

## Manufacture of Rainbow-colored Veneer by Natural Dyeing

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**Abstract:** The wood veneers were clearly rainbow-colored with natural dyes. As shown through Korean-style jacket with stripes of multi-colors beyond traditional obang colors (red, blue, yellow, black and white colors), eco-friendly coloring methods representing Korean colors familiar from old times could be used nobly by coloring natural wood veneer being raw material of wood products. In terms of industrialization, the study to manifest korean color, substituting chemical stains such as dye and pigment, would be necessary. In order to realize this purpose, the study about economical dyeing materials and characteristics, that is, mordant, dyeing and drying techniques showing environment-friendly coloring and high coloration level ought to be followed. In addition to this, investigating discoloration transition by fading test for interior and exterior uses would have to be carried out.

**Keywords:** wood veneers, natural dyes, stripes of multi-colors, environment-friendly coloring

### 1. Introduction

Colored veneers were being used as natural fancy and artificial fancy veneer, etc. for wood products. Recently, cloth, leather, and paper as well as wood products dyed with natural dyes obtained out of nature are becoming more popular according to social trends which prefer eco-friendly natural materials. Consequently, it is anticipated that the application to wood construction, furniture, and wood handicraft industry by eco-friendly colorants and coloring method will increase in the future.

In case of chemical stain for current interior decorative use, an exposure to volatile organic compounds harmful to the human body can not be avoided. For these reasons, there is growing

trend to employ natural dyes derived from plants to clothing etc. instead of chemical dye-based colorants. However, though dyestuff and mordant used in these dyed products consist of natural materials, waste water disposal after dyeing is restricted and harmful materials could not be excluded completely, as chemical mordant is used in fixing color. Accordingly, the appearance of dyeing method using pure natural materials is required. In era before industrial revolution, all the world have used dyeing technology and realized colors using natural dye materials which are not chemical substances. Although mineral pigments harmful to human body have been used in painting, most countries have applied dyeing technology providing diverse colors for life according to their own environment and culture. From our intrinsic plants, wood, paper, leather, and cloths were dyed in diverse colors. Particularly, our traditional colors were applied

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into social life with various colors obtained from plants.

In addition, because the wood is directly dyed with ingredients which the wood holds, the environment and human could be protected with eco-friendly elements by eliminating chemical elements. And, there is an advantage that people can have organic connection to nature. So the need of research in a variety of colors with a wood stain would assure to apply the functional and environmental characteristics of wood. For example, yellow dye derived from the Chinese scholar tree (*Sophora japonica*) could defense against insects when dyeing the wood and paper materials with a prominent preservative effect. Accordingly, the study of choosing material and staining wood color for application to the real life is necessary to be carried out continuously.

The informations related to dyes etc. could be introduced through the past documents as follows;

In our country, traditionally colors have been created with using a variety of materials obtained from nature (Shin and Jeong 1474; Seo early 19C). The coloring substances contained in those have been created using trees and grass (Lee 1809). Lee has summarized everything in the household such as dyeing, food, hobbies in form of encyclopedia. Household pieces using dyeing and painting are being used these days and have also retained their own colors. The materials that produce a variety of colors through the wood and paper, textile, leather, grass (sedge) were used for dyeing and painting (Takji-bu late 19C). The use of stained wood or painted furniture is how to preserve and use for a longer period (Lee late 19C). Coating colors to the wood and furniture protects the wood from insects, and also this can add aesthetic elements to furniture. Staining wood with tradi-

tional staining techniques contains for filling color and painting as well as applying diverse oils on it for keeping its own colors, and contains filling only its own color (Sangui-won 1750). Jeon (1450) recorded in details on cook and dye as medical officer in Joseon Dynasty. At same medical scopes, Heo (1597) mentioned plants related to colors of the materials through records of various medicines and woods. In late 19th century, the financial office called as takji-bu published regulation on grass, wood, dyeing plants, as well as the standard and colors of each items in dyestuff chapter, style and color of the leather clothings.

In relation to medicine and natural dyeing, the introduction on their characteristics, medicinal use, and dyestuff for 128 species grown in our fields and mountains issued by Oriental Medicinal Herb Institute and Korea Traditional Dye Institute (2012).

In this study, the veneers peeled from log were dyed with only natural dyes and natural mordants. Therefore, red, orange, yellow, green, blue, deep blue, and purple colors such as rainbow colors were realized, excluding any use of chemical mordant. These dyes were stained into veneers and then colored veneers like rainbow striped-clothing were made. In the future, our amiable colors which is realized into stripes of many colors can be revitalized into the Korean Wave culture. And it is believed that it is very meaningful to have this opportunity to inform foreign people of these traditional colors.

## 2. Materials and Methods

### 2.1. Materials

As the dyed materials, about 2.7 mm thick radiata pine veneers which are common raw materials at plywood-manufacturing company



**Fig. 1.** Natural dyeing materials and fermentation for indigo-dyeing.

were used. The face color of radiata pine veneer figures somewhat light tones of wood substance, therefore, separate bleaching was not required. Considering this, a direct dyeing was executed on dry veneers. To realize rainbow like-colors, the dyes of gallnut, madder, sappan wood, the safflower, amur cork tree, indigo plant, gromwell root were used and eco-friendly mordant were added (Fig. 1).

## 2.2. Experimental Methods

Dyeing method of veneers was as follows. The plants with dyestuff were infused and heated in water. The other one is that this stuff plant was put in water and then put malt, and fermented for a certain time. Thereafter, veneers were put in dyestuff-infused water, taking ratio of water wt. 45~55 (%) to dyestuff wt. 1 (%), and heated up to 50 to 70°C, dyeing for a certain time.

Then dyed veneers were washed in water to remove foreign materials and dried. In the step

to infuse dyestuff, starch syrup is added in water putting malt so that disintegration of sugar may be done well.

## 3. Results and Discussions

Natural dyeing depends on how to extract coloring matter from plant by infusing in water or by fermentation so that its color can reach peak. The occurrence of difference in making dyestuff is due to water-insolubility of plant's original color. Through fermentation using malt, alcohol which melts coloring matter is generated spontaneously. Fermentation is executed 28 to 35°C for 2 to 15 days. It is desirable that the amount of malt is 1 to 5.5~6.5 as weight ratio comparative to dyestuff, that is, 100 g of malt is mixed with dyestuff of 550 to 650 g.

In particular, coloring matters of water-insoluble purple gromwell root, madder, etc. are fermented, using the malt, and then produce alcohol spontaneously. At this time, these compo-

nents are changed into soluble dyeing matter. If they are fermented, the grit of coloring matter changes into small size and coloration ratio increases. Also, when the plant which does not contain sugar is fermented, it is desirable that starch syrup is added into malt-put water so that the glycolysis performs well.

When sappan wood (*Caesalpinia sappan*) (sappan wood, or red wood) extracting red-color dyes is water-boiled and dyed, red-dyed stuff is faded away by sun light. However, if it is changed and dyed into neutrality of about pH 7 using camellia lye, as dyeing liquid of fermented sappan wood is acid when sappan wood is fermented using a malt, color fastness increases and high quality dyeing is acquired. Because dyeing in this case is bad at low temperature, it is preferably dyed at 55 to 65°C.

For orange-colored dyeing, first dried flower petal of safflower is soaked in water, following extracting yellow colored matter, and then red color extracted from sappan wood is additionally dyed.

Yellow-colored dye is extracted from amur cork tree (*Phellodendron amurense Ruprecht*). In order to acquire this dye, barks of amur cork tree are soaked in water and heated, following extraction for 40 to 70 minutes at water temperature of 55 to 65°C. After yellow-colored dyeing in these acquired yellow dyes, diverse colors of yellowish green and green colors through dyeing by indigo plants can be obtained.

Blue-colored dyes are extracted from indigo (*polygonum tinctorium*) of annual plant. Dyeing liquids are made from pouring beanstalk lye into indigo clay and fermenting after putting malt. In process of fermentation, alkaline beanstalk lye is changed to neutrality which helps dyeing well. The dye liquid after finishing fermentation makes dyeing well regardless of temperature, however, the color fastness turns out high when

room temperature is maintained.

Purple-coloring is obtainable through red-coloring by sappan wood dyeing after blue-coloring by indigo dyeing. At the same time, this dyeing is possible through mixing dye extracted from indigo plant and dye extracted from sappan wood. In case of a such double dyeing, two or more coloring matters are originally mixed and at a time dyed. Otherwise, when one color-dyeing is done, then other color-dyeing can be executed to various colors such as orange, yellowish green, green and purple and so on.

If indigo-dyed blue veneers are dyed by gallnut, the deep blue colors come out. When extracting gallnut dyes, first of all gallnut is dried, and thereafter extraction of tannin is completed in weak alkaline distilled water at 70°C within about 20 minutes. Expression of diverse colors can be obtained, as tannin of gallnut acts on increasing fastness after dyeing.

Purple dyes are extracted out of purple gromwell root, however, coloring matters of purple gromwell root are water-insoluble. In a style to brew rice wine, the purple gromwell root is fermented with malt and glutinous rice flour, and by this process coloring matter of purple gromwell root becomes water-soluble. In the process of fermentation the alcohol is created, and favorable dyeing is possible by changing water-insolubility of coloring matter of purple gromwell root into water-solubility. Extract of purple gromwell root shows the most vivid purple colors in the pH 4.0~6.5.

The appearances of dyed and dried veneers were as in Fig. 2.

#### 4. Conclusions

The naturally-dyed veneers clearly were colorized like rainbow color. Beyond traditional five colors (Obang-saek of red, blue, yellow, black,



**Fig. 2.** Colored veneers by natural dyeing.

and white colors), which represent four directions and center and clothings with sleeve of multi-colored stripes, the eco-friendly dyeing methods to embody Korean colors familiar with us from old times might be way to use nobly by coloring natural veneers of raw material of wood-based panels.

In these meanings, the research on realization of Korean traditional colors to have characteristics alternative to chemical stains such as dye, pigment is necessary to industrial level. On the other hand, the cost-effective dye and its characteristics should be studied, and further studies on dyes, mordants, dyeing and drying techniques for eco-friendly and high efficient dyeing should be carried out. In addition, investigating discoloration transition of dyed materials needs to be accompanied, implementing fading test indoors and outdoors.

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