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Resurgence the Local Knowledge: Environmental Catalysis Practiced in Local Textile Dyeing

Nurul Syahida Mat Hussin¹, Ahmad Rasdan Ismail^{1,2}, Nawwal Abdul Kadir¹, Sarah Wahida Hasbullah¹, Hanisa Hassan¹ and Norfadzilah Jusoh¹

¹Faculty of Creative Technology & Heritage, Universiti Malaysia Kelantan, 16300 Bachok, Kelantan, Malaysia

²Centre for Management of Environment, Occupational Safety and Health (CMeOSH), Universiti Malaysia Kelantan, 16300 Bachok, Kelantan, Malaysia

Email: rasdan@umk.edu.my

Abstract. The resurgence of local knowledge by using natural colourant in textile dyeing has gaining popularity due to the eco-friendly advantages and benefits. Textile dyeing process is keen as both art and science that has been practiced since human development. This paper aim to identify the process practiced in local textile dyeing with adaption of environmental catalysis. The methodology used in this study is reviewing the content by referring the previous study, text documentation and discussions. There are three (3) types of dyeing process identified in local textile production which are natural dyeing, naphthol dyeing and Remazol dyeing. The dyeing technology change with time and consumer demand by considering the economic purposes but neglecting the environment and vicinity safety. Therefore, the introduction towards environmental catalysis substances in the process of natural dyeing has led the eco-friendly chain process practices for local textile production, besides it is an initiative to create awareness and acknowledge about eco-friendly dyeing and local knowledge on textile dyeing process.

1. Introduction

Environmental catalysis briefly referred as an alternative process in order to reduce the unacceptable compound [1,2]. Environment catalysis plays an important role in sustainable development with its materials and technologies approach [3]. Sustainable development is one of the blueprint discussed in Bruntland Report since 1987 as environment partly issued with economic and socio as defined ‘...*the need of present without compromising the ability of future generation to meet their needs*’ [4] has been initiated for further discussions and implementations platform. Meanwhile, the environmental catalysis usually has been discussed in treating the emanation from the industrial activities such as atmospheric pollutant [5], recycling the solid waste (sludge) [6], waste water contamination [7] etc. yet less discussed and overlooked towards the local knowledge which provides the environmental friendly process as what have been practiced in traditional textile dyeing productions.

Malaysia well known as having splendid traditional textiles like *songket*, *tenun* (weaving), and *batik* (resist). Local knowledge inevitable has been nurtured and naturally developed the idea of creating, inventing and manipulating surrounding objects with creativity by as the way to survive and express the craftworks without harming the milieu [9]. The process of the traditional textiles dyeing practices involve extraction from fruits, barks, flowers, leaves, minerals, insects and animals are nature sources



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relatable to the concept of environmental catalysis [11–13]. Therefore, nowadays locals practice based environmental catalysis changes due to the current demand and being replaced by the synthetic's materials for textile dyeing [14].

The issue towards environmental catalysis has been discovered in textile dyeing processing chain. In this paper context, the process from the local people in dyeing textiles has kept the idea of environmental catalysis and it is naturally developed as indigenous knowledge among them. Specifically, dyeing process changes with times depending on the current demand. This paper aims to provide an overview to identification of the process and technology involved in traditional textile dyeing practiced by the local batik manufacturers in East Coast of peninsular Malaysia. It is very significant to review the traditional methods practiced among local manufacturers to emphasize the process and substances involved, besides it has been manipulated and mixed with inorganic substances. Then it can create the awareness in implying and practicing the natural dyes as an alternative colourant and enhance the biodegradable related solvent released by the textile dyeing process. This paper uses the term 'local textile' to refer to local production textile and 'current textile' as refer to nowadays or modern approach in textile production.

2. Literature Review

The review prompts to introduce the topics on the local textile dyeing process and the modern approach used in current textiles dyeing imply with the environmental catalysis. Therefore, introductory towards the local textile and the process involves with environmental catalysis features gives the structural concept and choices appropriately to be adapted and practiced by the practitioners and designers as appreciating local knowledge and minimizing the ecological consequences.

2.1. Local and Current Textile in Glance

There are splendid traditional textiles in Malaysia known as *tenun* (weaving), *songket*, *limar* and *batik*. These local textile productions mainly involve with the dyeing process of thread and pieces of fabrics. It starts to be structured by the stunning designs and surface decorations by applying colours and variety techniques for creating ornaments on textile – it is part of local people expression, symbolism and religious ritual [27,28]. This is technology which refers to the process of creation aided with the mild complementary. This primitive technology practiced has not influenced the aesthetic meaning or ritual belief [29]. Therefore, the traditional or local textile dyeing is one of the genuine local knowledge include the passion of experimenting materials to dye the textiles. It provides as early as possible the eco-friendly materials in the process of dyeing.

2.2. Textile and Eco-friendly Approach

Textile and cloth generally define as '*...material made by weaving or knitting*' [31] but the condition of both textile and cloth are differently describe. Textile refer to fabric or woven cloth, meanwhile, cloth associated with functions and aesthetics or refer as apparel. There are two (2) types of fibres to make textiles uses in industry which are (1) natural fibres – derived from vegetable fibre, animal fibre and mineral fibre – cotton, wool, silk etc. (2) Man-made fibres – developed entirely from chemical like rayon, viscose, nylon etc. [32]. Both of those materials provide advantages and disadvantages in the performance of colour absorption, tensile, durability, quality, time-consuming and cost. However, in today's textile production, protection for the environment become a challenge in chemical industry [33]. Most of the studies in textiles process shows an interest towards solving the environmental issues caused by the textile wastewater [21,34]. Besides, there is study on potential eco-friendly system in textile dyeing process to minimize the contamination and water consumption [35,36]. Therefore, the intervention of environmental approach has been widely discussed and studied, however, it is not practicable for the local textile productions due to highly cost on the wastewater management and hardly focus on the residual dyes and dyeing auxiliaries that can cause polluting effluents.

2.3. Textile Dyeing Process

Dyeing process is one of the treating methods for maintaining the durability of the fibres by colouring threads or fabrics. Nature resources materials like plants, fungal animals, insects, soils and minerals has been extracted to perform colours on fabrics [11,37,38]. However, in 1856, the first synthetic dyes founded by William Henry Perkin has develop the high returns dyeing production opposite with the natural dyeing processes [39]. The synthetic dyes easily accepted and practiced on textile by the dyers manufacturers' due to low operation process, high fabrics durability, bright and various colour outcomes and less time consuming [11,40]. In Malaysia, the influx of synthetic dyes or reactive dyes has been introduced estimated in 1920 for local textile production substitute natural dyeing. In addition, the government at the time encouraged the local textile manufacturing to increase and maximize the heritage crafts work products especially batik to get promoted in the global market [13,41]. Therefore, uncontrollable and untreated wastewater dyes released not support the sustainable environment and gives long-term detrimental. Hence, in this paper, the flow process involves in preparing dyes for batik descriptively explained. It consists three types of dyeing practices which are dyeing with 1) natural resources, 2) Naphthol and 3) Remazol as mention below.

2.4. Natural Dyeing Process

Natural dye derives from the process of using natural resources from surrounding including plants, invertebrates or minerals by involving the extraction and mordanting process applied. Natural resources mostly can be extracted and use to dye the thread and fabrics as keen as the historical colour development in antiquity. Natural dyes usually can be classified into several group of dye derivation which are 1) animal/insects-derived dyes, 2) plants-derived dyes and 3) mineral-derived dyes as descriptively describe in table 1.

Table 1. Natural dyes derivation classification, the sources and colour obtained.

Natural Dyes Derivation	Sources / Materials	Colour Obtained	Reference(s)
1: Animal/Insects-derived Dyes	<i>Hexaplex trunculus</i> / sea snails / Mollusc shells	Purple/Tyrian Purple	[45–50]
	Cochineal insects (<i>Dactylopius coccus</i>) / Kermes (<i>Kermococcus vermilus</i>) / Lac insects (<i>Laccifer lacca Kerr</i>)	Red / Scarlet Red / Crimson Red / pink	[42,51–56]
	Fruits: Areca Catechu	Brown	[57]
	Leaves : <i>Carica papaya L.</i> Leaf : <i>Dracaena angustifolia</i>	Grey – Brown Green	[58]
2: Plants-derived Dyes	Flowers: <i>Clitoria Ternatea</i> Flower	Grey	[59]
	Barks: <i>Syzygium Cumini</i>	Brown	[60]
	Roots: Madder	Red - Brown	[61]
	Fungi/Mushrooms: <i>Trichoderma sp.</i> : <i>Aspergillus sp.</i>	Yellow	[62]
	Rhizome: Turmeric	Yellow	[63]
	3: Mineral-derived Dyes	Mud Dye	Black
Orpiment Dust		Lemon Yellow	[43]
Graphite Dust		Dull Grey	[43]

The flow process of textile dyeing with nature resources illustrated in figure 1 is generally practices in local textile production. The process start with pre-treatment by scouring and bleach the fabrics or thread to remove the remaining impurities and starch using detergent or 20 to 30 minutes soaking in hot

water [67–69]. Then, the difference found in natural dyeing process which is the use of mordant. Mordant can come in eco-friendly solution like myrobalan [71], turmeric, henna [72] or lemon extract [59] orange peel, pomegranate peel, amla powder and harda powder [58] and gradually change to heavy metal mordants like Aluminium Potassium Sulfate, Calcium Acetate, Copper Sulfate, Iron Sulfate, Potassium Dichromate [11,57,73]. The shades of colour stains on textiles also depend on the factors of duration, types and mordanting techniques applied [74].

In material extraction process, some materials firstly are freshly or dried collected from surrounding, washed then undergo the process of grinding or chopping into small pieces before going through into several extraction process that has been practiced by the practitioners. The material can be extracted using hot water aqueous (boiling), cold water aqueous (soaking) and fermentation [75]. The process in local textile production level still practicing mild technologies with simple tools, but they tend to change the materials used as provided by the manufacturer's recommendation. Then, it proceeds to dyeing processes by soaking with the time consuming to get more dye absorption for textiles. Lastly, the fabrics get rinse with tap water and dry in the humid conditions. It is applicable to boil the water and fabrics to remove wax, however in some local practices, natural dyestuff needs for petrol to remove the wax and it is believed to enhance the durability of the fabrics.

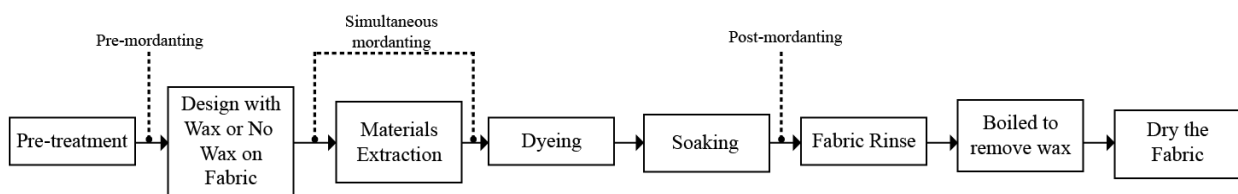


Figure 1. Natural dyeing flow process practiced in local textile.

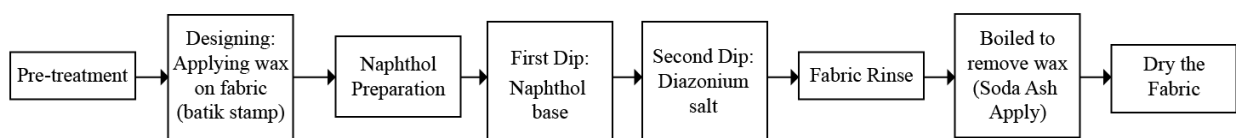
2.5. Naphthol Dyeing Process

Naphthol dyes are synthetic dyes belong to insoluble azo dyestuff. It comes in colourless, white or yellow crystal with a phenolic odour. Naphthol dyes are not 'readymade' dyes but are formed by combining two substances called Naphthol base and Diazonium salt [77]. The process of applying naphthol dyes to colour textile need for extra care because of the hazardous chemical reaction that have been found to be toxic and potentially cause carcinogenic [78,79]. Naphthol is one of the favourite dyestuff for the local textile practitioners due to the advantages provided – can be used in various physical forms, very good in colour fastness properties, excellent reproducibility and economic viability [80].

The naphthol dyeing process as illustrated in figure 2 starts with the fabric treatments where the textiles or fibres got scoured by undergo the washing or boiling process to remove the stains and starch. Then, the designing process allow the practitioners to apply any resist techniques to form the pattern on the fabrics before going through the colouring process. In the phase of naphthol preparation, there are two distinctive substances needs which are 1) Naphthol AS (function as base and used as in the first dip). 2) Diazonium Salt (function as colour determinants and use in the second dip). Fabrics or fibres then rinsed with water to get the excess colours removed. Lastly, if there are wax on the fabrics, boiled the water with soda ash (Sodium Carbonate) to remove wax, then dry the fabrics [82]. Table 2 shows the example of naphthol and salt base combination colour and there are 1500 possible colours produce for 30 different naphthol and 50 bases, however the colour may be repeated, dull shades and also do not have adequate colour fastness properties [77].

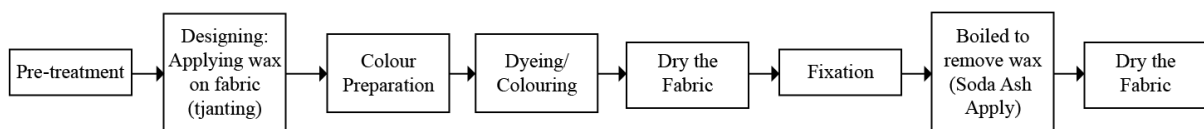
Table 2. Examples of colour obtained from the combination of Naphthol and salt bases [80].

Naphthol/ Salt Base	Colour Obtained					
	AS	AS-G	AS-SW	AS-D	AS-BR	AS-BG
Orange GG	Bright Red	Bright Yellow	Bright Yellowish Red	Yellowish Red	Reddish Brown	Reddish Orange
Violet B	Bright Blue Violet	Reddish Yellow	Dull Reddish Violet	Dull Violet	Dull bordeaux	Bluish Red
Scarlet RC	Bright Red	Yellow	Bright Red	Bright Red	Reddish Orange	Bright Red

**Figure 2.** Naphthol dyeing flow process applied in the local textile production.

2.6. Remazol Dyeing Process

Remazol dyes process or Remazol ® is a brand for reactive dyestuff and has been widely used by the local practitioners in colouring textiles and thread. The process of Remazol dyeing practices in local textile illustrated in figure 3. The process starts with the pre-treatment process by washing the fabrics with detergent or sodium carbonate or water to remove the stains and starch. This process also allowed the dyes to be absorbed efficiently to the fabrics [33]. Then, the designing process by decorating textile surfaces in combining the techniques with wax lead to the local textile known as *'batik retak'* (crack wax techniques), brush stroke techniques and *'teknik guris'* (scratch technique) [82,90]. Colour preparation using Remazol dyes undergo simple mixture where the powder of Remazol can be dissolved in cold, warm or hot water. The colour can be mixed as same as the colour mixing guide. The colouring process happens in humid conditions and need for dry condition to be fixed with sodium silicate. Dye bath with Remazol colouration should undergo fixative process which take 4 to 8 hours to prolong and maintain the colours on fabrics [82]. Textiles then boiled with the soda ash to remove wax and washes for excess colourant water, then dry the fabrics.

**Figure 3.** Remazol dyeing flow process applied in the local textile production.

3. Methodology

PICO tool is used in this study to formulate the research question. PICO developed suitable research question to review based on the four (4) main concepts namely Problem (P), Intervention (I), Context (C) and Outcomes (O). Four main aspects in the review have included namely Uncontrollable materials used in Traditional Textile Dyeing (Problem), Environmental Catalysis Adaption (Intervention), Synthetic Dyeing Practiced for Traditional Dyeing (Context) and Natural Dyes Process (Outcome). Therefore, based on the guide, the main research question for this study formulated – What are the process to be practiced for traditional textile dyeing in adapting with the environmental catalysis? And

in order to review the dyeing process practiced in traditional textiles, it has been discussed accordingly to previous studies and has been listed as mention in results.

4. Analysis and Results

Analysis and result in this study has being discussed towards the dyeing process procedures practiced in local textile productions. Local textile dyeing process is significantly practicing as the local knowledge with mild technologies involved. It has been encouraged the creativity of the practitioners to develop and produce fascinating colours and hues on textiles and thread. There are three (3) types of dyeing process practices by the local practitioners as discussed above which undergo natural dyeing process, naphthol dyeing process and Remazol dyeing process. Textile dyeing process generally not too much changed from prior to current, but the technology involved in enhancing the fabrics durability, colour fastness properties, high reproducibility with low cost rapidly grow due to consumer demand and rivalry in fashion and apparel [91]. Therefore, table 3 briefly summaries the general flow process of textile dyeing and technologies involve undertaken by the local and current textile productions.

The understanding towards the overall process of textile dyeing tend to briefly explain the manipulation subdivisions that possibly can be approached with chemical and non-chemical substances, machineries manufacturing and remediation or treatment involved. Therefore, there are two (2) elements has been identified that can be emphasized for manipulation contributions which are 1) the technology and 2) the materials. The element of technology in textile refer to the production process [100] and it also associated with the knowledge and environment [101]. Meanwhile, the element of materials refers to the substances used either for colouration process or catalyst actions. It is very significant to show that knowledge, skills and techniques has develop the technologies towards easier. It is also undeniable to dispute the technologies, but the combination of prior and current knowledge, skills and techniques may provide the balance approach towards sustainable development and minimize the defection to environment and vicinity.

Table 3. The general flow of textile dyeing process along with the technologies involved.

Flow Process / Types of Dyeing Process	Technologies Involved					
	Fabric Pre-treatment	Designing on Fabrics / Fibres	Colour Preparation	Dyeing/ Colouring	Fixation	Finishing
Natural Dyeing	Wash using Water / non-ionic detergent	Stamping / tjanting / tie and dye / thread colouring / plain background colouring	: Aqueous extraction [102] : Fermentation [42] : Spray-drying : Freeze-dried : Sonicator : Soxhlet	: Soaking : Gamma-rays : Ultrasound	: Pre-mordanting : Meta-mordanting : Post-mordanting	: Rinse, boil and dry.
Remazol Dyeing	Wash using Water /detergent	Stamping / tjanting / tie and dye / silk screen printing	: Aqueous	: Colouring : Dipping	: Fixative agent (sodium silicate)	: Rinse, boil and dry.

Naphthol Dyeing	Wash using Water /detergent	Stamping	: Aqueous	: Colouring : Dipping	-	: Rinse, boil and dry.
Mill Process	Enzymatic scouring / Sizing/Desizing/ Scouring/Washing/ bleaching/ Mercerizing	:Digital printing	: Aqueous	:Loose-stock for fibres. :Hank for yarns :Jigger/ winch /jet / beam for fabrics. :Rotary drum for garments. [98]	Steamer/ batch steamer /continuous steamer / double-spiral steamer etc.	Calendering/ compacting / sueding / softening/ water-repellent finishes etc.

5. Discussion

Table 4 shows the summary of relatable items between sustainable development, issues on local textile dyeing and its strategy by emerging the perspective of cultural form. Cultural form defines as the idea generated by the society as their actions and activities practiced. Therefore, it can be extracted to three (3) cultural form which ideas, actions and artefact [104]. Cultural forms not only guide to build the cultural element but being considered as solutions thought in the current matters. The discussion of those elements briefly explained in this discussion.

Table 4. Summary on the relatable issues of sustainable development and cultural form to give an idea towards stabilizing and retain the textile local dyeing and environment safety.

Sustainable Development	Issues related to the study		Cultural Form
	Textile Dyeing	Sustainable Strategy	
Economy	: Preservation	: Awareness	Idea
Social	: Environmental causes : Local knowledge	: Implementation	Action
Environment	: Natural Dyeing	: Eco-effectiveness with intervention of environmental catalysis	Artefact

Firstly, sustainable issues towards textile dyeing practices has been discussed related to the preservations of cultural heritage (local textile dyeing process) and environmental safety. It becomes a big concern to the world nowadays because of maintaining both precious given from the society and nature. They provide ample advantages further through recognition as cultural identity, authenticity, dignity and in advance taking care the vicinity. In cultural form point of idea – idea refers to the ability of mind to think creatively in solving the problems. Therefore, the idea of preserving local textile dyeing process and environment leads to expand the economic opportunity.

Secondly, the cultural form that explain about the action interpreted as – from the idea of creating awareness through economic demand, there is the action of acceptance among the societies. Action closely relates to society, whereby every activity, every commonality and customs contribute to the cultural development in the societies. After the idea of recognizing awareness towards the environmental caused by the uncontrollable process in local textile dyeing process, the implementation to the societies will change the perception, mind setting and firmly towards the action in experiencing the sustainable issues.

Lastly, the emergence of ideas and actions create solution through the artefact (either in the form of products, process or practices). It can be visualized into tangible or intangible form of heritage contribution. Therefore, in this discussion context, sustainable development and heritage preservation are giving a holistic perception with the cultural forms' preferences. Natural dyeing process, either

practiced accordingly to traditional technology or current machinery technologies, provides better environmental solution by having intervention with environmental catalysis and it is parallel with the principle concept of sustainable development.

6. Conclusion

As a conclusion, resurgence the natural dyeing process practiced in local textile production give positive effort towards approaching and giving awareness on sustainability. Besides, minimizing the consequences relates to dyeing process become the main priority instead of focusing only for the economic growth. The influx of various dyeing substances and intention to explores new materials has led to the creative ideas which one has been visualized into textiles. However, due to high demand and uncontrollable productions, chemical substance has replaced and immerse into the process without concerning the long-time consequences. Therefore, re-conduct the local practice not only resurgence the precious local knowledge, but gives an affirmative sight towards developing identity through local knowledge, skill and technology practiced. In this paper, there are two (2) significant point highlighted which are process and materials (which refer as technology) used in textile dyeing. The implication towards the practices by using natural dyes with intervention with environmental catalysis in textile colouration leads to eco-effectiveness practices and drive the awareness towards sustainable development.

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