# New Technology of Leather Processing "Barguzin"

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## Abstract

The paper is devoted to the actual problem of processing of raw materials, chrome tanning and sewage treatment. The technology of liquid processing has not been changed for many years and is characterized by a big consumption of water; wastewater pollution; long duration of processes.

The paper concerns new principles of introduction of chemicals into leather structure. The tanning process lasts one hour instead of 10-12 hours.

As a result the intensive acceleration of penetration of the tanning material into leather is observed. The duration processes of tanning, dyeing and fatting is reduced to 2 times, sewage - to 4-5 times due to the low water consumption (30%) and specific properties of composition. The size of the processed leather is enlarged to 10-12 %, hardness is reduced.

The technology is protected by the Russian Federation Patents.

**Key words:** chrome tanning, sewage, water consumption, technology, leather

## Introduction

The improvement of processing technology of leather is directed to the major challenges in the leather industry, the most important of which are:

- Reduction of processing raw hides cost;
- Water purification from pollution, in particular, from chromium salts;
- Reduction of water consumption for technological needs and a waste water reduction.

The transposition of the liquid processing of hides up to Wet-blue and Crust on the territory of a number of countries is not the best way to solve the above mentioned problems, because nobody can block the river flow running on the territories of two or more countries.

The subject of a particular concern among the ecologists is chromium salt which is used for leather tanning. At present time, despite the existence of new tanning methods, 85-90% of leather in the world is produced using chromium salts. Accordingly the problems connected with pollution and the necessity of waste purification from chromium salt are still actual today.

The scientific group of the East Siberian State University of Technology and Management consisting of V. Dumnov, O. Titov and the author have been working at the creation of a fundamentally new technology of leather processing. In the paper some of the results of the work are presented.

## Materials and methods

The main object of the study were hides of cattle of conserved by means of wet salting. Raw material was processed according to the experimental and control procedures. Control method is a technique for processing of leather uppers of chrome tanning out of cattle hides [1].

The experimental processing was realized in a tumbler of a special construction. It is connected with the problem that the new processes are fulfilled at the expenditure of the composition of 20-30 % which is completely absorbed by the pelt. The tumbler has the device to pipe the working composition.

The dyes and organic tanning agents were dissolved in the volume of water - 20% from Wet-Blue weight. They were filtered and poured into the tumbler through a special device during the rotation.

For the tanning water solutions dry chrome tanning was used (State standard 6-18-219-75). The tanning is performed with fattening. The chemical composition and physical and mechanical properties of leather were determined in accordance with the standards (Table 1).

Table 1 Methods for determining the properties of the finished leather

| № | Data | State standard |
|---|---|---|
| 1 | Moisture content,% | 938.1-67 |
| 2 | Chromic oxide content,%, at least | 938.3-77 |
| 3 | Mass fraction of substances extractable by organic solvents, % | 938.5-68 |
| 4 | Tensile strength, 10 МПа, at least | ISO 3376-76 |
| 5 | Elongation at a voltage 10 MPa,% | ISO 3376-76 |
| 6 | Rigidity, Newton | RF Patent № 1395983 [2] |
| 7 | Leather cure temperature,$^0$C | ISO 3376-76 |

## Results and discussion

It is known that the duration of processes is determined by the rate of diffusion of chemicals into the thickness of raw material. The new technology of tanning and dyeing and fatting processes “Barguzin” is based on the reduction of the diffusion component of the processes by increasing the degree of the mechanical impact on the raw material at the expense of the reduction of the consumption of the working compositions up to 20-30 %, and besides, by using of working compositions with complex properties. For the transportation of the chemicals into the pelt, liquid hydrocarbons are used. As a result the intensive interaction of the corium structural elements with the removal of water is reduced and it contributes to a

significant acceleration of the penetration of chemicals into the derma and gives the new technological effect.

The cattle hides were processed up to the tanning by the method of processing leather shoe uppers [1]. The splitting of the pelt was not performed. The pickling solution was poured out. Then the tanning disperse composition "liquid – liquid" was added in the amount of 30% by weight of the pelt. The consumption of the chromium oxide was 2,5% from the pelt weight. The tanning penetration rate into corium was determined (Figure 1).

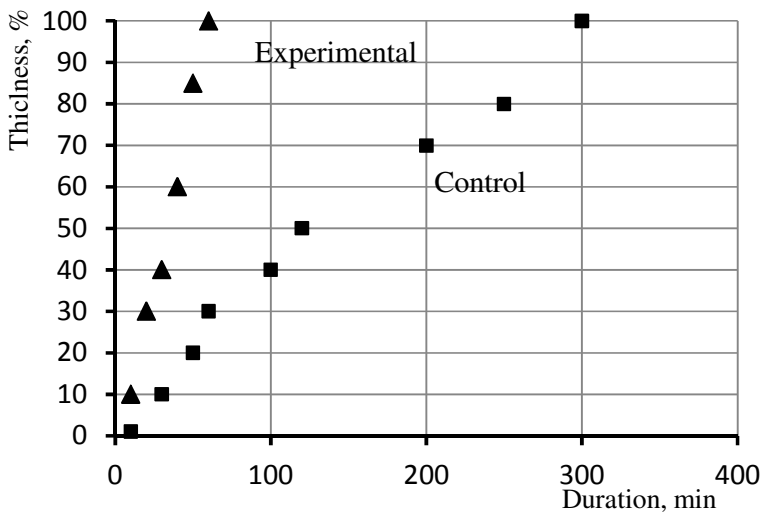


Figure 1 shows that the rate of tanning penetration into pelt of the experimental variant is much higher. The full penetration of tanning agent has been observed after 60 minutes past. The full penetration of tanning agent in control variant has been observed 300 minutes (5 hours) past. In the end it was found out that the pelt had absorbed the whole volume of working composition.

The experimental leather cure temperature equaled to 103°C, in control - 80° C at the same expenditure tanning agent.

Thus, the principle possibility of the sharp intensification of the chrome tanning process with the full absorption of the working staff was established. As a result the depth of the acid penetration into the derma looses it's significance for the acceleration of tanning diffusion (Figure 2).

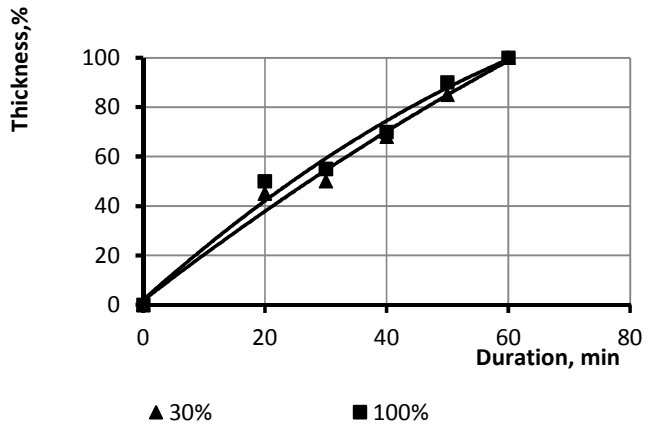


Figure 2. The impact of the saturation degree by acid of pickling pelt on the penetration of chrome tanning agent into the thickness of the derma.

The usual technological scheme of leather processing consists of the consequent fulfillment of the preliminary processes, tanning and dying – fatting processes. The including of the new tanning method to the usual technological scheme is impossible, as there exist difficulties connected with the following further mechanical operation (shaving). That is why we studied the different schemes of processing of raw materials (table 2).

Table 2. Experienced technological schemes of processing raw hides

| Scheme1 | | | Scheme 2 | | | Scheme 3 | | | Scheme 4 (Control) [1] | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Process | Duration, hour | Water consumption, % | Process | Duration, hour | Water consumption, % | Process | Duration, hour | Water consumption,% | Process | Duration, hour | Water consumption,% |
| Pickling | 3 | 70 | Pickling | 3 | 70 | Pickling | 3 | 70 | Pickling | 5 | 70 |
| Tanning – Fat-liquoring | 1 | 30 | Processing of chromium salts | 1,5 | 0 | Processing of chromium salts | 1,5 | 0 | Tanning | 7 | 17 |
| Ageing | 7 | 0 | Neutralization | 0,7 | 150 | Mechanical operations. Weighing | | 0 | Mechanical operations. Weighing | | |
| Mechanical operations. Weighing | | | Washing | 0,7 | 300 | Tanning – Fat-liquoring | 1 | 30 | Retanning organic tanning agents | 1,5 | 70 |
| Neutralization | 1 | 150 | Mechanical operations. Weighing | | | Neutralization | 0,7 | 150 | Washing | 0,7 | 400 |
| Washing | 0,7 | 300 | Dyeing - Retanning organic tanning agents | 1,0 | 30 | Washing | 0,7 | 300 | Neutralization | 1,0 | 150 |
| Bleeding | | | Tanning – Fat-liquoring | 1,0 | 30 | Bleeding | | | Washing | 0,7 | 400 |
| Dyeing - Retanning organic tanning agents | 0,8 | 30 | Washing | 0,2 | 300 | Dyeing - Retanning organic tanning agents | 1,0 | 30 | Dyeing | 1 | 200 |
| Washing | 0,2 | 300 | Ageing | 8 | | Washing | 0,2 | 300 | Fat-liquoring | 1 | 150 |
| Ageing | 8 | | Pressing | | | Ageing | 8 | | Retanning organic tanning agents | 2 | |
| Pressing | | | | | | Pressing | | | Washing | 0,2 | 400 |
| - | | | - | | | - | | | Ageing | 8 | |
| - | | | - | | | - | | | Pressing | | |
| Total: | 21,7 | | | 16,1 | | | 16,1 | | | 28,1 | |

The processes up to pickling for all variants were performed according to the same technology [1]. The processes of the dehairing and liming were performed using sodium sulfide and calcium hydroxide. After liming the fleshing and the splitting processes were performed.

The pickling solution contained ammonium sulfate, sulfuric acid, urotropine. The processing by chromium salt was performed at consumption of chrome oxcide 0,3%.The neutralization was performed in the solution of bicarbonate and sodium formate. After neutralization performed mechanical operations: pressing, shaving, weighing were performed .

Consumption of the chemicals for the following processes was from the mass of shaving wet-blue. The tanning was processed with fatting in disperse system "liquid-liquid". Dyeing was processed together with retanning organic tanning agents in disperse system “gas –liquid”. The depth of penetration of the dye into the leather increases ( Figure 3), and dyeing uniformity and intensity of the color surface increases. The working solution imbibes completely in 30-40 minutes.

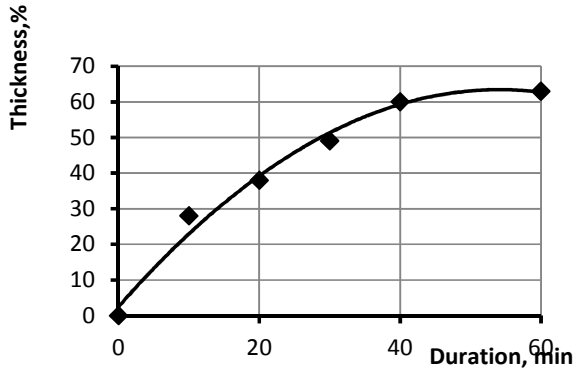


Figure 3. The depth of penetration of dyes into the dermis during dyeing

The processing according to the scheme 1 causes the difficulties of the fulfillment of mechanicals operations after tanning-fattening. During processing according to scheme 3 the intensity and color uniformity of leather are reduced, due to the reduction of dye adsorption on the fibers of leather pretreated with fat.

If dyeing is done before tanning (Scheme 2) the color intensity increases due to the formation of additional bonds between the adsorbed dye and chrome tanning agent on the fibers of the leather. Besides, during in the neutralization and washing after tanning-fattening the chrome tanning agent is lost. The most appropriate variant is processing according to the scheme 2 (Table 3).

| Scheme number | Leather cure temperature, $^0$C after | | | Chromium oxide content in the waste liquid after, g/dm$^3$ | | | |
|---|---|---|---|---|---|---|---|
| | processing of chromium salts | tanning – fat-liquoring | tanning | processing of chromium salts | tanning – fat-liquoring | tanning | retanning by salt chrome |
| 1 | - | 105-110 | - | - | 0,0 | - | - |
| 2 | 73-75 | 115-120 | - | 0,7 | 0,0 | - | - |
| 3 | 73-75 | 115-120 | - | 0,7 | 0,0 | - | - |
| 4 | - | - | 105-107 | - | - | 7 | 1,9 |

Table 3 Properties of semi-finished figures and waste liquid after process

The data on the effect of the new tanning processing from the point of view of consumption and loss of the chromium compounds is shown in Table 4.

Table 4. Expenditure and loss of chrome oxide

| Variant | Expenditure of chrome oxide, in % of flow in control | Loss of chromium oxide, in % of flow |
|---|---|---|
| Conrol | 100 | 16,6 |
| Experimental (cheme 2) | 49,5 | 3,0 |

The drying and finishing processes were performed the same for control and experimental variants [1]. The chemical composition and physical and mechanical properties of finished leather were determined (Table 5).

Table 5 Comparative analysis

| № | Data | Standard of Russia 939-88 | Experimental | Conrol |
|---|---|---|---|---|
| 1 | Moisture content,% | 10-16 | 14,4 | 14,5 |
| 2 | Chromic oxide content,%, at least | 4,3 | 5,3 | 5,6 |
| 3 | Mass fraction of substances extractable by organic solvents, % | 3,7-10,0 | 8,8 | 7,0 |
| 4 | Tensile strength, 10 MPa, at least | 1,6 | 2,3 | 1,8 |
| 5 | Elongation at a voltage 10 MPa,% | 15-35 | 33,6 | 30,1 |
| 6 | Rigidity, Newton | | 2,8 | 3,9 |
| 7 | Yield of leather, % | | 110 | 100 |
| 8 | Chrome oxide expenditure to 1 ton of raw hides, kg | | 12,3 | 24,8 |
| 9 | Chrome oxide loss, in % of expenditure | | 3,0 | 16,6 |
| 10 | The volume of sewage on 1ton of raw hides, $m^3$ | | 1,5 | 7,3 |

As can be seen from Table 3 the chemical composition and physical and mechanical properties of the experimental finished leathers are in accordance with the standard requirements.

**Conclusion**

New principles of liquid processing allowed to work out the new technology, which has a number of advantages.

The duration processes of tanning, dyeing and fatting is reduced to 2 and sewage - to 4 -5 times due to the low water consumption (30%) and specific properties of composition. The size of the processed leather is enlarged to 5-10 %, hardness is reduced, chrome tanning material is evenly distributed in leather.

The application of the new method is foresees nontraditional scheme: dyeing is fulfilled before tanning.

New Technology "Barguzin" is protected by the patents of the Russian Federation.

**Reference**

1. The method of production chrome tanned leather and an assortment of different thicknesses for the top and lining of shoes from the hides of cattle, M.1983.
2. Dumnov V.S., Sovetkin N.V. A device for determining the stiffness of elastic materials. RF Patent № 1395983.