Improve Dyeing Levelness of Iron-Complexed Dye on Vegetable Tanned Leather

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IMPROVE DYEING LEVELNESS OF IRON-COMPLEXED DYE ON VEGETABLE TANNED LEATHER

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Abstract

Dyeing levelness on vegetable re-tanned leather is often affected by the presence of iron. Although adding vegetable tannins is very cost-effective for increasing the fullness of the leather, the polyphenolic compound of vegetable tannins can react with excess ferrous ions from ion-complexed dyes and form black complexes and precipitates on leather. Herein, we present a quantitative measurement of dyeing levelness in a series of vegetable tannins and ferrous ions concentrations. Then we provide a practical solution for lowering the formation of black complexes and hence improving the dyeing levelness of leather.

Keywords: dyeing levelness, vegetable tannins, ferrous ions

1. Introduction

Plants extracts such as wattle, tara and mimosa are some of the vegetable extracts which are commonly used in leather tanning with great abundance and economic advantage. The combination of chrome tanning and vegetable re-tanning can give leather both higher shelf life in process and increase fullness at product stage [1]. During re-tanning process, vegetable tannins react with amino groups of leather fiber, and some insoluble tannins can also serve as filler to further increases the thickness of the leather. Follow up in the dyeing stage, the choice of dyestuffs can also affect the consumption and color fastness properties of leather [2]. Compared to simple acid dyes, metal complex dyes are reported with better dyeing properties when used in vegetable tanned leather [3]. However, if the concentration of vegetable tannins is above certain level in the retaining process, the excess polyphynoic compounds will be carried out by the dyeing stage and react with metal-complex dyes, forming black, stain-like complexes. Finding a practical and cost-effective solution for preventing this reaction is necessary for increasing dyeing levelness.

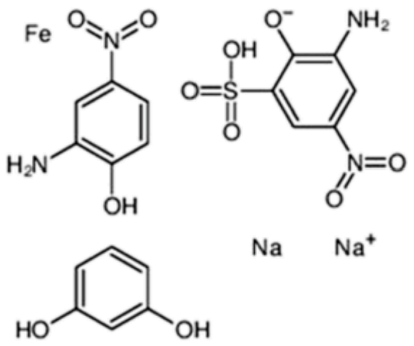
This work aimed to investigate the dyeing levelness of vegetable tannin re-tanned leather with a ferric ion-complexed dyestuff.

2. Material and Methods

2.1 Materials

Conventionally processed wet blue full grain cow hides (thickness 1.2-1.4 mm) were taken for the post tanning process. Chemicals used for post tanning process were of industrial grade. The dyestuff used in present experiment is acid brown 414, a dye with dark brown color and contains around 1% of ferric ion-complex in weight. Detailed chemical structure can be seen in Figure 1.

Figure 1. Chemical structure of acid brown 414.



2.2 Post tanning process

The post tanning process were carried out by the recipe of Table 1. Wet-blue cow hides were cut into 40 * 35cm rectangles, each piece weighs about 200g. Then these samples were used for post tanning process with varying mimosa concentration of 3, 5, 7, 9, and 12%, and each concentration has three samples for further comparison. Amount of chemicals for re-tanning process is based on shaved weight of wet-blue.

Table 1. Experimental formulation of post tanning process for making full grain cow crust.

Process	Chemicals	(%)	Temperature (^{o}C)	Duration (min)	Remarks
Wetting-back	Water	300	30	30	
Neutralization	Water	80			
	Sodium formate	1		20	
	Sodium bicarbonate	0.75		50	pH 5.3
Washing	Water	300		5	
Re-tanning	Water	40	30		
	Acrylic tanning	5		30	
	Mimosa	3-12		30	
Dyeing	Dyestuff	3		60	Acid Brown 414
Fatliquoring	Water	120	50		
	Syntheic fatliquor	4			
	Lecithin	1		60	

Fixing	Formic acid	1		3 x 20	pH 3.8
Washing	Water	300		5	

2.3 Determine excess mimosa before dyeing

Before the dyeing process, 100 ml of re-tanning liquid were taken, and then mixed with 3g dyestuff for testing precipitate and determine the amount of excess mimosa. The mixture was filtered through Whatman no.1 filter paper, then precipitates at the paper was dried and weighted for further analysis.

3. Results and Discussion

3.1 Dyeing levelness

Dyeing levelness have been evaluated by experienced tanners and recorded by comparing the difference based on grey scale for color change (ISO 105- A02) [4]. The results are given in Table 2. The results show the dyeing levelness of acid brown 414 drop rapidly with increasing mimosa concentration. From visual inspection, the dyeing results start to show some unevenly distributed black stains on leather crust when the mimosa concentration is above 7%. Combining visual inspection and the precipitate testing results, we suggest that adding more than 7% mimosa may cause the excess mimosa, not absorbed by leather in the re-tanning liquid, to react with ferric ion-complex during dyeing process. Examples of leather crust with low dyeing levelness (grey scale 2) are shown in Figure 2.

Table 2. Dyeing levelness and mimosa concentration.

Mimosa	Grey scale sample 1	Grey scale sample 2	Grey scale sample 3	Grey scale average
3%	4-5	4-5	4-5	4-5
5%	4-5	4	4-5	4-5
7%	4	3-4	3-4	3-4
9%	2-3	3	3	3
12%	2	2	2	2

Figure 2. Examples of leather crust with low dyeing levelness.



3.2 Improve dyeing levelness

The results of precipitate from section 2.3 were gathered in Figure 3. It shows high correlation between the amount of mimosa used in the re-tanning process and the precipitate after re-tanning. Based on the partial extractable nature of mimosa [5], we came up with an experimental trail of adding one extra washing with 300% weight water for 5 minutes before dyeing process to test whether if the excess mimosa can be remove by this process. We conduct another post tanning process based on Table 1 and add one washing before dyeing for mimosa concentration of 7, 9, and 12%. The improved dyeing levelness are listed in Table 3. The result shows that most of excess mimosa can be removed from this process, but at the concentration of 12% mimosa, the improvement of dyeing levelness is limited. The reason is probably for not adding enough water for removing excess soluble mimosa. After washing, the dyeing levelness using acid brown 414 can be improved, and the upper limit of mimosa concentration for good dyeing levelness (above grey scale 4) is enlarged from 5% to 9%.

Figure 3. Correlation between the mimosa concentration and the weight of precipitate after re-tanning.

Table 3. Improved dyeing levelness after wash off excess mimosa**.**

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Mimosa	Grey scale sample 1	Grey scale sample 2	Grey scale sample 3	Grey scale average
7%	4-5	4-5	4	4-5
9%	4	4-5	4	4
12%	3	3	3-4	3

4. Conclusion

The mimosa concentration in re-tanning process is important for modifying properties of leather, and providing extra fullness. By evaluating the correlation between mimosa concentration in re-tanning process and the weight of precipitate, we proposed an extra washing process for wash-off the excess soluble mimosa. The improved dyeing levelness and enlarged useable mimosa concentration range is demonstrated for this modified post tanning process with the ferric ion-complexed acid brown 414 dyestuff.

5. References

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