Studies Betterment of Work Environment, Standardization of Work Process, and Improvement of the Properties of Leather Based on the Application of Bio-tech Leather Processing Agent

Bio-tech 피혁 가공제의 적용에 따른 작업 환경의 개선, 작업공정의 표준화 및 물성증진에 관한 연구

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요 지

생활용품을 포함한 제조산업에 관계되는 환경오염 문제가 심각한 국내문제로 제시되어 왔으며, 제혁산업은 심각한 환경문제를 야기시키고 있다. 본 연구는 Bio-tech 피혁가공제로 Lupin LE-10 을 개발하여 탈모공정에 적용하고자 하며, 화학적 탈모방법과 비교를 통하여 Lupin LE-10 탈모 방법의 여러가지 장점의 검토를 하고자 한다.

따라서, 본 연구는 개발한 Bio-tech 피혁가공제를 효해공정과 수적공정에 적용하여 Lupin LE-10의 유용성과 제혁산업으로 부터 야기하는 환경문제의 개선, 가죽의 수율과 물성증진에 기여하고자 한다.

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1.Introduction

It is understood that desire of those engaged in leather industry is to produce the quality leather from good raw materials. In order to achieve this objective and to improve work environment, steady efforts are being made by tanneries and chemical manufacturers[1,2,3].

Preparatory process of leather industry consists of Soaking and Unhairing[4]. Unhairing process consists of chemical, biological, and enzymatic Unhairing[5,6].

However, general enzyme Unhairing is not generally utilized by the leather industry because it takes longer time, is less active and has the defect of leather quality being spoiled due to stability when lowered at a high PH[7].

In order to make up for this defect, the Bio-tech leather processing agent, Lupin LE-10, is developed based on the advanced genetic technology[8].

Some merits may be pointed out; first of all, the work environment is improved because the poisonous gas such as H_2S is not produced and disposal of water becomes easy because BOD and COD are remarkably reduced[9]. Secondly, as for the quality of leather, increase of output of leather with clean leather surface as well as removal of wrinkle, and improvement of the property of material are possible[10]. Thirdly, profitability of the company is increased owing to the improvement of productivity through shortening of work process, which may bring about epoch-making transformation period in the leather industry[11,12].

This study compares Lupin LE-10 with chemical Unhairing, calculates loosening degree of collagen fibre and area of skin pores, measures properties, chrome content, and the rate of output of leather for the purpose of contributing to putting into practical use of the Lupin LE-10. Furthermore, this study is intended for the contribution to improving environmental problem of leather industry, standardizing utilization of Bio-tech leather processing agent for Bating and Soaking.

2. Experiment equipment and methods

2-1.Experiment method

This study is to find out the effects of Unhairing by chemicals(Unhairing by lime) and Unhairing by Lupin LE-10, the Bio-tech leather processing agent.

In order to determine the optimum condition for job standardization of Unhairing

process, names of experimental equipment and characters of Lupin LE-10 used in the experiment are shown in Table 1 and Table 2.

Table 1. Equipment of experiment

Name	Maker
Scanning electronic microscope (SEM)	Joel (Japan)
Image analyser	Pias (Japan)
Tensile strength tester	Toyoseki (Japan)
Dose drum	Dose (Germany)
Wood drum	Sangok (Korea)
Integral tester	Sangok (Korea)

Table 2. Character of Lupin LE-10

Item	Lupin LE-10
Usage	Unhairing
Activity (PU/g)	100,000
Appearance	Light brown powder
Optimum PH	10.0 - 13.50
Optimum temperature (℃)	30.0 - 50.0
Properties	Special enzyme by Bio-tech, stability in salt, hard water, temperature, and activation of storage

2-2.Details of experiment

This study is to examine the increase of rate of output and improvement of properties through prevention of loose grain. Also, this study is to effect stability of work environment and improvement of environmental pollution against respective use of chemical agents such as Lupin LE-10, the Bio-tech leather processing agent in Soaking and Unhairing processes.

According to the methods based on the Korean Industry Standard, this study is to examine concentration, temperature, time of Unhairing, concentration of alkali agent in use

and its kinds, and reliming at an optimum condition for Unhairing when Lupin LE-10 is used. Furthermore, it is to work out a method of its utilization for Bating and Soaking process by developing the Bio-tech leather processing agent.

3. Result of experiment and studies

3-1. Observation of cross section of leather

The state of opening of collagen fibre is observed by means of scanning electronic microscope in the cross section of lime pelt, wet blue, and crust.

Different states of the cross section of lime pelt, wet blue, and crust are found regarding the opening of collagen fibre according to respective Unhairing methods used.

It is found out that more opening has been made in the fibre of lime pelt, wet blue, and crust by the use of Lupin LE-10, the Bio-tech leather processing agent. This result confirms how important the preparation process is in
leather industry. It is deemed that if collagen fibre is evenly opened, the combining rate of the tanning agent may be improved and the rate of output increased.

3-2. Observation of leather surface

States of skin pores and surface of lime pelt, wet blue, and crust according to Unhairing method used are observed by means of scanning electronic microscope. As for the surface of wet blue which demonstrates the size of skin pores, Lupin LE-10, the Bio-tech leather processing agent becomes bigger pore size than the chemical. This means that the output has been increased. In the case of crust changes in skin pores may be expected according to the type of fatliquoring agent used.

3-3. Analysis of skin pore areas on leather

The graphics obtained by the observation of lime pelt, wet blue, and crust by means of image analyser with scanning electronic microscope regarding the number and area of skin pores have been converted into data. The data on Table 3 show a total number and the area of skin pores existing within a certain unit, which relates to the state of collagen fibre, opening of skin pores, and shows Lupin LE-10 as the most excellent Bio-tech leather processing agent.

In order to confirm the image, analysis of the image obtained from replica of physical properties of leather surface has been carried out.

Table 3. Surface analysis on wet blue and crust

Item		Chemical Unhairing	Lupin LE-10 Unhairing
Total No. of skin pore	wet blue	184	123
	crust	148	95
Average area of skin pore	wet blue	478	736
	crust	657	997

3-4. Testing of physical properties of leather

Table 4 shows the data obtained by means of anaylsis instrument complying with the method prescribed by the Korea Industry Standard regarding tensile strength, tear strength, rate of stretch, and bursting strength of wet blue and crust of leather for garments, and shows when Unhairing is carried about by chemical and Lupin LE-10, the Bio-tech leather processing agent respectively.

Table 4. Comparison of crust with wet blue on physical properties

Item		Tensile (Kg_f/1.27)		Tear (Kg_f)		Elongation (%)		Burst (Kg_f)
		Length	Width	Length	Width	Length	Width	
Chemical Unhairing	wet-blue	12.8	10.0	3.1	4.1	32.0	35.0	9.6
	crust	8.1	8.0	2.5	1.8	50.0	36.0	8.6
Lupin LE-10 Unhairing	wet-blue	20.0	16.1	5.5	5.1	30.0	40.0	11.7
	crust	14.7	16.7	2.8	3.6	72.0	66.0	18.8

3-5. Chrome content and measurement of rate of output

When tanning is carried out under the same condition as Table 5, application of Lupin LE-10, the Bio-tech leather processing agent results in more chrome content and higher rate of output.

Table 5. Chrome content and output of wet blue

Item	Chemical Unhairing	Lupin LE-10 Unhairing	Remarks
Chorme (%)	4.34	4.55	KS M 6882 [13]
Output (%)	119.8	154.2	

3-6. Unhairing process

According to the said test, Unhairing is executed most effectively after 7~9 hours from the start of Lupin LE-10 Unhairing. To keep up activeness of Lupin LE-10 and effectively remove the remaining hair, it is considered very desirable that 0.1~0.2 % of total quantity be added.

As the test result shows, the effect of Unhairing increases by more than 97% if concentration of more than 0.4% is applied. Since the Unhairing effect remains at similar level of 97% at a concentration of more than 0.4%, it is found that 0.4~0.5% is the optimum concentration of Lupin LE-10 for Unhairing process.

From the said test, water temperature of than 29~32℃ is suitable for Unhairing by Lupin LE-10 method.

According to the test, it is found that the primary salt substance is bigger in plumping and the secondary salt substance has an excellent effect of Unhairing. According to the measurement of Unhairing effect of $Ca(OH)_2$, DEA, and Na_2CO_3 in various concentration; all the alkaline agents show excellent Unhairing effect at a concentration of more than 3% and $Ca(OH)_2$ at a concentration of more than 1%.

In the case of chemical Unhairing, sodium calcium co-exist in leather but in the case the of Lupin LE-10 Unhairing, reliming process is necessary because plumping occures less when sodium is applied because Unhairing is only effected by calcium. Reliming accelerates even opening of leather through full fibre separation, increases fullness, prevents loose grain, and contributes to smooth band knife.

3-7. Test on soaking process

It is found that as the concentration of Bio-tech processing agent for Soaking increases, the area also increases. This is because opening up of protein fibre is increased according to the increases of activeness.

3-8. Test on bating process

In the Bating process, it is learned from measuring output and quality of leather according to concentration of the Bio-tech processing agent for Bating that as the concentration of the Bio-tech processing agent for Bating increases, output also increases. Judging from the fact that at more than 0.6% of concentration of the Bio-tech processing agent for Bating, the rate of output increase slows down. It is confirmed that marginal concentration of the Bio-tech processing agent for Bating is 0.6%. Compared with existing Bating agent, effect of removing elastin from around hair root appears to be excellent. Flexibility also appears to be excellent.

3-9. Measurement of BOD and COD

Table 6 shows the data of BOD and COD measured in the waste water after chemical and Lupin LE-10 Unhairing method.

Table 6. BOD and COD of Flot after chemical Unhairing and Lupin LE-10 Unhairing

Unit : mg/l

Section	Chemical Unhairing	Lupin LE-10 Unhairing	Testing method
BOD	10,000	938.7	KS M 0111 [14]
COD	5,267.6	1,884.2	

According to the said test, BOD and COD are remarkably lowered when Lupin LE-10 Unhairing method is used than when chmical Unhairing is used. This shows that in case of Lupin LE-10 Unhairing method, the cost of waste is reduced and the disposal of waste water becomes easier.

4. Conclusion

Following is the test result on the improvement of features of leather, improvement of work environment, and standardization of work process through application of the Bio-tech leather processing agent Lupin LE-10;

1. In the Unhairing process, the opening of collagen and the size of skin pores are more increased by Lupin LE-10 Unhairing than by chemical Unhairing. The highest rate of output results from the use of Lupin LE-10 followed by special enzyme and then chemicals.
2. BOD and COD are remarkably reduced when compared with chemical Unhairing and in addition, job environment and the problem of environmental pollution are improved.
3. Optimum effect is obtained after 20 hours when $Ca(OH)_2$ is used as an alkaline agent at a concentration of 0.4~0.5% and at a temperature of 29~32℃.

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REFERENCES

[1] Kryszt of Bienkiewicz, Physical Chemistry of Leather Making, E.Krieger Publishing Company, Inc., 1983.

[2] Michael L. Shuler and Fikret Kargi, Bioprocess Engineering Basic Concepts, Prentice Hall, Inc., 1992.
[3] Stanley E. Manahan, Fundamentals of Environmental Chemistry, Lewis Publishers, 1993.
[4] 工業振興廳, 製革技術敎本(上), 67-153, 1978.
[5] 韓桓洙, 製靴技術, (株)東星技術硏究所, 87-110, 1988.
[6] 宋啓源外 2人, 皮革과 毛皮의 科學, 先進文化社, 58-77, 1994.
[7] 工業振興廳, 技術指導報告書 (製革編), 1978.
[8] M.M. Taylor, D.G. Bailey and S.H Feairheller, JALCA, vol.82, 153-163, 1987.
[9] 小劵利章, 酵素應用 과 知識, 幸書房, 1986.
[10] K.T.W. Alexander, JALCA, vol.83, 287-311, 1988.
[11] N.L. Nemerow, Industrial Water Pollution Origins, Characteristics and Treatment, Addeison-Wesley Publishing Company, 1978.
[12] D. Brady, J.R. Dungan and A.E. Russell, JALCA, vol.85, 334-344, 1990.
[13] 韓國工業規格, K S M 6682-1982, 環境汚染工程試驗法.
[14] 韓國工業規格, K S M 0111-1981, 環境汚染工程試驗法.