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Batik Color Fixation Through Infrared

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Abstract

In this paper, ceramic infrared is used in order to fix dye onto the fabrics for batik making. Traditionally, sodium silicate is used as a medium in achieving the fixation of dye. However the use of sodium silicate contribute to environmental issue and using a large volume of water. The purpose of this study is to prove that ceramic infrared can be used as batik fixation and to overcome the environmental issue from the batik industries. The study was done on batik cotton fabric by canting technique.The fabric has been exposed to the infrared ranging from 10 to 30 minutes for different samples. All the samples have been tested with Rotawash Colourfastness Tester and then examined using colour matching cabinet. It shows that the exposure of the infrared for 30 minutes gave the most identical result compared with the sodium silicate method. "Batik Color Fixation through Infrared" proven that there is other media, which is suitable to replace sodium silicate during batik fixation.

Keywords*: infrared, batik, canting, sodium silicate, batik fixation*

1.0 Introduction

Batik was mentioned in the 17th century Malay Annals. The word is first recorded in English in the Encyclopædia Britannica of 1880, in which it is spelled *battik*. It is attested in the Indonesian Archipelago during the Dutch colonial period in various forms: *mbatek*, *mbatik*, *batek* and *batik* [Blust,1989]. The word *batik* is Javanese in origin. It may either come from the Javanese word *amba* (to write) and *titik* (dot), or may derive from a hypothetical Proto-Austronesian root **beCík* (to tattoo). Batik is a technique of manual wax-resist dyeing applied to whole cloth, or cloth made using this technique. Batik is made either by drawing dots and lines of the resist with a spouted tool called a *canting* (tjanting), or by printing the resist with a copper stamp called *cap*. The applied wax resists dyes and therefore allows the artisan to color selectively by soaking the cloth in one color, removing the wax with boiling water, and repeating if multiple colors are desired. A tradition of making batik is found in various countries, including Indonesia, Nigeria, China, India, Malaysia, Philippines and Sri Lanka [Sumarsono et al., 2013]. The method of Malaysian batik making is different from those of Indonesian Javanese batik, the pattern being larger and simpler with only occasional use of the *canting* to create intricate patterns. It relies heavily on brush painting to apply colors to fabrics. The colors also tend to be lighter and more vibrant than deep colored Javanese batik. The most popular motive are leaves and flowers. Malaysian batik often displays plants and flowers to avoid the interpretation of human and animal images as idolatry, in accordance with local Islamic doctrine. However, the butterfly theme is a common exception. The batik of Indonesia, however, is the most well-known. Indonesian batik made in the island of Java has a long history of acculturation, with diverse patterns influenced by a variety of cultures, and is the most developed in terms of pattern, technique, and the quality of workmanship. On October 2009, UNESCO designated Indonesian batik as a Masterpiece of Oral and Intangible Heritage of Humanity [Indoneisan Batik, 2009].

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Sodium silicate is the common name for compounds with the formula $Na_2(SiO_2)_nO$. A well known member of this series is sodium metasilicate, Na_2SiO_3. Also known as waterglass or liquid glass, these materials are available in aqueous solution and in solid form. The pure compositions are colorless or white, but commercial samples are often greenish or bluish owing to the presence of iron-containing impurities. They are used in cements, passive fire protection, textile and lumber processing, refractories, and automobiles. Sodium carbonateand silicon dioxide react when molten to form sodium silicate and carbon dioxide [Greenwood et al,. 1997].

The used of sodium silicate for the color fixation was widely used since long time ago. It's due to the effectiveness for the colour fixation on fabric. In hand dyeing process, sodium silicate solution is used as a fixative for with reactive dyes that require a high pH in order to react with the textile fiber. After the dye is being applied to a cellulose-based fabric, such as cotton or rayon, or onto silk, it is allowed to dry. After that the sodium silicate is painted onto the dyed fabric, covered with plastic to retain moisture. Left for reaction for an hour at room temperature [Burch, 2010]**.** Most of the small industries using this method because of it easy to get and one can recycle it for a few times. Besides that, the cost of this material is very low compare to the other method. By using sodium silicate, the process took at least 8 hours for the fixation process, need more operators, end up a messy workshop and chemical effect to human. This is due to the water pollution and the environmental effect.

Infrared (IR) is invisible radiant energy, electromagnetic radiation with longer wavelengths than those of visible light, extending from the nominal red edge of the visible spectrum at 700 nanometers (frequency 430 THz) to 1 mm (300 GHz) [Liew, 2007] (although people can see infrared up to at least 1050 nm in experiments) [Sliney et al., 1976]. Most of the thermal radiation emitted by objects near room temperature is infrared. Infrared radiation was discovered in 1800 by astronomer William Herschel, who discovered a type of invisible radiation in the spectrum beyond red light, by means of its effect upon a thermometer [Michael, 2013] . Slightly more than half of the total energy from the Sun was eventually found to arrive on Earth in the form of infrared. The balance between absorbed and emitted infrared radiation has a critical effect on Earth's climate. Infrared energy is emitted or absorbed by molecules when they change their rotational-vibrational movements. Infrared energy elicits vibrational modes in a molecule through a change in the dipole moment, making it a useful frequency range for study of these energy states for molecules of the proper symmetry. Infrared spectroscopy examines absorption and transmission of photons in the infrared energy range [Reusch,1999] . Infrared radiation is used in industrial, scientific, and medical applications. Night-vision devices using active near-infrared illumination allow people or animals to be observed without the observer being detected. Infrared astronomy uses sensor-equipped telescopes to penetrate dusty regions of space, such as molecular clouds; detect objects such as planets, and to view highly red-shifted objects from the early days of the universe. Infrared thermal-imaging cameras are used to detect heat loss in insulated systems, to observe changing blood flow in the skin, and to detect overheating of electrical apparatus. Thermal-infrared imaging is used extensively for military and civilian purposes. Military applications include target acquisition, surveillance,night vision, homing and tracking. Humans at normal body temperature radiate chiefly at wavelengths around 10 μm (micrometers). Non-military uses include thermal efficiency analysis, environmental monitoring, industrial facility inspections, remote temperature sensing, short-ranged wireless communication, spectroscopy, and weather forecasting. Infrared radiation is essentially a range of wavelengths that comprise a subset of the electromagnetic spectrum. The electromagnetic spectrum includes:

i. Gamma radiation.
ii. X-ray radiation.
iii. Ultraviolet (UV) radiation.
iv. Infrared radiation.

Infrared wavelengths occur in the spectral 0.7 to 80 µm. Industrial ceramic infrared radiators generally use wavelengths between 2 and 10 µm. Infrared wavelengths are absorbed as heat into materials. Materials absorb infrared energy at different rates. The absorption rate is a factor of material type, color, emissivity (reflection of infrared waves) and other factors. The infrared spectrum from the sun is responsible for heating the Earth. Similar to the way a concrete sidewalk is noticeably cooler than the adjacent asphalt under the same sun exposure, the absorption rate of process materials is an important consideration in the effectiveness of infrared technology.Infrared radiation extends from the nominal red edge of the visible spectrum at 700 nanometers (nm) to 1 mm. This range of wavelengths corresponds to a frequency range of approximately 430 THz down to 300 GHz. Below infrared is the microwave portion of the electromagnetic spectrum.

Light comparison[8]			
Name	**Wavelength**	**Frequency (Hz)**	**Photon Energy (eV)**
Gamma ray	less than 0.01 nm	more than 30 EHz	124 keV – 300+ GeV
X-Ray	0.01 nm – 10 nm	30 EHz – 30 PHz	124 eV – 124 keV
Ultraviolet	10 nm – 380 nm	30 PHz – 790 THz	3.3 eV – 124 eV
Visible	380 nm–700 nm	790 THz – 430 THz	1.7 eV – 3.3 eV
Infrared	700 nm – 1 mm	430 THz – 300 GHz	1.24 meV – 1.7 eV

Microwave	1 mm – 1 meter	300 GHz – 300 MHz	1.24 µeV – 1.24 meV
Radio	1 mm – 100,000 km	300 GHz – 3 Hz	12.4 feV – 1.24 meV

Table 1.0 Infrared in relation to Electromagnetic spectrum

In general, objects emit infrared radiation across a spectrum of wavelengths, but sometimes only a limited region of the spectrum is of interest because sensors usually collect radiation only within a specific bandwidth. Thermal infrared radiation also has a maximum emission wavelength, which is inversely proportional to the absolute temperature of object, in accordance with Wien's displacement law. Therefore, the infrared band is often subdivided into smaller sections. The International Commission on Illumination (CIE) recommended the division of infrared radiation into the following three bands:

i. IR-A: 700 nm – 1400 nm (0.7 µm – 1.4 µm, 215 THz – 430 THz)
ii. IR-B: 1400 nm – 3000 nm (1.4 µm – 3 µm, 100 THz – 215 THz)
iii. IR-C: 3000 nm – 1 mm (3 µm – 1000 µm, 300 GHz – 100 THz)

Therefore, a new technique used to prove that ceramic infrared can be use as batik fixation and to overcome the environmental issue from the batik industries. This research is focusing on the canting process as it is widely used in Malaysia batik industries. Besides that the material used in this research is cottton fabric only because of the setting for temperature and dyestuffs used are depending on material. For example, polyester, by using the man made fabric, disperse dye need to be used and the temperature for the process even higher. It’s very hard to get the best result as well as to control the process.

2.0 Batik Techniques

There are a few ways of making batik. Either canting technique or stamping technique. For this research, we concentrate of the canting technique since it widely use in Malaysia. Below are the flow process of making batik by canting technique.

Figure 2.0 Flow chart process of batik making using canting technique

According to Figure 2.0, batik making using canting technique starts with melting the wax and resin in 95%-5% ratio in a bowl with heater. Once it is melting, fill the canting with the mixture of wax and resin. Draw the wax on a white fabric. The fabric can be cotton or silk. The process has to be fast and accurate because the wax will cool faster and cannot be corrected once it is being applied. By using the color brush, artist paint the enclosed area with the needed colors. Sometimes, clean water is used to produce shading effect. Again, the choice of color is limited only to the creativity of artist. When the color is dry completely, apply a layer of sodium silicate on the fabric to fix the color. Leave it for at least 4 hours to dry. The colors will be durable and will not fade easily. Put some soda in the water and boil the fabric for few minutes. The wax will come off of the fabric. Hang and dry the fabric. A piece of batik was created.

1.0 Methodology

3.1 Design Concept

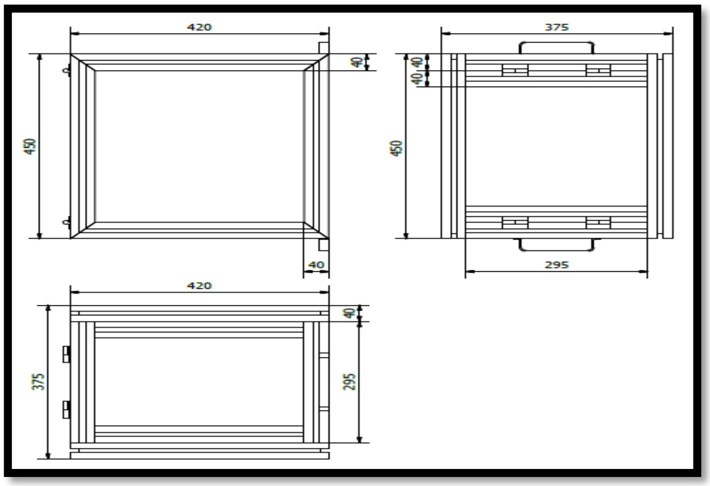

Figure 3.1.1 Technical drawing of the project design

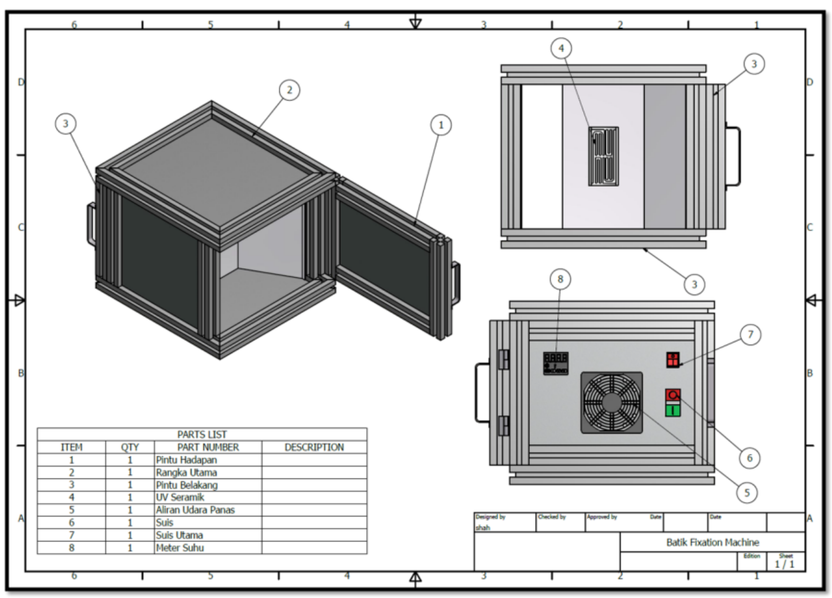

Figure 3.1.2 Cover part of the project design

3.2 Material Selection

Material which have been selected are based on certain criteria;

i. Cost of the materials
ii. Durability of the materials and the funtionability.

iii. Ease of supply.
iv. Easy to assemble.

3.2.1 Components of the project

i. Ceramic Infrared **-** the main component of the project.
ii. Aluminium Profile **-** all the frame is made of aluminium.
iii. Temperature Controller **-** indicate the temperature in the machine and auto stop the thermostat for the temperature controlling.
iv. Timer **-** To set the time allotted during the test
v. Fan **-** used to create a flow of air
vi. Screw and nut – joining the parts

2.0 Result

All the sample fabrics have been tested with Rotawash Colourfastness Tester by following the AATCC method 61-1980 Test No IIA. From the washing test result, all the samples have been examined using colour matching cabinet. The results are as follows:

TEMPERATURE : 98°C		
FABRIC TYPE : COTTON (100%)		
SAMPLE	**TIME (MINUTE)**	**SCALE (COLORFASTNESS TO WASHING)**
1	10	3
2	15	3/4
3	20	4
4	25	4
5	30	4/5

Table 4.0 Colourfastness result according to exposure period

According to Table 4.0, all of the samples were exposed to the infrared for different time periods ranging from 10 to 30 minutes. The sample that was treated with sodium silicate was used as control sample. The samples were graded by using gray scale indicator. It shows that the exposure of the infrared for 30 minutes gave the most identical result compare with the sodium silicate method. It has been graded as 4/5 using the gray scale indicator.

5.0 Conclution

As a conclusion, "Batik Color Fixation through Infrared" proved that there is other media, which are suitable to replace sodium silicate during batik fixation. Overall, this infrared fixation concept could help batik producers to replace sodium silicate in their production. Furthermore, it could save the production time, large amount volume of water deductible and as a result, protect the environment from water pollution caused by the batik industries.

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