Factors Related to the Pigment Production Using Natural Dye

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Abstract- Although many chemicals are supplied by the development of technology, the present is a time when the reliance on or expectation of a natural material cannot be overlooked, either.

This report aims at pigments made by natural dye, and offers findings on the pigment's dye for pigment adsorption and the dyeing fiber. The Phellodendron amurense dye cohered by alum was collected effectively with absorbents that have large negative values of zeta potential, and it was thought that the relationship between the size of pigment and dyeing fiber radius was important for the pigment dyeing.

Keywords – Natural dye pigment, Zeta Potential, Fiber radius

I. INTRODUCTION

Recently, lifestyle is felt to be a uniform trend, developing along with science and technology. Items used as daily tools that are becoming mainstream have been produced through our increasing scientific capabilities. This trend is also observed in clothing, where the use of synthetic fibers has increased in clothing material, and synthetic dyes account for the majority of all dyes. But the life seeking natural materials is not necessarily lost; fiber production of cotton is an increasing trend [1]. As for the popularity of natural dyes being higher, indigo dyes that have been made in various areas provide testimony. Also, vegetable dyes (pigment) that have been used as drugs since ancient times have become effective as health drinks in recent years, but there are few efforts to use them more effectively.

This study is an attempt to prepare a pigment effectively through the use of vegetable dyes. It is known that the production of paint from trees and plants depends on the cohesion/adsorption of the pigment [2-3].The cohesion/resolution effect of the pigment in various types of mixed dyes is reported to produce ferric chloride [4] and titanium [5] as waste fluids. These can have adverse effects during disposal. Because natural pigment is biodegradable, alum is thought to be a suitable flocculant for the manufacturing of color, owing to its ease of acquisition and handling. Development of pigments show distributed systems for pigments; development of the pigment itself is a little eggshell [6].

In this report, there were aims to recover dye using commercial adsorbent to clarify the influential factors in pigment dyeing.

II. EXPERIMENTAL

A. Samples –

Dyeing samples are dry Phellodendron amurense and alum (TANAKANAO). The fiber samples are cotton and hemp (NAKAO FILTER). The commercial adsorbents are Silicagel (Wako, Wakogel C-100), cellulose (Whatman, FIBROUS CELLULOSE POWDER CF11), zeolite (Wako, Zeolite, Synthetic, A-3, Powder) and slaked lime (Wako ， $Ca(OH)_2$).

The extracted material was gathered, adding water 100 times the sample weight to the Phellodendron amurense sample, and heating it for 30 minutes immediately before boiling. The measure of the total amount of liquid was matched to the volume of water used.

B. Measurement of pH, color and turbidity of the dye solution by alum –

pH was measured with a pH meter (HANNA, HI991300) and turbidity and hue were measured with a turbidity meter (NIPPON DENSHOKU Drainage Analyzer NDR-2000) for analyzing the dye solution with the change of alum concentration.

C. Measurement of the physical properties of the commercial adsorbent –

The particle size of the zeolite and slaked lime was measured with a microscope (KEYENCE DIGITAL MICROSCOPE VHX−100). Zeta potentials for the absorbents were measured by the electrophoretic method (Malvern, Conductometric analysis ZS). The specific surface area and pore distribution were measured by the Chokedamp adsorption method (SHIMSDZU, Micromeritics TriStar II).

The zeta potential was measured after distributed processing for 1 minute through ultrasonic irradiation by adding 100ml of pure water to sample 0.1g. Parameters of the dispersant are the numerical value of the water.

The specific surface area and pore distribution was measured after degasification. Degasification was done for zeolite for over 15 hours at 300℃, for silica gel and slaked lime over 15 hours at 200℃ and for cellulose over 15 hours at 110℃. 0.2g to 2.3g of each sample were used for the measurements.

D. Measurements of dye adsorption am ount –

After the absorbent of 0.01% to 14% weight was put into the extraction dyestuff liquid measure it was stirred it for 1 hour with a shaker (AS ONE, SHAKER SRR-2), it was then separated for 1 minute at 3000rpms. Then the permeability of the clear supernatant liquid was measured with a spectrophotometer (SHIMADZU**,** UV-1600). The absorbent's amount of the dyestuff was shown in the ratio in which the permeability of the extraction dyestuff was assumed to be one.

E. Evaluation of the adsorbent pigment –

After putting alum and an adsorbent in the dye solution, and having stirred it, the dye solution was filtered with filter paper (ADVANTEC, No.5c) and the pigment was collected. In a sealable plastic bag, 10 volumes of water and pigment fabric of the same weight and pigment were dyed for 5 minutes. After having repeated swing washing twice, the dyed fabric was dried by air. Then, ΔE^* was determined from L^*, a^*, b^* using a color difference meter (NIPPON DENSHOKU, NF777).

III. RESULTS AND DISCUSSION

A. Cohesion of Phellodendron amurense dye by alum concentration –

The relationship of the Phellodendron amurense dye and concentration of alum is shown in Figures 1 and 2. Turbidity is a maximum when the 0.04% alum concentration, change in hue (| h |) showed a maximum at this concentration. Because it is thought that turbidity is relatively high and the alum concentration with a few changes of hue are approximately 0.1%, alum was added in an amount to 0.1% concentration.

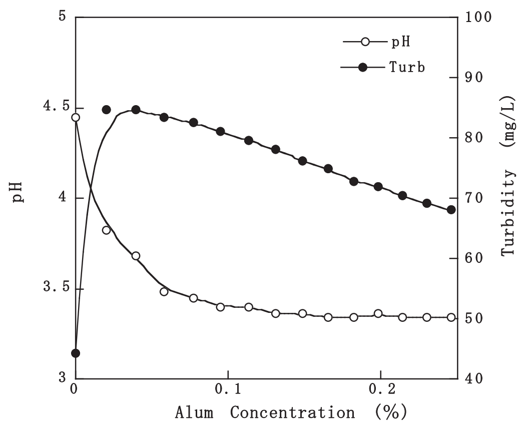

Figure 1. Change of pH and turbidity in Phellodendron amurense dye solution on Alum concentration

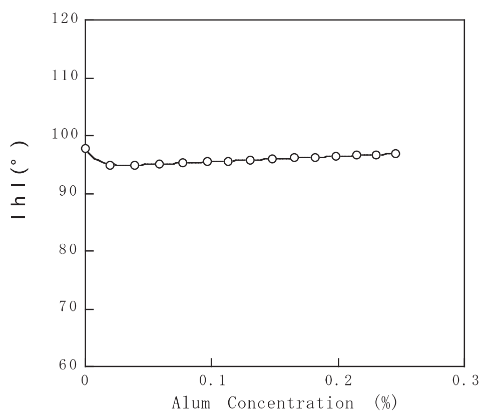

Figure 2. Color change of the Phellodendron amurense dye solution on Alum concentration

B. Adsorption effect of dye cohesion by commercial adsorbent –

The adsorption of dye cohesion by each adsorbent is shown in Figures 3 and 4, and the basic properties of each adsorbent are shown in Figure 5. The adsorbent concentration indicated of 20% of adsorption amount is Slaked lime and Zeolite > Cellulose > Silicagel. Figure 5 showed that a minus level of the zeta potential of the Zeolite is maximum, average minute hole diameter of Slaked lime is maximum, the specific surface area of the Silica gel is greatest. Because the pigment adsorption degree of the adsorbent and the dye used on this study is basic dye, it was considered that the amount of the dye adsorption was influenced of negative zeta potential.

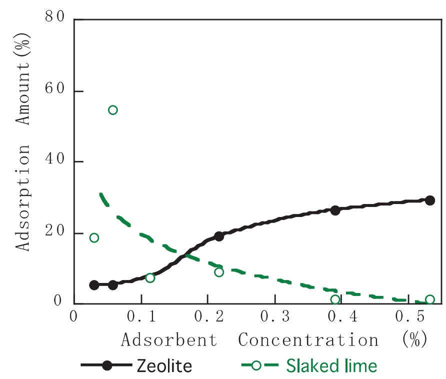

Figure 3. Adsorption of Phellodendron amurense dye for Zeoliteand Slaked lime

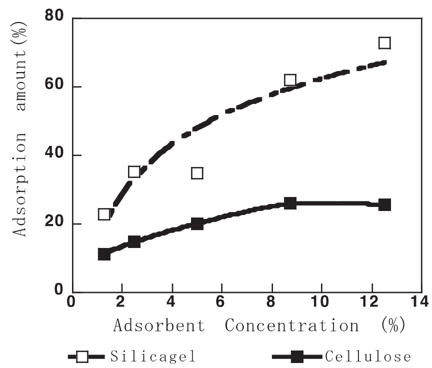

Figure 4. Adsorption of Phellodendron amurense dye for Silicagel and Cellulose

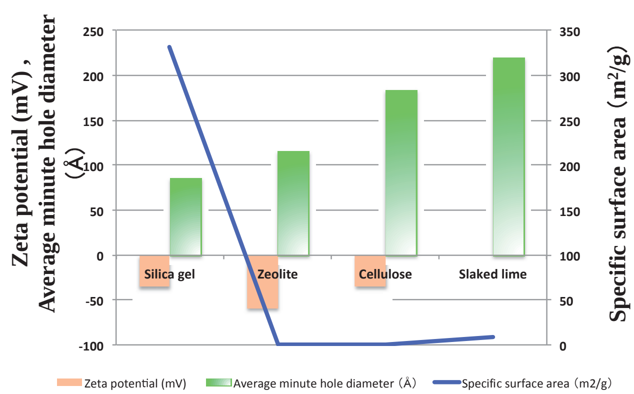

Figure 5. Basic property of adsorbent

C. Effect and factors affecting the pigments dye –

Pigments are made by the amount of the absorbent that adsorbs the cohesion dye by about 20%, and each absorbent's dye performance is shown in Figure 6. It was thought that the zeolite with a small amount of the absorbent used for the pigments production was effective for pigment production though good dye performance were admitted by the dyeing of pigments using cellulose and the zeolite as adsorbents.

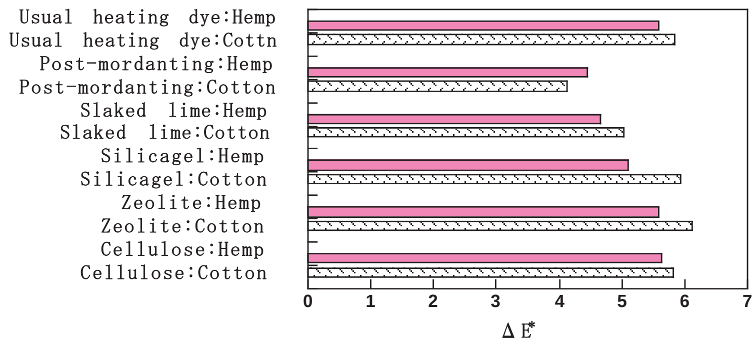

Figure 6. Dyeing of each material cloth by each Phellodendron amurense pigment

Generally paste agent is used for paint's dye. On the pigments dyeing when not using a paste agent, it is thought that the relation between the structure of dyeing fabric and the size of pigment particles is important.

When the fiber section is assumed to be a circle and the radius is assumed to be R, the radius size (r) of the particle caught in the gap between the fibers is calculated by the following equation [7]. $r = R(2/\sqrt{3} - 1)$

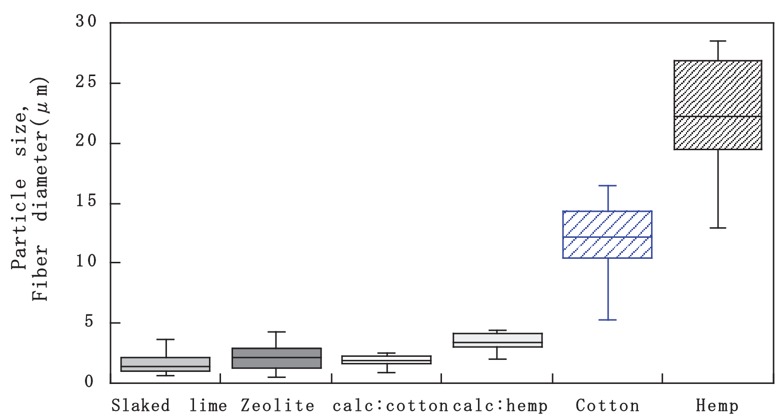

Figure 7. Size of the adsorbent particles, fiber width and of the gap size calculated from the fiber width

The particle size of the slaked lime and zeolite adsorbed much of the cohesion dye, the fiber width of hemp and cotton fabrics and calculated gaps size are shown in Figure 7. The calculation values obtained according to the fiber width radius of cotton and hemp are about 2-4 ㎛, and this value almost perfectly corresponds to the size of the zeolite. Thus the results showed that it was important to use an absorbent of a size suitable for the fiber width.

IV. CONCLUSION

The following result was obtained by examining the pigment production conditions for the effective use of natural pigments in consideration of the use of natural materials.

It was shown that there were a lot of adsorptions of the Phellodendron amurense dye cohered by alums in the zeolite and slaked lime. Moreover, it was clear that the relation between the diameter across the dyeing fiber and the size of the pigment particles influenced the pigments dyeing.

ACKNOWLEDGEMENTS

Part of this work was supported by JKA 26-130.

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