Optimize of Retanning Process Plate of Stimulate-glaze Goatskin Upper Leather

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Abstract: The retanning process plate of stimulate-glaze goatskin upper leather was optimized by orthogonal experimental design method. It was found that: the different impacts on leather of retanning were in thickness, weight and yield. The merits order of sensory properties of pelts retanned by different processes was: SY-01, SY-02, SY-04 and SY-03. the primary and secondary order of the factors that affect on the effectiveness of retnning was: the feeding order of retanning agent, the combination of retanning agent and compatibility of retanning process. The optimum of retanning plate is: the feeding order of retanning agent 1- the combination of retanning agent 1 - matching process 1.

Key words: simulated-glaze; goatskin upper leather; retanning; process plate; optimize

1 Introduction

There are abundant in nature resource of goatskin in China. There are over 4 millions of goatskin every year, but top grade and medium grade of raw skin are only about half of them. Many technological fruits of upper leather have been achieved in recent years through many curriers's efforts in our country. However there are a gap between holistic level of technology in China and advanced technology of other country. More study should be carried through in the saving of resource, clean technology, effective utilization of leather-making.

There are many quality problems in native goatskin glazed upper leather. The key problem are biggish location difference, less fullness, low tight and low fine grain[1]. After summarized the native and overseas experiences of goatskin glazed upper leather, mode of leather-making plate and method of orthogonal design[2,3] was applied in the study of retannage technology plate in order to obtain the optimal plate.

2 Experimental procedures

2.1 Materials and instruments

Sichuan road blue wet goatskin was supplied by Bailejing biology science and technology company. All materials used in leather processing were commericial grade. KRI-A polyoxometalate tanning agent and KMC chrome tanning agent were supplied by Tingjiang fine chemical company, Tannesco HN chrome tanning agent was supplied by TFL company, Truptan R83 was supplied by trumpler company, Edaplin Gpu was supplied by Munzing of Germany, quebtocho extrace(ATO) was supplied by UNITAN company of Argentina, Butan 7815 was supplied by BASF,DEφ350-φ450 stainless steel controllable temperature double-barreled drum was supplied by Dongbeitan mine machine shop of Xishan, QJ91 constant weight thickness meter was supplied by Zhejiang Yuyao light industry machine shop, AI-9000S servo control

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universal testing machine was supplied by Gotech testing machine Company.

2.2 Orthogonal experiments

Forty pieces of blue wet goatskin of Sichuan Road were randomly chosen, 8 of them were randomly chosen after shaving (the thickness was 0.9mm~1.1mm). Every piece of skin was numbered, weighted, grouped, thickness measured, and obturated for using. Several sorts of tanning agent with representative and excellent property were selected as table I. Orthogonal experience were processed as the method of table 2, table 3, and table 4. After retanned, the leather were dehydrated by centrifugal machine.

Table 1 The types and name of retanning agent

Types	Retanning agent
Mineral	KRI-A，KMC
Synthetical	Tannesco HN，containing retanning agent CR
Resin	Edaplin GPU，CAR-I，Truptan R83，Butan 7815
Vegetable	Black wattle extract，quebtocho extrace，waxberry extract，HS
Aldehyde	modified glutaraldehyde

Table 2 The levels of factors [L_4（3^2）]

	A Combination of retannage	B Feeding order	C Matching process
1	Combination 1	Order 1	Method 1
2	Combination 2	Order 2	Method 2

The retanning agent was grouped according to table 3. The feeding order 1 of retanning agent processed as follow: mineral, aldehyde, Synthetical, resin, vegetable. The feeding order 2 of retanning agent processed as follow: aldehyde, mineral, resin, Synthetical, vegetable. The match process I operated as below: rinse, washing, pre-retannig, retanning, washing, neutralization, washing, coloring, fatiliquoring, filling, washing, piling. The match process II sequence operated as below: rinse, washing, pre-retannig, retanning, neutralization and washing, coloring and fatliquoring, washing, piling.

Table 3 the matching of retannage

	Mineral	Synthetical retannage	Resin retannage	Vegetable retannage	Aldehyde retannage
1	KRI-A	Tannesco HN	CAR-I	Black wattle extract, quebtocho extrace Edaplin GPU	modified glutaraldehyde modified glutaraldehyde
2	KRI, containing retanning agent CR		Butan 7815 Truptan R83	HS, waxberry extract	

Table 4 The orthogonal experiments

Number	A Combination of retannage	B Feeding Order	C Matching process
SY-01	1（combination 1）	1（Order 1）	1（method 1）
SY-02	1	2（Order 2）	2（method 2）
SY-03	2（combination 2）	1	2
SY-04	2	2	1

2.3 Testing and handle of leather

The thickness of the leather was respectively the trisection point thicknesses of dorsal ridge line of the pelts. All values reported was an average of 3 measurements. The areas were obtained from electronic area-meter. Besides, yield of leather (%)=[(the area of the pelts after retanned - the area of the pelts before retanned) / the area of the pelts before retanned] × 100%. The weight was measured by electric balance. The evaluations of the firmness, fullness, flexibility grain looseness and the fineness of grain of each retanned leather were assessed by 5 professional and technical personnel with rich experience in tanning by handle and visual examination. And the score of 5 was the best and 1 was the worst. The final score of each item was the average score given by all the experts. Finally the value of them were synthesized analyzed, and the optimal method was obtained.

2 Results and discussion

2.1 The thickness, area and weight

Table 5 The property of thickness, area and weigh before and after retanning

Experience		1	2	3	4
thickness	Before retanning	1.005±0.005	0.935±0.035	0.895±0.021	0.940±0.071
	After retanning	1.140±0.071	1.190±0.057	1.025±0.035	1.000±0.071
	Increasing rtae	13.40±1.45	27.25±1.244	14.52±1.24	6.38±0.52
weigh	Before retanning	309.5±1.2	363.4±1.2	339±1.2	334.5±0.5
	After retanning	350.8±9.3	462.0±34.4	390.0±34.4	356.3±45.4
	Increasing rtae	13.39±1.41	27.10±0.98	15.00±0.56	6.50±0.28
area	Before retanning	0.492±0.026	0.619±0.042	0.570±0.035	0.454±0.062
	After retanning	0.517±0.028	0.639±0.044	0.590±0.003	0.460±0.063
	Increasing rtae	5.18±0.16	3.23±0.24	3.52±0.02	2.67±0.17

The changes in the thickness, the weight and area of the pelts before and after retanned are shown in table 5. From the table 5, the impacts of the retanning on the thickness, the weight and area of the leather as follows: (1) the primary and secondary order of the different retanning processes effect on the thickening of the leather was: SY-02>SY-03>SY-01>SY-04. The primary and secondary order of the different retanning processes effect on the weight increment of the leather was: SY-02, SY-03,SY-01, SY-04. The primary and secondary order of the different retanning processes effect on the yield of leather was: SY-01, SY -03, SY-02, SY-04. Obviously, they had consistency in thickening and weight increment, but hadn't in yield. Oppositely, the experimental scheme that could significantly improve the thickness and weight always resulted in the lower yield. Experience had shown that the direct performance of

thickening was favorable to increase the yield while the fullness improved. Therefore, it necessary to find out a balance point in the actual production.

2.2 The sensory property evaluation of retanned leather

The results of the sensory property of the pelts after retanned were showen in Table 6. It can be seen that, the merits order of sensory properties of pelts retanned by different processes was: SY-01, SY-02, SY-04 and SY-03. The results showed that the experiment of SY-01 achieved to a better and an ideal state on the balance and the matching.

Table 6 The results of sensory property evaluation of retanned leather

Number of experiment	Firmness	Fullness	Flexibility	Grain looseness	Fineness of grain	Average score
1	2.88±1.24	3.00±0.35	3.50±0.00	3.38±0.88	3.13±1.24	3.18±0.26
2	2.00±0.00	3.38±0.18	3.58±0.25	3.39±0.18	3.45±0.64	3.26±0.73
3	2.38±0.88	3.25±0.35	3.63±0.18	3.25±1.06	3.38±0.53	3.18±0.47
4	2.50±0.71	3.63±0.53	3.63±0.18	3.75±0.35	3.50±0.00	3.40±0.52

Table 7 The evaluation result of retanning orthogonal experients

	A	B	C	The sum of sensory properties and area
1	1（combination 1）	1（Order1）	1（matching process1）	8.36
2	1	2（Order2）	2（matching process2）	6.49
3	2（combination 2）	1	2	9.70
4	1（combination 1）	1（Order1）	1（matching process1）	6.07
I_j	8.14	8.15	7.84	
II_j	6.68	6.67	6.98	
R_j	1.46	1.49	0.87	

2.3 The evaluation result of retanning orthogonal experients

As can be seen from Table 7, the primary and secondary order of the factors that affect on the effectiveness of retanning:

feeding order　　combination　　matching retanning process

→

Primary　　secondary

The effects of the feeding order of retanning agent: As Table 7 shown, under the premise of certain combination of retanning agent and compatibility of retanning process, the feeding order of retanning agent become the key factor. The sensory property of final leather was influenced by retanning agent feeding sequence in two ways. First of all, the feeding order of retanning agent has a effect on the style of the final leather due to the former agent would occupy the important active position of the skin. So the leather properties have more characters what the former retanning agent imparted. Secondly, the binding capacity and fastness of retanning agent were significantly influenced by the feeding order retanning agents, because the former agent would have more chance to react with the active position. All of these were what we called "the order effect". The results showed that the first feeding order of retanning agent was the best one.

To obtain a ideal performance, we should select the appropriate type retanning agents and define the

usage compatibility according to the requirements of the final leather. The retanning agents with different characteristics were selected in the study. Fot instance, the single use of containing chromium retanning agent KMC was lack of requisite filling effect, resulting in the final leather with a poor fullness and a high rate of grain looseness. However, due to its selective filling effect the application of KRI-A which was a kind of chromium-zirconium-aluminum multi-metal complexes retanning agent would increase the fullness, decrease the rate of grain looseness, reduce the location difference as well maintain a good softness and flexibility of the final leather. Besides, Tannesco HN Synthetic tanning agent had better properties than CR retanning agent in retanning property, the leather retanned by the former possesses had excellent performances: fine grain, good fullness and flexibility. Wattle bark extract was suitable for making rather thick leather owing to its good permeability and the smaller convergence characteristics, while the pelt retanned by quebracho extract has good firmness. So the combination of the two were better than the combination of HS and bayberry tannin extract in the fullness and the firmness of the leather. And these would be in favor of glazing.

Influence of the matching retanning process: It can be seen that the matching of retanning process had significant effect on the retanning property. To achieve the optimal effect, the whole process should be firmly concentrated on the demands of the final products with the comprehensive consideration on improving the quality and yield of the final leather as well as reducing the cost. As the latter had strict requirements on the type, dosage and the reatnning technological Conditions. The results showed that, it was more advisable to adopt a conventional retanning process than a compact type in the experiment. During the process of compact type, the successive or simultaneous application of the retanning agent with the similar purpose in one-bath would meet the demand of less bathe, which was favorable for the interpenetration, uniform distribution, time saving and liquid saving[5].

3 Conclusions

The different impacts on leather of retanning were in thickness, weight and yield, which have consistency in thickening and weight increment, but there are differences in thickening , weight increment and yield. Oppositely, the experimental scheme adopted could significantly improve the thickness and weight but resulting in the lower yield. The primary and secondary order of the factors that affect on the effectiveness of retnning was: the feeding order of retanning agent, the combination of retanning agent and compatibility of retanning process. The optimum of retanning plate as follows: the feeding order of retanning agent 1- the combination of retanning agent 1 - matching process 1. The theory of model of process plate of leather-making could be applied to solve the complicated process question of leather-making.

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