.0
	3.1	3.03	-2.3	2.95	-4.8
ND chrome tanning	3.1	3.02	-2.6	2.96	-4.5
	3.1	3.01	-2.9	2.95	-4.8
	3.0	2.92	-2.7	2.85	-5.0

The table 2 shows that the area of drum tanning and ND tanning are all reduced when leather is rewetted and redried, there are almost no difference on reduced area between drum chrome tanning and ND chrome tanning, and the reduced area is acceptable ($\leq 5\%$), so, the increased leather yield of ND chrome tanning technology is stable.

4.2 Beautify leather grain

The grain of leather made by drum chrome tanning technology is nature, if there are damages on the surface of skin, they will appear on the leather grain. ND chrome tanning technology can improve this situation, and increase leather use ratio. On the one hand, the fibre of skin is tanned when it is stretched, it will make leather smooth, and some small scars will disappear even; on the other hand, the pickled skin that it's grain stick on the conveying belt with pattern is tanned under pressure, the pattern which imprint on the grain of the pickled skin is fixed by chrome, so the leather grain pattern will be same as conveying belt pattern, and the pattern will not disappear after other making leather processes. So, we can make different pattern grain leather by designed different pattern conveying belt, it not only can cover the damages on the leather grain and increase the leather use ratio but also can change nature grain pattern and increase the leather variety of designs, it can enlarge the use range of some low added-value leather like pig leather, and increase product's added-value. Picture 2 shows some different grain pattern pig leather made by ND chrome tanning technology.

4.3 The protein content in the spent liquor

There is dissoluble protein which decomounds from skin in the spent chrome liquor, it will be more and more as recycling times increase. The accumulated protein will bond with chrome of spent liquor, and affect the cross-bonding of chrome and collagen, reduce the tanning power of chrome in the spent liquor^[5]. So, the protein content in the spent liquor can indicate indirectly if the chrome spent liquor is easy to recycle. Table 3 lists the results of protein content and chrome content in the drum tanning and ND tanning spent liquor.



Picture 2 Different grain pattern pig leather made by ND chrome tanning technology

Table 3 shows that protein content in the ND chrome tanning spent liquor reduces greatly, the corresponding protein content of 1 g/l Cr₂O₃ reduces 68.8%. That is because that the skins in the drum will be thrown, collided, rubbed continuously when the drum runs, the large quantity protein will be decomposed from skins and come into the spent liquor. The protein will bond with chrome of spent liquor, and reduce the tanning power of chrome. But, ND chrome tanning technology tans the skins by tanning machine, the skins are wound round the tanning roller one by one, there are no the mechanical actions like throwing, colliding and rubbing among skins. The mechanical actions are small, so the protein which comes into the spent liquor reduces greatly.

The quantity of dissoluble protein in ND chrome tanning spent liquor is lower than in drum chrome tanning spent liquor, the influence on chrome tanning power is less, so comparing with drum tanning spent liquor, ND tanning spent liquor is recycled easily.

Table 3 the protein content and chrome content in the spent liquor

	Protein mg/l	Cr ₂ O ₃ g/l	corresponding protein of 1 g/l Cr ₂ O ₃ mg/l
Drum tanning	542.5	5.68	95.51
ND tanning	393.75	13.21	29.81
changes			-68.8%

4.4 Energy consumption of tanning equipment

The equipment of drum chrome tanning is drum, the power when the drum runs is mostly used for overcoming the torque which produced by skins and tanning liquor. Besides, impacting action that produced by moving of skins and tanning liquor may increase drum's energy consumption, and when the drum runs, some operations like stopping, starting, adjusting the position of door are often done, because the drum's moment of inertia is big, energy consumption of starting the drum is several times bigger than normal running the drum, so the energy consumption of tanning by drum is very big.

The equipment of ND chrome tanning is leather tanning machine, the skins are spread on the conveying belt and wound round the tanning roller, the weight of skins distributes around the tanning roller relative uniformly, when the tanning roller runs, it almost doesn't produce torque; There is not impacting action that produced by moving of skins and tanning liquor when the tanning machine runs; some operations are done in the tanning tank, operations like starting and stopping need not to be done

often. So comparing with drum tanning, ND tanning technology can reduce greatly energy consumption.

5 Conclusions

5.1 Comparing with drum chrome tanning technology, ND chrome tanning technology can increase the yield of leather.

5.2 Comparing with drum chrome tanning technology, ND chrome tanning technology can beautify the leather grain, cover the surface damages, and increase the leather use ratio.

5.3 Comparing with drum chrome tanning technology, the spent liquor of ND chrome tanning technology was recycled easily.

5.4 Comparing with drum chrome tanning technology, ND chrome tanning technology can save energy, reduce energy consumption of tannage.

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