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The Development of Surface Textile Design Techniques Based on the Use of Easy-to-access Materials and Tools
(Developing Marbling Techniques on Fabric)

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Abstract

In the creative economy, the fashion sector is ranked 2nd after culinary in the economic contribution of the Republic of Indonesia and is ranked first in export contribution. This creativity and innovation-based economy opens opportunities to develop competitive Indonesian products. Competing in mass fashion lines with China, Vietnam, and Bangladesh is not wise because they have cheap labour costs and a robust system to manage these fashion lines. The marbling technique, widely known before the 15th century, has great potential in the textile and fashion industry. This technique was initially applied to paper as a medium, with specific tools and materials, grew and developed in West Asia, spread to various European countries, and underwent adaptations of tools and materials. Marbling techniques on textiles are now widely carried out by artists. Even though several big brands have issued marbling kits, the difficulty of accessing them is an obstacle if we want to practice them in Indonesia. Based on this, the author looks for alternative tools and local raw materials that can be applied to textiles using marbling techniques, experimental methods, literature approaches, and historical studies. Tapioca flour is the most suitable local raw material as a thickening medium and an ingredient for colouring in screen printing techniques as a colouring agent in marbling techniques. Meanwhile, the tools used in this engineering practice are simple tools commonly found in domestic environments. Local raw materials and equipment at affordable prices have good potential for small to medium textile industry players. This development can ultimately be justified as a process of cultural evolution manifested in the development of textile processing, which is driven by economic and technological motives.

Keywords: marbling technique, textile, surface textile design, easy-to-access tools and material.

1. Introduction

Of the various existing textile production techniques, the marbling technique has enormous development potential because it has yet to be popular in society, and many developments have been carried out (Hendrawan, 2017). The marbling technique, or ebru, is a Persian paper decorating technique whose basic principle is to form motifs by playing with dye floating on the surface of a liquid (Wolfe, 1990). Based on the author's observations, there are variations in the basic materials, tools, and methods used in the marbling technique. The choice of primary materials is closely related to place (country), time, environment, and culture. Currently, the application of this technique is broader than just being used as decorative art on paper or book covers.

Figure 1.1 Placard pattern (marbling on paper)

(source: University of Washington Libraries).

In its current development, the marbling technique has begun to be applied to textile materials, as can be seen from the emergence of artists or crafters who apply this technique, especially from the West, with various adjustments to materials and procedures. Apart from the tremendous potential, if the textile marbling technique follows existing procedures and is linked to the environmental conditions of residents in Indonesia, the author finds several obstacles to be faced. These obstacles include the minimal availability of data regarding marbling techniques on textile materials, which needs to be improved; most of the data regarding marbling techniques currently available is for paper materials. It has yet to be tested for success in terms of visuals or strength when applied to textile materials. Mainly if used for fashion materials that must be washable. The second is the availability of materials in traditional marbling techniques; the material used for thickening or making gel is gum tragacanth, a sap obtained from the stem of a thorny plant called Gaven. The Gaven plant grows naturally in the regions of Persia and Türkiye. Apart from being challenging to find, preparing a solution from tragacanth sap has proven to be a severe problem. The thickener most widely used for marbling techniques is carrageenan, but this material is also difficult to find in Indonesia.

Moreover, even if there is, the price is relatively high, around Rp. 350,000/kg. Third is environmental conditions, where the mineral content in groundwater is relatively high. This condition affects the success rate of the marbling technique because the dye will sink in a liquid or size that contains high minerals. Therefore, the water used to make gel must be water that has undergone distillation. It becomes an obstacle when producing large-sized marbling because it also requires high costs to obtain marbling water. Several art and craft supply brands have exploited the potential of this marbling technique phenomenon in several countries. These brands include Marabu from Germany, Pebeo from France, Suminagashi from Japan, Decoart, and Jacquard from the USA. They do this to accommodate the needs of marbling crafters, with a secret formula for each brand, offering practicality and quality that meets the visual character and principles of marbling techniques. However, this technique in Indonesia is exclusive, considering that to access these kits, you must import them from the provider country, which has relatively high prices and shipping costs.

Figure 1 Pebeo brand marbling kits for fabric

(source: https://en.pebeo.com)

The picture above is a marbling kit released by the Pebeo brand from France, which is priced at USD.60.82 or the equivalent of IDR.986077.70, excluding shipping costs and taxes. This price is relatively high for the general public in Indonesia, making it an exclusive item. Contents of the collection box: 10 x 45 ml bottles (dropper nozzle for optimal dosage) assorted colours: White, Lemon Yellow, Vermilion, Bengal Pink, Ultramarine Blue, Cyan, Emerald Green, Sienna, Black), Marbling bath, ten rolled diffusion paper sheets, ten sticks, 1 x 50-page booklet with creative ideas for projects and workshops. Kits do not include a liquid thickener as a medium for floating the dye before forming a motif pattern. Another tool on the market is a marbling comb, which can produce the effect of a bird's scale or feather pattern, as shown in the image below.

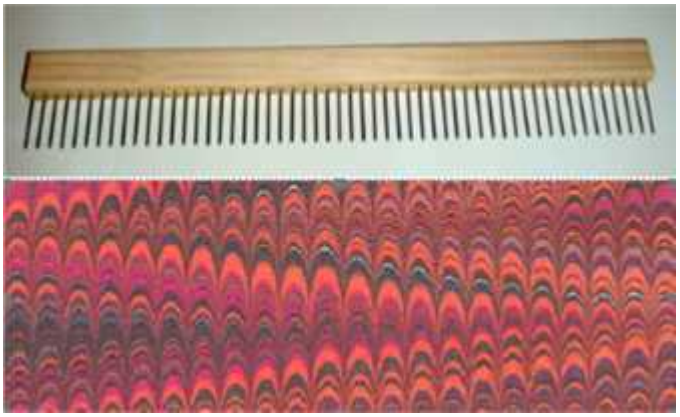

Figure 2 standard marbling comb

(source: www.marbleart.us)

Technology and innovation elements have become logical consequences and solutions to the problems above in its development. This study attempts to see the shifts in terms of technique and medium in textile processing using marbling techniques. The experiments are mainly related to finding local raw materials that can be used with approximately the same level of effectiveness as the raw materials that should be used. It is prioritized to reduce production costs when applying marbling techniques in small to medium industrial centres. The great potential of applying this technique to textile materials can enrich creativity, finding new motifs and visuals from the textile industry in Indonesia.

The vital material for marbling techniques is the size/the thick liquid as a mediator. The size functions as a dye medium to float on it, shape it into the desired motif, and then transfer the motif that has been formed onto the fabric. The basic materials used for the size in the marbling technique are diverse. However, in this experiment, the author used tapioca, also known as kanji, as an alternative local material that is easy to obtain and cheap. There are challenges related to its practice in Indonesia, especially the availability of information and data regarding the technique and limited access to tools and materials. Currently, the high cost of importing marbling kits from the provider country has created a significant barrier, limiting access to only a few. To address this issue, a study and development of this technique, involving science, is a logical solution. This writing aims to explore the shifts in technique and medium in textile processing using marbling techniques, as well as to understand the principles and workings of this technique. The results of the analysis of these data became the basis for the experiments carried out, especially in finding raw materials and simple local tools that were easy to access. Another goal is to achieve production efficiency in the application of marbling techniques, making them a viable alternative for small to medium industries. It is hoped that the potential of applying this technique to textile materials can significantly enrich creativity, leading to the discovery of new motifs and visuals in the Indonesian textile industry.

This creativity and innovation-based economy opens opportunities to develop competitive Indonesian products. Competing in mass fashion lines with China, Vietnam, and Bangladesh is not wise because they have cheap labour costs and a robust system designed to manage these fashion lines (Ministry of Trade of the Republic of Indonesia, 2017). Moreover, the fashion sector is ranked 2nd after culinary, the most significant contributor to the creative economy. Meanwhile, the contribution of exports, fashion with 56% and crafts with 37%, are far superior to other subsects (Culture Creative Foundation, 2021). Developing marbling techniques on textiles with local and easy-to-access tools and materials will enrich surface-textile design techniques, which can be applied to various textile and fashion products. It will have a positive impact on practitioners working in the creative industry (mainly textiles and fashion), for fashion enthusiasts, as well as for the country through contributions to the creative economy.

2. Methodology

This study uses a qualitative methodology with an experimental approach on several local materials, and the effects of their use are tested using marbling techniques on textile media. Some of these local materials are tapioca flour as a thickener, colour pigments for screen printing techniques as dyes, and binder GL as a fixator for colouring. The qualitative method is applied mainly in collecting data from experimental results to obtain a formula suitable for the material composition of dyes and thickeners as media mediators for these dyes. As part of this study, a literature review and historical analysis were conducted to understand the evolution of techniques and mediums in creating marbling motifs. The literature review was achieved by reviewing articles and similar previous studies, providing a valuable context for the experimental findings.

3. Results and discussion

History and Shifts in Textile Marbling Materials and Techniques

The marbling technique, a decorative art synonymous with Middle Eastern countries, has a mysterious origin. While it is unclear when and where the art of marbling was born, Persian sources suggest it first appeared in India. From India, it journeyed to Persia, and then to the Ottomans. Other sources claim the art of marbling was born in the city of Bukhara in Turkestan. In the West, 'Ebru' is known as 'Turkish paper.' This technique was dubbed 'marbling' by Europeans who, upon seeing the intricate patterns, likened them to marble. The Persians originally called it 'Ebru', meaning cloud art, in the 15th century. Ebru, in turn, is interpreted as a motif of waves or coloured waves on paper. Most scholars believe that marbling originated in Persia in the 1400s. The identity of the technique's creator remains a mystery. The story of its creation is thought to be a stroke of luck. The inventor noticed that paint was floating on water, sparking the inspiration to try a technique called marbling. The original formula for the first marbling has been lost to time. However, the process spread from city to city, from Turkey to Spain, Italy, France, and other European regions. Each city adapted the technique, replacing materials and recipes to suit their local ingredients.

This marbling technique is prevalent in the Middle East, where most are Muslims. The fine arts of Muslim societies have a solid ornamental feel (usually floral), whereas European societies are prevalent for their realist fine art expressions. Because Islamic teachings prohibit drawing humans and animals, the fine arts popular in society are calligraphy, illumination, and ornamental art. The marbling technique is no exception. This marbling technique was also used in China during the Ming Dynasty, which then developed in Japan. In the Japanese craft tradition, there is a technique called 'suminagashi.' *Sumi* means ink, while *nagashi* means floating. Apart from decorating books, the suminagashi technique is also used to wrap gifts or furoshiki.

In the 18th century, there was a general interest in marbling. This technique is applied to decorative paper used in bookbinding. The British were credited with spreading this marbling technique, as they had published several books on the marbling process, which had previously been kept under wraps. The British initially became acquainted with this marbling technique when traveling to the Middle East and then documented and published it. It is known that George Sandys, who, in 1610, made a note of the existence of patterned paper in Türkiye. Sir Thomas Herbert also mentioned the existence of these papers in his travel notes to Persia in 1627-1629. The most popular book on marbling techniques was written by Charles Woolnough, a marbling artist from England, who published his book, The Art of Marbling, in 1853. Over the centuries, this art has been utilized in various forms; the Turks used it as an element of figurative art. They lay down cut paper stencils or media blocks, then marble different areas with human and animal figures. They also use a marbling pattern for the border frame. The development of the art of marbling cannot be separated from making manuscripts or manuscripts. Ebru paper manufacturers produce and supply it for official documents or artistic needs. The popularity and rapid growth of the ebru paper business industry has finally given rise to many famous marbling artists. They experimented with marbling techniques and then discovered motif after motif until they became so complex. The most popular and first known marbling artist was "Sebak," recorded in the "Tertib-i Risale-i Ebri," the oldest manuscript or document regarding marbling. Apart from Sebak, a marbling artist also popular at that time was Hatip Mehmed Effendi, who was considered to have a very distinctive style in his marbling work. Apart from being a marbling artist, he was a preacher at the Aya Sofya Mosque in Istanbul.

As time progressed, marbling paper began to be replaced by industrial paper from Europe, which was much more economical and practical. However, this eastern craft is still maintained and fought for. One of the popular ones is Mustafa Duzgunman, an influential marbling tradition figure who passes on and spreads it. Marbling paper was 'brought' to Europe around the 16th and 17th centuries, and the business began to develop in Germany and France and then spread to other European countries. The principle of the marbling technique can be said to be the same: the paint is made to float on the surface of water or gel, then the paint is formed into a motif according to the design we want and then transferred to paper material (Wolfe, 1990). Size (a thick liquid as a mediator) and dye are essential materials for marbling techniques. The size functions as a dye medium to float on it, shape it into the desired motif, and then transfer the motif that has been formed onto the fabric. Based on the materials and techniques used, the author classifies marbling techniques into two, which also mark the shift that occurs, namely:

a Traditional Marbling

Traditional marbling refers to the writings of Diane Maurer-Mathison 1999 in her book entitled The Ultimate Marbling Handbook: A Guide to Basic and Advanced Techniques for Marbling Paper and Fabric; it is marbling using methods and materials that are estimated or close to the original ingredients of the era. Formerly, this concoction is still widely used by artists in the Middle East, where this technique originated. In traditional marbling techniques, the materials used include gum tragacanth, a sap obtained from the stem of a thorny plant called gaven. The gaven plant grows naturally in the regions of Persia and Türkiye. Gum tragacanth is an essential recipe in traditional marbling. However, preparing a solution from tragacanth sap has proven a serious problem, and artists often fail to achieve good quality Turkish Ebru. Differences in location, weather, and water also influence the success of traditional marbling techniques. It causes the marbling technique to be called a "mysterious technique" and "like magic." Another "mandatory" recipe in traditional marbling is ox gall as a colouring mixture. Adding ox gall controls the colour on the water's surface and prevents colours from mixing (Wolfe, 1990).

b Alternative Marbling

According to Mathison, alternative marbling techniques are marbling techniques that have undergone developments and adjustments both in the materials used and, in the processes, carried out. Traditional marbling techniques have been proven to have their problems if carried out outside their "habitat." Apart from the availability of materials, differences in the chemical content of water are a factor in whether the technique is successful. Marbling artists in other countries are looking for substitute materials that suit the conditions in their countries. In this way, the marbling technique has undergone adjustments and developments over time. In alternative marbling techniques often used by marbling artists today, carrageenan is commonly used as a gel-making ingredient. However, other ingredients were also used to make this gel in the past, such as badderlock, which was widely used in Europe in the 19th century. The water used is distilled water because the mineral content in the water affects the success of this technique. The high mineral content means the dye does not float on the surface of the liquid. Meanwhile, the dye most marbling artists use today is acrylic paint (Tozun & Uzunca, 2015). Current artists and writers on marbling techniques, such as Ahmet Saral and Gelen Berry, have studied this technique to create various development materials and tools to support it. For example, Gallen Berry created a synthetic marbling gall substitute for cow gall. He also modified the tools that support this technique and commercialized his discoveries.

Table 1 Comparison between traditional and alternative marbling

		Traditional Marbling	**Alternative Marbling**
	Materials		
Water		Natural fresh water	Distilled water
Liquid thickener (for size)		Gum Traganacant	Badderlock, Irish Moss, Carrageenan.
Dyes		Vegan dyes/ochre, mineral dyes	Acrylic paint
Dyes additive		Ox gall	-
Mordant		Alum	Alum
	Applications		
		On paper as aesthetic element (artwork) or book binder	) On paper as aesthetic element (artwork) or book binder Pada tekstil) On fabric as fashion material

The table above shows a comparison of materials and their applications between modern marbling techniques and alternative marbling techniques. The general interest in this technique, which spread from West Asia to Europe, with all its limitations, to achieve the principles of the marbling technique, caused various shifts, especially in terms of materials. By understanding the principles of marbling techniques, they adapt materials with similar characteristics that are commonly found where marbling is practiced.

Marbling Technique Experiment Based on Materials that are Easily Accessible in Indonesia

The main principle of the marbling technique is to make the dye float on a thick liquid (size), form a motif pattern using a stick or comb, then transfer it to paper or cloth. Based on the previous explanation regarding marbling techniques, the author adjusted along with the use of tools and materials so that they are easily accessible and can be done by the general public because they are relatively cheap and commonly found. The materials used in this experiment are:

I Tapioca flour as a liquid thickener (size maker),
II Acrylic pigment (usually used for rubber paste colouring in screen printing techniques),
III Binder GL (usually used to reduce the viscosity of rubber paste), which functions as a fixator/colour binder on fabric,
IV Mineral water.

Apart from materials, the author also adjusted tools, including:

I Pan to make sizing (boil the tapioca flour solution until thickened),
II Spatula to stir the tapioca solution until it thickens,
III Plastic tray as container size/dye bath,
IV Plastic bottles with sharp mouths as dye containers,
V Skewer sticks to form motif patterns,
VI Fork comb (optional) to form a motif pattern,
VII Wiper/mop to clean the remaining size that sticks to the fabric's surface.

Figure 3 (left to right) pointed mouth bottle, plastic tray, and wiper

The author will apply this marbling technique to Mori cotton fabric - Primissima 135 gsm. The steps for this experiment are as follows:

I Prepare dye with the composition: 100 mL mineral water + 10 mL GL binder + acrylic pigment (amount depends on the desired colour intensity).

II Prepare the size (thick liquid), a vital element that functions as a medium for the dye to float and form a motif pattern. In 1 L of water, the author tried four tapioca flour compositions, 50 gr, 75 gr, 100 gr, and 125 gr, to get the most suitable viscosity. The way to make this measure is to add a tapioca flour solution (comparison composition as explained previously) to boiling water over low heat, then stir it until the liquid thickens and turns clear from white.

III Using a skewer and/or fork comb, form a motif pattern on a plastic tray (bath dye) that already contains the measurements.

Figure 4 Motif pattern making on the size surface.

(source: personal documentary)

IV Transfer the motif to the fabric medium by placing the fabric on a surface with a motif pattern.

Figure 5 Putting fabric on the patterned size surface.

(source: personal documentary)

V Clean the remaining size and dirt that sticks to the cloth using a rack and dry.

Figure 6 Dirt removing

(source: personal documentary)

VI Drying and washing using detergent.

VII

Composition Comparison of Water and Tapioca Flour (In Making Sizes) On Colouring Results

Size is a vital element in marbling techniques that determines success in practice. Material shifts have occurred in various places according to the availability of materials. Even if the original ingredient for gum tragacanth thickener is used in other places outside its habitat, the level of success cannot be ascertained, because the composition of the water content is different. This underscores the importance of the water content's composition in marbling techniques. By analysing the principles of marbling techniques, and understanding the function of size, the author replaced it with a common and cheap material, which has the property of thickening liquids, namely tapioca flour. There are 4 ingredient compositions that have undergone a thorough testing and comparison process to obtain the appropriate viscosity. We can see this comparison in the table below:

Table 2 Composition comparison of water and tapioca flour (in making sizes) on colouring results

No.	Composition	Result	Analysis
1	1 L water + 50 gr tapioca		The size is too dilute, causing the dye to sink, making the motif's definition unclear.
2	1 L water + 75 gr tapioca		The size is still too runny, and the dye only sticks to the surface of the fabric. Fading occurs after washing, causing the dye to sink, so the definition of the motif is not clear. .
3	1 L water + 100 gr tapioca		On the other hand, the ideal viscosity size allows for well-formed patterns, prevents dye sinking, and ensures the dye sticks to the fabric fibres, thereby preventing fading and maintaining clear motifs.
4	1 L water + 125 gr tapioca		The size is too thick and sticky, so forming motifs using a stick is difficult. The colour clumps on the surface of the size, causing bleeding, which makes the motif's definition less clear.

The experiments have led us to a suitable dye composition for the textile marbling technique. This composition, which includes 10 mL of binder GL / 100 mL of mineral water, allows for a pigment mixture that can be adjusted to achieve the desired colour intensity. The amount of GL binder is sufficient to lock the dye in the fabric fibres, preventing fading without making the fabric stiff. This is because the main ingredient of GL binder is rubber latex, and an excessive dosage would indeed make the fabric stiff. Meanwhile, the composition of the ratio of tapioca flour to water, which is 125 grams of tapioca / 1 L of water, ensures an ideal viscosity size. This allows the pattern to be formed well and keeps the dye from sinking, ensuring that the dye sticks to the fabric fibres and the motif is formed well.

4. Conclusions

Based on initial experiments on marbling techniques on textiles involving adapting materials and tools that are easily accessible to the general public at affordable prices, this can be done. With simple tools commonly found in domestic environments, such as skewers, plastic trays, dye baths, plastic bottles with sharp ends, and tapioca flour used as a

thickener, we can accommodate the needs to achieve the principles of marbling techniques. Ease of access to tools and materials, relatively easy working techniques, and a workplace that does not require a specific lab will make it easier for the general public to practice. This technique can be an alternative in surface textile design applied to various textile and fashion products to face the creative industrial era, where ideas, creativity, and product innovation are the spearheads.

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