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An Evaluation of Simulated Batik Techniques to Chrome Re-tanned Leather Substrates

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Article

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ABSTRACT

Batik is one of the most attractive and precious methods which enhances the value of leather even of a very simple one. Batik is mainly practised on clothes. Practising batik on leather is not yet mainstreamed. In the batik technique on leather, wax is typically used as a colour barrier and then different wax removers are used to remove wax from the leather surface. Wax and wax removers create some complexities in leather. This study aims to explore different techniques such as tie-dye, block, splashing, and painting to create a batik effect on the chrome re-tanned leather surface. Then different colour fastness tests (rub, wash, perspiration, light, and heat fastness) are accomplished to assess the quality of batik leather. The resulting appearance and quality of the finished leathers are assessed with greyscale and found at a satisfactory level. In each fastness test, results in the greyscale ratings are 4/5 to 5. The produced leathers are then used for making coin purses, key cases, and ladies' purses. So, the new batik techniques are recommendable for practice.

KEYWORDS

batik, wax, tie-dye, greyscale, chrome re-tanned leather

INTRODUCTION

The Batik is an ancient form of art on fabric that utilizes the wax resist technique [1]. Although the root of batik is still not clear, UNESCO added Indonesian Batik to the Intangible Cultural Heritage of Humanity in 2009. Batik is cherished as an Indonesian culture, where the popularity of batik is growing rapidly [2]. The word batik is believed to be coined from the Javanese words "Ambatik" or "Tritik" [3]. In the Javanese language, the word "tick" means "to drip" or "write points" and the word "ambatik" means to draw, write, paint, or drip [4]. The batik design is the result of cultural and religious assimilation [5]. It often carries the regional culture, religious values, symbols, social status, spiritual or philosophical meaning, maritime trading, and history of colonization [6,7]. There are different kinds of batik such as tie-dye batik, brush batik, block batik, spray batik, hand-painted batik, and so forth. The batik method can be employed in leather during dyeing and finishing.

For leather, the batik effect can be obtained by dyeing specific portions of leather while covering the rest of the parts with a colour barrier. In dyeing leather with the batik technique, usually wax as a colour barrier is used. When using batik wax on the leather surface, some complications arise. The mixture of batik wax contains paraffin wax, beeswax, colophony resin (pine gum/gondorukem), animal fat, coconut oil, lancing wax, and dammar Batu resin (*Shorea javanica*) [8]. The colophony resin has two types of impacts. Firstly, it increases the melting point of batik wax as the melting point of colophony resin is high (100 °C - 150 °C), and secondly, it helps the batik wax from getting frozen quickly and to achieve better pattern line sharpness [9,10]. A high temperature of the wax helps the corium layer of leather to penetrate where removing the wax from the leather becomes difficult [11]. Secondly, batik wax contains the monomer of resin acid that opens up the collagen fibrils and penetrates the tanned leather. As a result, the epidermis layer is lifted to some extent [11]. Continuously using batik wax in a hot state can damage the structure of leather since it brings the temperature near 140 °C. The shrinkage temperature of chrome-tanned leather for laboratory conditions is 96 °C – 120 °C and for commercial conditions is 84 °C – 100 °C [9,12]. In the batik dyeing process, gasoline is usually used to release batik wax on leather; it is costly and possesses high inflammability. An alternative wax-releasing agent, sodium silicate (Na_2SiO_3), can also damage the structure of leather (tensile strength, sewing strength, skin elasticity, and enervation) if used in greater concentration than 6 g/L [9]. To avoid these complexities, finding an alternative method for the batik effect is important.

This study is conducted to explore alternative dyeing techniques by avoiding the use of wax as a colour barrier as well as avoiding wax-releasing agents to achieve the batik effect and to evaluate their quality in terms of different colour fastness (rub, wash, perspiration, light, and heat fastness). In this research, four different dyeing methods are applied to five different chrome re-tanned leather samples. Every sample scores more than 4 in greyscale rating in each fastness test and yields a satisfactory appearance. These results indicate that the samples belong to standards and that these methods are worthy of practice. Through the batik technique, more splendiferous and luxuriant leather with all sorts of colour combinations and anticipated designs can be made.

EXPERIMENTAL

Materials and Methods

Chrome re-tanned leathers are produced to employ the batik effect due to the multifaceted advantages of chrome tanning (availability of tannin, high shrinkage temperature, the flexibility of tanned leather,

speedy tanning, etc.) and the fact that about 90% of tanners across the globe are using it [13-15]. During chrome tanning, only 60-70% of the added chromium is absorbed in the pelt while the rest persists in the effluent [16]. On the contrary, through organic tannage, leather with inadequate physical strength and insufficient filling is produced [17]. Compared to mineral tannage, vegetable tannage is considered the most eco-friendly tannage as it releases minimum amounts of pollutants in the environment [18]. Currently, leather sector researchers concentrate on eco-benign tannin with less environmental impact [18]. To get the advantages of both tannages and to attain the batik effect, chrome re-tanned leather has been chosen to produce the five leather samples using the following techniques outlined below [19]:

1. Spraying (using block)
2. Painting
3. Splashing and
4. Tie-dyeing

Table 1 shows the stages for the production of all five samples. For samples 1-3, the batik effect is provided to the leather surface during the finishing operation, hence, for those samples, Table 2 is followed except using dye and leather tying is omitted.

Table 1. Stages of manufacturing wet blue leather from raw goat skins

Process	Chemicals	Amount, % (raw weight/pelt weight)	Duration (min)	Remarks
Pre-soaking	Water	300	120	Drain
	LD-600	0.2		
	Soda Ash	0.3		
Main Soaking	Water	300	60	Leave overnight in the bath. Drain, and wash well.
	LD-600	0.5		
	Soda Ash	0.25		
	Preservative (Busan 40L)	0.5		
Liming	Water	150	180	Hauling for 10 min. in every 30 min.
	Sodium Sulphide	4		
	LD-600	0.5		
	Lime	6.0	60	Leave for 3 days with regular hauling. Scudding by hand. Fleshing, weighing.
	Soda Ash	0.3		
	Liming Auxiliary	0.4		

Process	Chemicals	Amount, % (raw weight/pelt weight)	Duration (min)	Remarks
Deliming	Water	50	45	pH=8.0 Drain.
	Ammonium Sulphate	1.5		
	Ammonium chloride	0.5		
	Sodium Metabisulphite	0.5		
Bating	Water (at 37°C)	50	120	pH=8 Scudding, washing well, and Drain.
	Ebranil-PFE	1.5		
	LD-600	0.5		
Pickling	Water	80	20	pH=2.8 Leave overnight, Drain 50% liquor.
	Salt	8		
	Impropal CO	0.3	10	
	Formic Acid (1:10 dilution)	0.5	3×10+20	
	Sulphuric Acid(1:20 dilution)	1	3×10+30	
	Hypo	0.3	30	
Tanning	Basic Chromium Sulphate	2.0	90	pH=3.8 Drain, horse up, piled for 3 days.
	OCS	1.0		
	Neosyn-N	2.0		
	Sodium bicarbonate	0.5	3×15+60	
	Sodium Formate	0.5	60	
	Preservative	0.25		

*After basification, sammying and shaving have been done.

Table 2. Stages of making chrome re-tanned leather from wet blue

Process	Chemicals	Amount % (based on shaved weight)	Duration (min)	Remarks
Acid Wash	Water	200	30	pH=3.3 Drain, Rinse well.
	Oxalic Acid	0.8		
	Nisapol	0.3		
Rechroming	Water	150	10	pH=3.8 Horse up overnight.
	Formic Acid	0.2		
	Basic Chromium Sulphate	2.0	60	
	Chrome Syntan	2.0		
	Sodium Formate	1.0		
	LDW	1.0		
	GTW	1.5	30	

Process	Chemicals	Amount % (based on shaved weight)	Duration (min)	Remarks
	RWP	2.0	20	
	Hexatan CP	2.0	20	
	RF	2.0	30	
	Busan 30L	0.2	30	
	Sodium bicarbonate (1:20 dilution)	0.8	3×10+60	
Neutralization	Water (at 45°C)	100		pH=4.7
	BS3	2.0	45	Drain and rinse.
	Sodium Formate	1.0		Leave overnight.
Washing	Water (at 50°C)	200	10	Drain well
	Water (at 50°C)	100	20	
	RE	3.0		
	Regulan D	3.0	30	
	Neosyn-N	2.0	10	
	Acid Dye (For Sample 4- scarlet; For Sample 5-Blue)	6	60	
Re-tanning, dyeing, and fat liquoring	Mimosa	3.0+3.0	60	Check penetration. pH=3.9
	OS	3.0+3.0		
	RWP	3.0+3.0		
	Basyntan AN	3.0		
	DLE	2.0+3.0		
	DX-1202	2.0		
	C2	5	30	
	Synthol O	0.5		
	Formic Acid (1:3 dilution)	1.0	3×10+30	
Top Fat	LDW	0.5	20	Drain, wash well, and horse up
	RF	0.5		overnight. Setting and Toggling

Sample 1: Spraying (using scotch tape as a barrier or block)

Procedure:

A white base coat is created by spraying two cross coats on the leather surface. After drying, masking tape is attached to the leather surface and plating is done at 70 °C/35 bar. The intermediate coat of contrast colour (pigment with maroon colour) is applied, and after drying the tape is removed. The pigmentation process for the base coat and intermediate coat is applied according to Table 3.

Table 3. Chemical composition for the base and intermediate coat

Chemicals	Amount (Parts)
Acrylic resin binder	120
Soft PU binder	120
Top PU binder	60
Lustre	80
Wax	40
Penetrator	10
Pigment	120
Water	450

Afterwards, a top coat of one cross is applied on the leather surface according to the recipe given in Table 4 and dried well. Roto press is done at 80 °C/30 bar.

Table 4. Chemical composition for top coat

Chemicals	Amount (Parts)
NC lacquer	680
Silicon emulsion	20
Water	300



Figure 1. Sample 1

Sample 2: Painting (using brush)

Procedure:

Following the pigmentation recipe in Table 3, a base coat on the leather surface by spraying two cross coats is given. The sample is well-dried. Plating is done at 80 °C/30 bar. A picture is then drawn on a leather surface using a brush and the chemical composition is given in Table 5. To achieve a multiple-colour effect, different coloured pigments (maroon, yellow, blue etc.) are used. After drying, kiss plating is done at 70 °C/35 bar.

Table 5. Chemical composition for intermediate coat

Chemicals	Amount (parts)
Acrylic Resin Binder	120
Soft PU Binder	120
Top PU Binder	80
Lustre	80
Wax	40
Penetrator	10
Pigment	120
Water	430

The top coat is given using the same recipe as Table 4. The top coat is sprayed as one cross, dried well, and the Roto press is done at 80 °C/30 bar.



Figure 2. Sample 2

Sample 3: Splashing

Procedure:

The base coat using the pigmentation recipe given in Table 3 (pigment colour-yellow) on the leather surface by spraying two cross coats is applied. The sample is dried well. Plating is done at 70 °C/35 bar. The design is created on the leather surface by splashing the chemical formulation given in Table 5. Maroon, blue and golden-yellow coloured pigments have been used in the recipe separately. After drying, the top coat of the leather surface formulation recipe given in Table 4 is applied by spraying. The top coat is sprayed as two cross coats and dried well, while the Roto press is done at 80 °C/30 bar.



Figure 3. Sample 3

Sample 04: Tie-Dye method

Sample 4 is produced differently, using the recipe in Table 1 and Table 2, followed by the neutralization process. After completion of neutralization, the leather is tied strongly with rope and left to rest overnight. Second-day leather is washed and dyed with scarlet-coloured acid dye. The rest of the steps followed according to Table 2. As the leather is tied strongly before dyeing, dye can't penetrate the tied area providing new gorgeous look creation on the leather.

Afterwards, a base coat is given on the leather surface according to the chemical composition given in Table 3 (except pigment usage) by spraying two cross coats, drying and kiss plating at 70 °C/35 bar. The

top coat is applied according to the recipe from Table 4, spraying two cross coats and drying well. Roto press is conducted at 80 °C/30 bar.



Figure 4. Sample 4



Figure 5. Sample 5

Sample 5: Tie-Dye method

Sample 5 is produced following the recipe given in Table 1 and Table 2 up to the neutralisation process. The leather is tightly tied with a rope giving some marbles inside and left to rest overnight after which is well washed. Afterwards, using blue-coloured acid dye the dyeing is carried out. The following steps are as specified in Table 2. As the leather is tied strongly inserting marbles inside before dyeing, dye can't penetrate that area and an appealing leather has been produced. The base coat is given on the leather surface according to the chemical composition of Table 3 (except using pigment) by spraying two cross coats, drying and kiss plating at 70 °C/35 bar. Lastly, the top coat is applied according to the recipe given in Table 4, spraying two cross coats and drying well. The Roto press is done at 80 °C/30 bar.

Using produced leathers, different products are made (Figure 6).

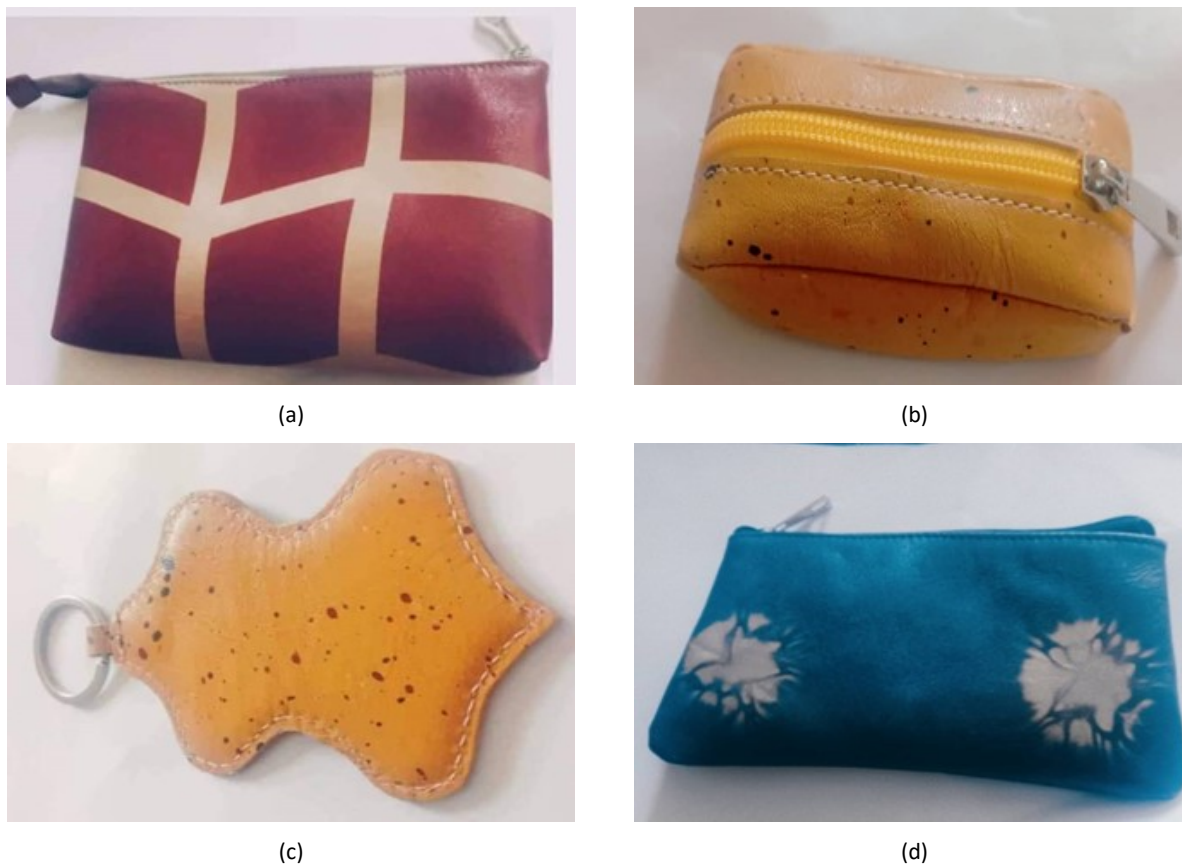


Figure 6. A glimpse of Leather Products (a) Laddies Purse (b) Coin Purse (c) Key Ring and (d) Ladies Purse

RESULTS AND DISCUSSION

All five leather samples are subjected to different colour fastness tests such as dry and wet rub fastness, wash fastness, perspiration fastness, light fastness and heat fastness to determine the quality of finished leather and thus practicability of the method [20-24].

The results of the tests are depicted in Table 6 showing that the performance of sample 1 is slightly better than other samples in each performed test. Sample 4 and sample 5 on the other hand yield relatively less satisfactory.

All leather sample scores are between 4/5 to 5 on the greyscale, showing that all the samples meet the standard value. This is mainly due to the high affinity and reactive nature of dyes to the leather as well as the good anchoring of pigments to the latter.

Table 6. Results of different colour fastness tests on finished leather samples

Sample ID	Batik technique	Rub fastness		Wash fastness		Perspiration fastness		Light fastness	Heat fastness
		Dry	Wet	Leather sample	Cotton fabric	Leather sample	Standard fabric		
1	Spraying (scotch tape)	5	5	5	5	5	5	5	5
2	Painting (brush)	5	5	4/5	4	5	4/5	5	5
3	Splashing	5	5	4/5	4	5	4/5	5	5
4	Tie-Dye	4/5	4	4/5	4	4/5	4/5	5	4/5
5	Tie-Dye	4/5	4	4/5	4	4/5	4/5	5	4/5

CONCLUSION

The main focus of the research was to avoid the negative effects of wax and wax remover and at the same time, maintain the finishing quality of the leather. The chrome re-tanned leather has been chosen to produce the five batik leather samples using spraying (using block), painting, splashing and tie-dyeing techniques. The final results are satisfactory in terms of different fastness tests of the finished layers. The leather's appearance and fastness tests imply that the new techniques can be considered alternative techniques for leather batik. The value-added batik leathers can be used in making exclusive leather products as the demand for these products is increasing across the world.

Author Contributions

Conceptualization – Naher UHB; methodology – Naher UHB, Chowdhury MMR.; formal analysis – Naher UHB, Chowdhury MMR, and Rakib NK; investigation – Chowdhury MMR and Rakib NK; resources – Naher UHB; writing-original draft preparation – Naher UHB, Chowdhury MMR, and Rakib NK; writing-review and editing – Naher UHB, Chowdhury MMR, and Rakib NK; visualization – Naher UHB.; supervision – Naher UHB. All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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