Testing Chinese Ink as a Natural Dyestuff on Silk and Cotton Fabrics: The Foundation for a Collection of Wearable Art

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Purpose

This research is a part of a sustainable wearable art design project inspired by techniques and aesthetics of traditional Chinese painting. Fabrics colored with natural dyes return to earlier stages of history (Shahid, Islam, & Mohammad, 2013) when socially responsible, non-toxic and biodegradable textile production techniques were used, versus synthetic dyes. Ink used in Chinese painting is carbon based and was originally extracted from pine soot (Winter, 1974). In preparation to undertake this wearable art project, the feasibility of using Chinese ink as a natural dyestuff for submersion dyeing on fabrics made from silk and cotton fibers was determined by measuring: (a) color strength, and (b) color difference, color parameter, colorfastness (light, washing, and rubbing) and fabric hand.

Methods and Procedures

Silk organza, silk charmeuse, bleached cotton and unbleached cotton were submersion dyed with 50% owf[1] depth of dyeing at a liquor ratio of 1:50 (dry fabric:water), salt (0% owf, 5% owf, 10% owf and 20% owf) and 2% omf[2] white vinegar for a total 16 groups of treatments. Meta-mordant method was used to dye the fabrics. Five samples of each group were dyed under the identical conditions. The color strength of the dyed fabrics was measured using K/S values generated by a HunterLab ColorQuest XE® Dual Beam Spectrophotometer. The relative color strength between the untreated fabric sample and treated fabric samples were also evaluated using the following equation: relative color strength (%) = (K/S of treated sample/K/S of untreated sample) x 100. To evaluate the color difference and color parameter, CIE Lab system was used. Color fastness to light (AATCC:16-2004), washing (AATCC:61-2007) and rubbing (AATCC:8-2007) were conducted on the dyed fabrics. Color fastness and staining ratings were evaluated by comparing the Grey Scale from 5 to 1 for Evaluating Change in Color (ISO International Standard 105/A02) and Grey Scale for Evaluating Staining (ISO International Standard 105/A03). Fabric hand of each dyed fabric was evaluated according to AATCC EP 5-2006.

Results

The results from the color fastness tests indicated that the color strength and the hue (K/S values) increased as a function of increasing salt concentrations from 10% to 20% of the weight of dry fabric for both cotton and silk. All three types of fabrics except silk charmeuse had good wash fastness withstanding repeated hand laundering at the temperature of 105±5 °F with 0% and 5% salt concentrations. As a result the deterioration in change of color in the wash fastness tests was observed at high salt concentrations for all four types of fabrics. Similar to the wash fastness, silk charmeuse had relatively poor dry and wet rubbing fastness. All four types of fabrics exhibited excellent colorfastness to light. The fabric hand of the dyed bleached cotton and silk organza

[1] owf stands for weight of dry cloth.
[2] omf stands for the amount of water.

became rougher and stiffer after dyeing. The color on three fabric samples except bleached cotton was soothing and even. Thus, according to the L^* value and K/S value for the silk fabrics, 20% salt concentration will be adapted to the final dyeing project for the design collection in order to get the darker black.

Based on the results of the color fastness measurement, the feasibility of using Chinese ink solutions (including salt and white vinegar) to hand-painted silk organza satin and silk charmeuse was also tested using color fastness to light (AATCC:16-2004) and washing (AATCC:61-2007). The results from the hand-painting tests demonstrated that both silk organza and silk charmeuse had excellent color fastness to light. Silk charmeuse has very poor wash fastness. Hand-painted silk organza samples using different white vinegar to ink ratios (vinegar:ink =ink only, 0.5:1 ,1:1) showed no color different by hand laundering testing at a temperature of 105±5 °F. The silk organza samples were painted using 1:1 white vinegar to ink ratio and 20% owf shows color difference. Hand-painted silk organza samples using 0.5:1 and 1:1 white vinegar to ink ratio show good color fastness to hand laundering at the temperature of 80±5 °F. However, silk organza had a poor wash fastness when laundered in home machines.

Implications

The results of these AATCC colorfastness tests provided information on the optimum conditions to perform submersion dyeing and silk painting with Chinese inks. This background research provides valuable information and confidence in the use of Chinese inks in the creation of the textile and wearable art inspired by Chinese painting. Silk charmeuse was determined to be the most suitable main fabric for the design collection since it has the most luster and soft hand feel with the best light fastness. As a precaution, the proposed wearable art will be displayed in the gallery under museum lighting to prevent color fading. The lower results for wash fastness and rub fastness are not critical for wearable art, therefore the future pieces created from Chinese inks can be carefully hand washed at temperature of 80±5 to 105 ±5 °F when necessary. The white vinegar to ink ratio 1:1 will be used as the mixing ratio of the ink used for hand-painting silk organza, since the tests showed excellent color fastness of hand laundering at low temperature. Chinese painting was done on silk fabrics before *Xuan* paper was invented during Sui Dynasty (approximately 1,000 years ago) and is still the preference of artists for Chinese painting, thus this project warrants the use silk fabrics.. Unbleached cotton muslin will also be considered for future design projects since it has excellent light fastness and good fabric performance after dyeing. Bleached cotton muslin will not be considered using for the future design project since the dyed color is non-uniform after dyeing. ,

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