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Theme: Bioenergy, Biobased Product and Process Development

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Accelerated Chamois Leather Tanning Process Using Hydrogen Peroxide as an Oxidizing Agent

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Abstract. Leather tanning is a process of modifying the structure of collagen fibres, so animal skin or hide that decays easily is transformed into leather, which is durable and stable to the environmental influences as well as has variety of applications. One of the leather products is oil tanned leather, known as chamois leather. It has unique uses for cleaning, drying, filtration, and garment. A weakness of chamois leather production practiced nowadays is its oxidation process taking relatively long time, i.e. nine days to two weeks. The use of an oxidizing agent was reported to shorten the oxidation process of the tanning. It has been reported that chamois leather can be produced by using rubber seed oil and oxidizing agent of hydrogen peroxide. Appropriate condition for the tanning needs to be applied in order to improve the process efficiency and to obtain satisfactory quality leather. In this study, the best oxidation times inside and outside the rotary drum of the chamois tanning were investigated. The objectives of this study were to investigate the effect of oxidation times of the chamois tanning on the quality of chamois leather and to determine the best condition of oxidation time for the tanning accelerated by hydrogen peroxide. The experiment was conducted by tanning of pickled goatskin for 4, 6, and 8 hours oxidation times inside the rotary drum and 1, 2, and 3 days of oxidation times outside the drum. The physical and organoleptic properties of the leathers were tested. This study shows that the physical and organoleptic properties of the leathers met the quality requirements for the chamois leather. The best conditions for the tanning were oxidation times of 4 hours inside the rotary drum and 2 days outside the rotary drum. Therefore, the use of oxidizing agent could shorten the oxidation process in the chamois leather production.

Keywords: *acceleration, chamois leather, hydrogen peroxide, oxidation time, rubber seed oil, tanning*

1 Introduction

Leather products have many applications and high economic value. This is due to tanning converts raw skin or hide into leather which is durable and stable against physical, biological, and chemical influences, so it can be used for variety of applications and products [1].

One of leather final products is oil tanned leather or known as chamois leather. In traditional practice, production of the chamois leather is by impregnating wet pickled sheepskin with fish oil in the fulling stocks and then hanging it in warm stoves for the oil oxidation [2].

Chamois leather is a popular leather article in the market, as it has many uses and aesthetic value. The demand for the chamois leather in the global market increases continuously [3]. Use of the chamois leather is widespread and diverse. The leather has a

unique use in filtration of high-grade gasoline, cleaning and drying of optical instruments, manufacturing of gloves, garments, and orthopaedic leather.

Oil tanning practiced nowadays has some weaknesses, such as requires a long oxidation time, i.e. nine days to two weeks [4, 5]. This causes overall production time becoming relatively long; thereby it reduces the efficiency of the process and directly affects the production capacity of the leather industry.

Our previous study has shown that the addition of hydrogen peroxide (H_2O_2) was able to accelerate the oxidation time of the production of chamois leather [6]. However, currently the appropriate oxidation time for chamois leather using rubber seed oil and hydrogen peroxide has not been known. Appropriate oxidation time in the tanning is necessary to improve efficiency of the process and quality of the leather, thus it will increase added value of the product. The objectives of this study were to investigate the effect of oxidation time in the chamois tanning on the chamois leather quality and to determine the best condition of oxidation time for the tanning accelerated by hydrogen peroxide.

2 Materials and Methods

2.1 Materials and Equipment

The materials used in this study were pickled goatskin, rubber seed oil, hydrogen peroxide, glutaraldehyde (Relugan GT50), degreaser, formic acid, sodium carbonate, and salt. The equipment used in the tanning were rotary drum, stacking, buffing machine, shaving machine, sammying machine, toggle dryer, and the horses. Physical testing equipment used were thickness gauge, Kubelka glass apparatus, tensile strength tester (UTM Instron), calliper, and scissors.

2.2 Methods

2.2.1 Tanning

Tanning process consisted of pH adjustment, pretanning, fixation, aging, shaving, washing, oil tanning, washing, toggling, drying, and buffing. The oil tanning was carried out by using a modified method of Suparno et al. [7]. The modifications were the additions of oil diffusion process conducted in the rotary drum for 8 hours and oxidation processes inside the drum for 4, 6, and 8 hours. The inside rotary drum oxidation process was undertaken by using hydrogen peroxide as oxidation agent with concentrations of 6% based on the weight of rubber seed oil used. The outside rotary drum (hang on the toggle dryer) oxidation process was carried out for 1, 2, and 3 days. The tanning procedure is shown in Table 1.

2.2.2 Leather Testing

Physical and organoleptic properties of chamois leathers were tested. Physical properties, which were water absorption, tear strength, tensile strength, and elongation at break, were measured using SLTC methods [8]. Organoleptic properties, i.e. softness, colour and odour, were tested by two chamois leather experts.

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Table 1 Procedure of tanning using rubber seed oil
(modification from Suparno et al. [7])

Process	Chemical	Amount	Duration	Remark
pH adjustment	Water	200%	10 mins	Drum at 8 rpm Measure pH at 3 and °Be at 8
	NaCl	10%		
	Formic acid			
Pretanning	Relugan GT50	1.5%	4 x 15 mins, then 1 h	Dilute with water 3 times Drum at 12 rpm
Fixation	Sodium formic	1%	4 x 10 mins	Dilute 20 times
	Sodium carbonate	1%		Measure pH at 8
	Drain			
Aging			Overnight	Cover with plastic
Shaving				Shave both sides
Washing	Water	1000%	3 x 15 mins.	
	Drain			
Oil tanning	Water	200%	10 mins	Drum at 8 rpm
	Sodium carbonate	0.5%		
	Rubber seed oil	30%		Leave overnight Drum for 8 h
	Oxidation inside the rotary drum		4, 6, and 8 hours	Rotate in the drum
	Oxidation outside the drum		1, 2, and 3 days	Hang on the tiggler drier at room temperature
Washing	Sodium carbonate	3%		Stake Repeat 3 times
	Degreaser	0.2%		
	Water	300%		
	Drain			
Toggling and drying			1 day	
Buffing				Buff both sides

3 Results and Discussion

3.1 Water Absorption

Water absorption is the leather ability to absorb water per weight unit of leather and expressed in percentage. Water absorption is an important parameter in determining the quality of chamois leather, as the main use of the leather is as a filtering, cleaning and drying agents that require high water absorption capacity. The higher water absorption of the chamois leather, the better its quality.

Measurement of water absorption was carried out for the first 2 hours of water absorption by the leather samples. This study shows that water absorptions were in the range of 291.4 - 357.6% (Figure 1). In general, the water absorption of the chamois leathers in this study met the standard of SNI 06-1752-1990 [9], i.e. minimum of 100%.

Water absorption was affected significantly by oxidation time inside the rotary drum, while oxidation time outside rotary drum and the interaction between those two factors did not significantly affect the value of water absorption. The highest water absorption was obtained in the treatment with a combination of inside rotary drum oxidation time of 4 hours and outside rotary drum oxidation time of 2 days (Figure 1).

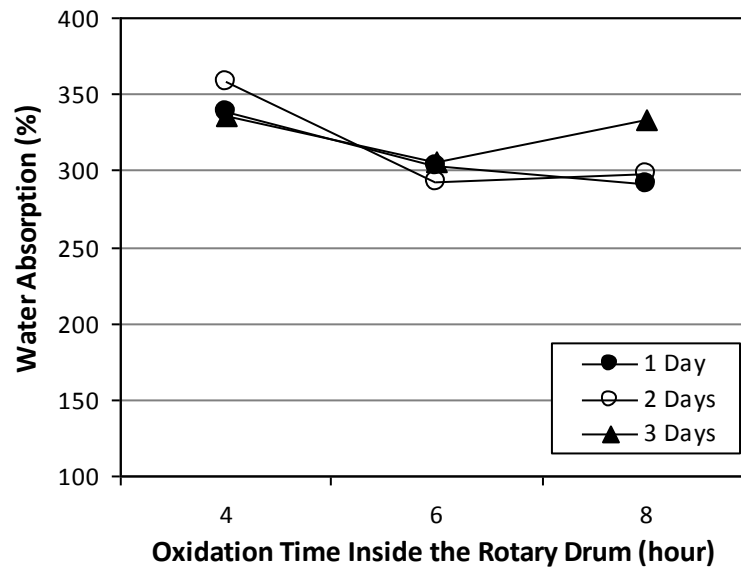


Figure 1 The relationship between oxidation times inside and outside the rotary drum and the water absorption of chamois leather

The treatment of 4 hours inside the rotary drum oxidation time gave a significantly different effect on the oxidation time of 6 hours and 8 hours, whereas the treatment of 6 hours and 8 hours gave almost the same or not significant effect. Oxidation time of 4 hours gave the highest average value of water absorption, 344%. This could be due to the longer oxidation time in the drum can lead to oxidative reaction occurs more dominantly on the leather surface, so that when the leather is oxidized in the open air outside the drum, oxygen from the air can not oxidize the oil in the deeper layer of the leather, because it was blocked by the oxidation products on the leather surface.

3.2 Tear Strength

Tear strengths of chamois leathers resulted in this study were in the range of 58.4 - 70.8 N/mm (Figure 2). In general, the tear strength of the leathers fulfilled the SNI 06-1752-1990 [9], where the tear strength must be at least 15 N/mm.

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Oxidation times inside and outside the drum and interaction of both affected significantly on the leather tear strength. The oxidation process outside the drum was assisted by oxygen from the air, so more oil can be oxidized. In addition, when oxidation outside the drum, leather was stretched on a toggle dryer, so there is a dry air flowing on both sides of the leather that causes the leather was stiffer, drier, and stronger inline with the increases of oxidation time outside the drum. The results of variance analysis showed that the oxidation times inside and outside the drum and interactions of both factors did not give significantly different effect on the value of tear strength.

One day oxidation time outside the drum gave insignificantly different effect on the treatments of 2 days and 3 days. Treatment of 2 days gave significantly different effect from treatment of 3 days. Treatment 3 days outside the drum gave the highest average value, i.e. 64.84 N/mm.

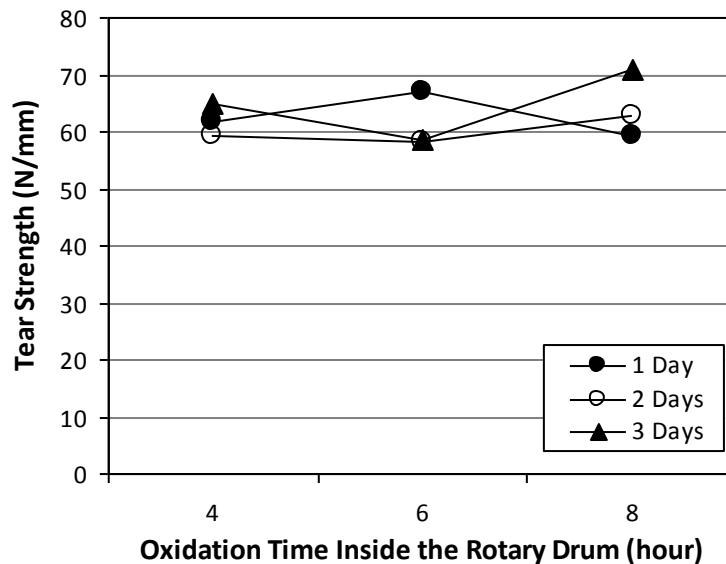


Figure 2 The relationship between oxidation times inside and outside the drum and the tear strength of chamois leather

3.3 Tensile Strength

Tensile strengths of chamois leathers resulted in from this experiment were in the range of 25.0 - 32.7 N/mm² (Figure 3). In general, the tensile strengths met the standard of SNI 06-1752-1990 [9], i.e. minimum of 7.5 N/mm².

Oxidation time outside the drum gave a significantly different effect on the value of tensile strength, while oxidation time inside the the drum and the interaction between those two factors did not give significantly effect. The presence of oxygen in the air when the leather is oxidized outside the drum can help the process of oxidation. Oxidation by oxygen for the air occurs spontaneously if material containing oil or fat is left in contact with air [10]. In addition, when oxidation at outside the drum, the leather was stretched on a toggle dryer, so there was a dry air flowing on both sides of the leather causing the leather was stiffer, drier, and stronger.

The oxidation time outside the drum for 3 days did not give significantly different effect on the treatment of 1 day and 2 days, but treatment of 1 day outside the drum gave a significantly different effect on 2 days treatment. Treatment of 2 days outside the drum gave the highest average value, 30.2 N/mm².

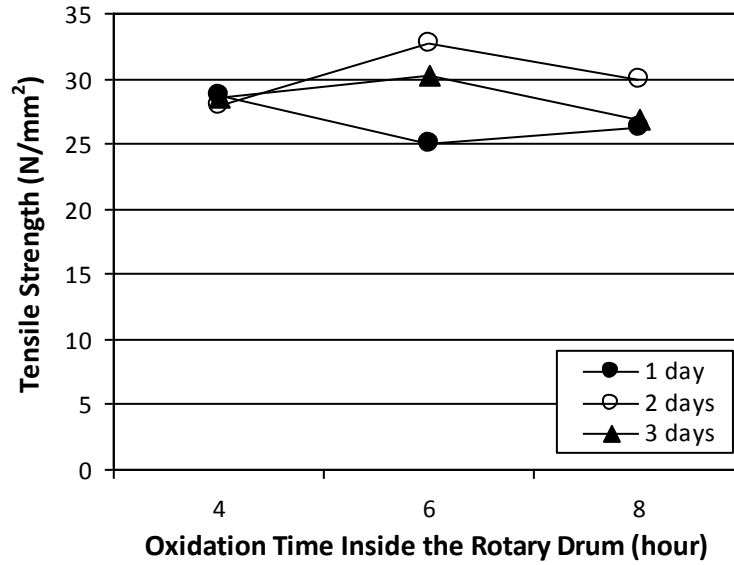


Figure 3 The relationship between oxidation times inside and outside the drum and the tensile strength of chamois leather

3.4 Elongation at Break

Elongation at breaks of chamois leathers resulted in from this study were in the range of 138.3 - 175.7% (Figure 4). Generally, elongation at breaks of the leathers met the standard of SNI 06-1752-1990 [9], i.e. minimum of 50%.

Oxidation times inside and outside the drum, as well as the interaction between those two factors did not give significantly different effect on the average values of elongation at breaks. This means that the treatments used in this study gave similar effects on the elongation at break of the leathers.

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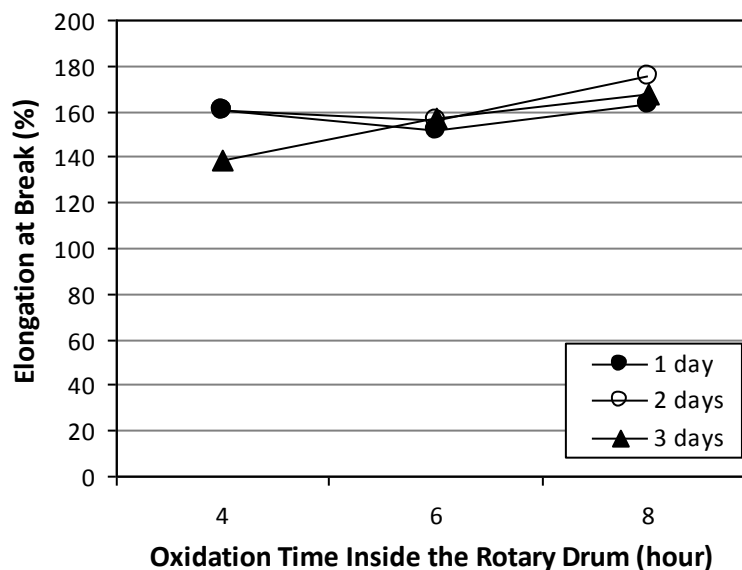


Figure 4 The relationship between oxidation times inside and outside the drum and the elongation at break

3.5 Organoleptic Properties

Organoleptic properties are important parameter for determining the quality of chamois leather. The organoleptic properties of the chamois leather are softness, colour, and odour (BSN, 1990).

3.5.1 Softness

Softness of chamois leather is very important to prevent the items cleaned or dried scratched, as the chamois leather is usually used for cleaning or drying. Besides that, soft leather tends to increase its water absorption and flexibility, so it will provide comfort during use.

Based on Figure 5, it can be seen that softness of the leathers obtained from this study were in the range of 4 to 9. This means that the softness of the leathers were good to very good.

Oxidation time inside the drum gave a significantly different effect on the leather softness, whereas oxidation time outside the drum and the interaction between those two factors did not gave significantly different effect. This is due to the addition of H_2O_2 as oxidizing agent was inside the drum, so its ability to oxidize the oil in the drum was more optimum than that of when the leather was left in the open air outside the drum. The highest value (8-9) of the softness was given by combination of inside drum oxidation time treatment of 8 hours and outside the drum of 3 days.

The inside the drum oxidation time of 6 hours was not significantly different from 8 hours, but they were different significantly with oxidation time of 4 hours. The treatment of 4 hours of oxidation time inside the drum produced the lowest value of softness with

the average value of 5.8. Oxidation time of 8 hours inside the drum gave the highest average value of softness, i.e. 8.2.

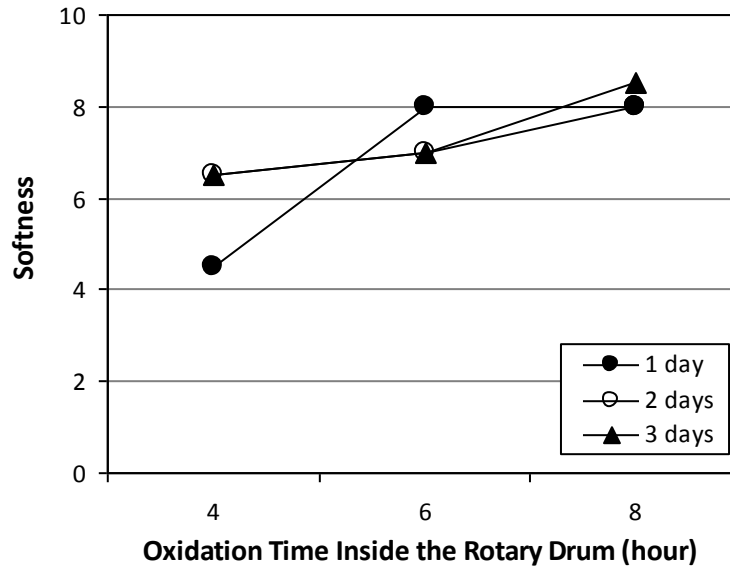


Figure 5 The relationship between oxidation times inside and outside the drum and the softness of chamois leather

3.5.2 Colour

Colour of chamois leather indicates the level of brightness and cleanliness of the leather. According to the SNI 06-1752-1990, preferred colour of chamois leather is yellow to nearly white [9].

Organoleptic test on colour provided the results that leather colour values were in the range of 7 - 8 (Figure 6). The leathers were pale yellow. The yellow colour was mainly due to the oxidation of linoleic glycerides forming a yellow unsaturated ketone compound. The yellow colour can also be produced from protein and nitrogen bases extracted together with oxidized oil [10].

Oxidation time outside the drum gave a significantly different effect on the value of colour, whereas oxidation time inside the drum and the interaction between those two factors did not give significant effect. This was due to when the leather was oxidized outside the drum, the leather was stretched and both sides were in contact with the outside air resulting in further oxidation and increasing colour intensity.

The outside the drum oxidation time of 1 day gave a significantly different effect on oxidation times of 2 and 3 days, while the outside the drum oxidation time of 2 days was not significantly different from 3 days. Outside the drum oxidation time of 1 day provided the highest colour values, with the average value of 7.8. Oxidation time of 3 days gave the lowest average colour value of 7. This is due to the longer the outside the drum oxidation time, it will be the longer the leather contacts with the air and more oil is oxidized, so that the resulting colour intensity increased to brownish yellow. High colour

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intensity is not desirable for chamois leather, as according to BSN [9], the preferred colour of chamois leather is yellow to nearly white.

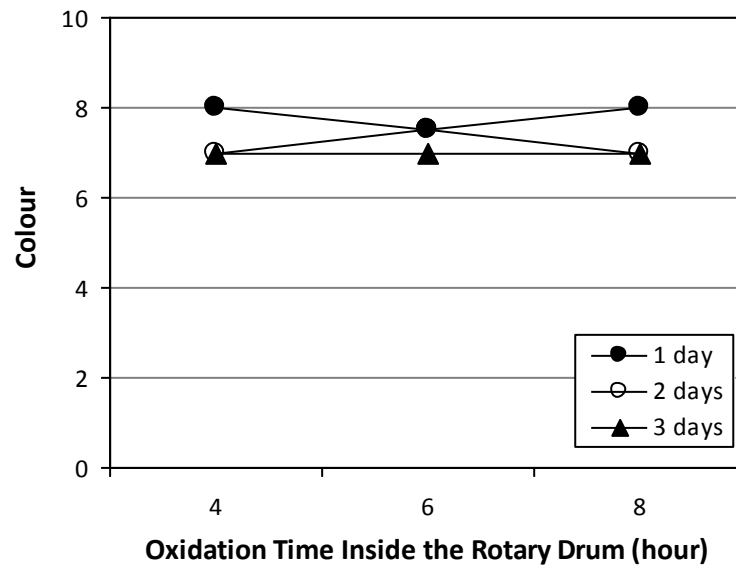


Figure 6 The relationship between the inside and outside oxidation times and the colour of chamois leather

3.5.3 Odour

Odour contained in the chamois leather is generally caused by oil residue left on the leather due to an insufficient washing process. Undesirable odour will decrease the aesthetic and consumer appeal on the product.

From the odour test, all combinations of treatments provided the same odour value, i.e. 7 - 8 (Figure 7). This suggests that the combinations of oxidation times tried in the tanning did not give significantly different effect on the odour of leather. Generally, odour of chamois leather is dependent upon sufficiency of washing process of the leather after oil oxidation. Insufficient washing process can leave an undesirable odour, since the odour is generated by the oil residue sticking to the leather, if it is not washed away completely.

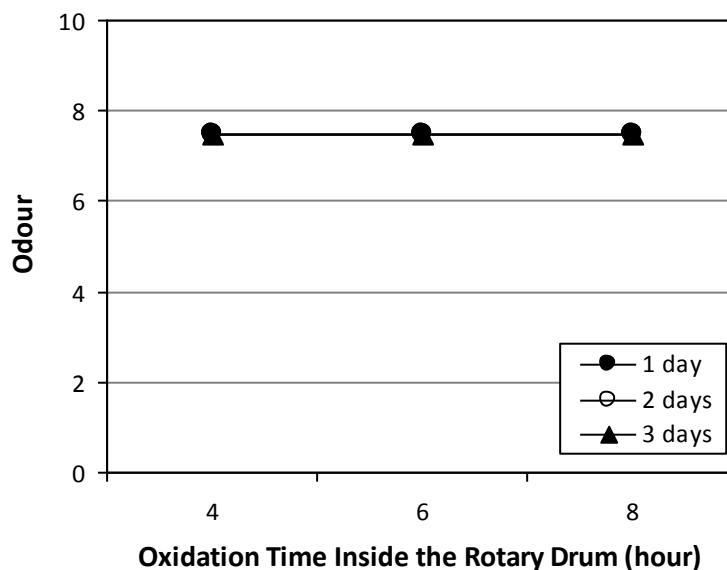


Figure 7. The relationship between the inside and outside the drum oxidation times and the odour of chamois leather

4 Conclusion

Combination of oxidation times inside and outside the drum in the chamois tanning process gave influence on the quality of chamois leather. Oxidation time inside the drum affected water absorption and softness of the leather. Oxidation time outside the drum gave effect on tear strength, tensile strength, and colour of the leather.

The combination of oxidation times inside the drum of 4 hours and outside the drum of 2 days was a selected treatment to produce the chamois leather. The treatment produced chamois leather with the highest water absorption capacity. In addition, the leather produced from the treatment showed good organoleptic properties.

Tanning with the selected treatment resulted in chamois leather with properties as follows: water absorption of 357.6%, tear strength of 59.3 N/mm, tensile strength of 27.9 N/mm², elongation at break of 160.4%, softness of 7, colour of 7, and odour of 8.

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