Finding Effective Ink Receiver Ingredient in Image Creation on Aluminum Plate to Replace Red Lacquer in Lithograph Process

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Abstract
Printmaking is an important process in Thailand, as required by many universities' curriculums as well as Thai artists. Lithograph is rather popular among printmaking techniques. Its process is mainly utilized chemical reaction, however some chemicals are rare, then needed to be imported from foreign countries. The problem are led to "Finding effective ink receiver ingredient in image creation on aluminum plate to replace red lacquer in lithograph process". Red lacquer is required by lithograph process as it is intermediate ink receiver but it is not produced in Thailand. The objectives of this research are included 1) Study ink receiving ingredients that are cheap and available within Thailand through the experiment. 2) Searching for chemicals that are lease affect health hazard. The research method is incorporated with 1) Reviewing information regarding wax or greasy components in Thailand. 2) Experimenting with black varnish and wax ingredients, as black varnish is the main component due to it is easily found and cheap in Thailand. Melting soy wax, Vaseline, and micro wax altogether by heating, then mixing with turpentine and wiping the plate afterwards as for replacing red lacquer. The results of this research showed that black varnish mixing with soy wax worked best. The 2:1 ratio makes appropriated grease that helps completed line contour and value. Moreover, it is easily washable and its smell is less than red lacquer's. Findings suggested that its qualities and effectiveness of being replacing red lacquer are the new aspects that benefits printmaking learning and creation in Thailand.

Keywords: Lithograph, Red lacquer, black varnish

Introduction

1. Rationale

In today's world, varieties of artwork creation techniques and presentation are available, for example, painting, sculpture, printmaking, and installation. Printmaking is one of the important creation processes in Thailand as it is designated in all universities' curriculum and there are many Thai artists working in this printmaking channel. Printmaking exhibitions have also been arranged on a regular basis. There are many printmaking techniques, for example, etching, lithograph, screenprint, and woodcut. One of the very popular technique in Thailand is lithograph.

Lithograph is classified as planography printmaking due to the planar surface of the block, which is different from the blocks created from other techniques. Lithograph block is made of limestone, zinc plate, or aluminum plate, and drawn by greasy material. Printmaking process is based on the immiscibility between water and grease. After being drawn, the block is then etched with acid under chemical reaction. Various chemicals are required for block making. However, due to the scarcity of chemicals, they need to be imported from overseas. The limitations of learning, teaching, and creating lithograph prints are therefore relatively high.

Red lacquer is one of the chemicals required for lithograph printmaking. It is a media for receiving ink, however, it has not yet been produced in Thailand. It also has a strong volatile odor and has some health impacts. For these reasons, this project aims to do a research for the ingredients of ink receiving solution to replace the red lacquer. Such ingredients should be common in Thailand, having the least health effects, however, maintaining the efficiency for image creation on aluminum plate, and has comparable qualities as the red lacquer imported from overseas. Such findings would enhance the knowledge development of lithograph printmaking creation, and achieve a more efficient learning and teaching potential in Thailand.

2. Objectives of the Research Project

2.1 To search for local ingredients and experiment on replacing red lacquer with such ingredients as ink receiving solution in lithograph process.
2.2 To minimize the import of chemicals that are hard to find and expensive.
2.3 To enhance knowledge development of printmaking learning, teaching, and creation in Thailand.

3. Boundary of the Research Project

3.1 This project studies the ink receiving ingredients that are available in Thailand and can replace red lacquer in producing an image on aluminum plate in lithograph process efficiently.
3.2 The study searches for the ink receiving ingredients that have the least health impacts.
3.3 The ink receiving ingredients can be practically used to create lithograph prints.

4. Relevant Concepts and Theories

4.1 Research Concept

The aim of this project is to conduct a research and study for the ink receiving agent that composes of local ingredients found in Thailand, and such chemicals should have the least health impacts. At the same time, these ink receiving ingredients must be able to create image on aluminum plate efficiently and can replace red lacquer in lithograph process. For these reasons, the concept of this research has been established.

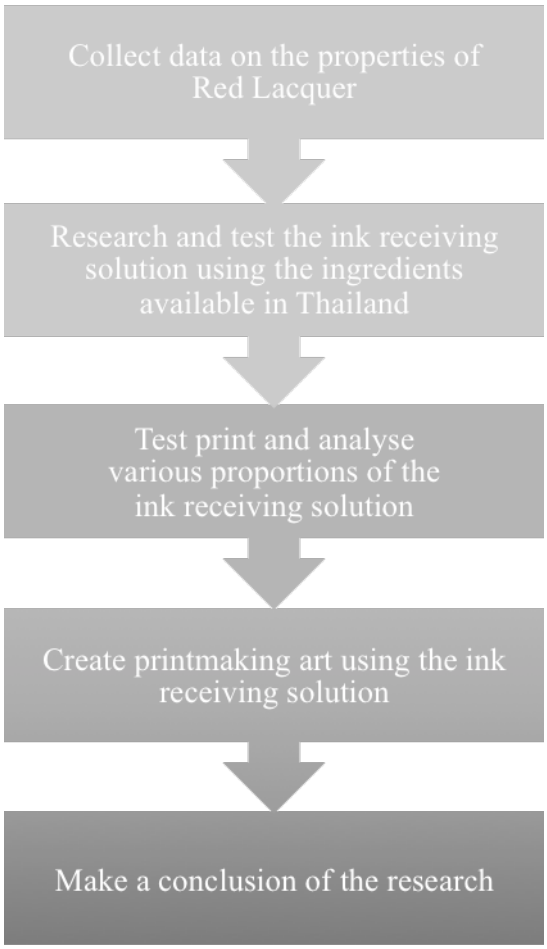

Figure 1: Concept of the Research

4.2 Relevant Theories to the Research

Lithograph Printmaking Process

The word LITHOGRAPH is derived from "LITHO" in Greek language meaning stone, while GRAPHE IN means drawing image. In late 1800s, Lithograph process was found by German artist, Alois Senefelder. He created a block using the limestone from Shonhofen in Bavaria, where the best quality limestone for making lithograph block was quarried**Error! Bookmark not defined.**. Today, lithograph prints can be made from 2 types of blocks including lime stone block and aluminum plate or zinc plate. Aluminum and zinc plates were found and replaced limestone in 1900s. The advantages of these blocks are their light weight, low in cost, and can be moved conveniently in case of large block. Printing technique is based mainly on chemical reactions. An image is drawn on aluminum plate using greasy materials eg litho-pencil, litho-crayon, stick tusche, or other materials containing grease. Before the grease drawn block is ready for multiple printing, the image must be created using chemicals. This step is called etching. The mixture of arabic gum, nitric acid, and phosphoric acid in

appropriate proportions is applied to the drawn block for an appropriate period of time in order to create a block which has weights and details as required. After etching, black soot in greasy material is removed, leaving only the grease coated on the block surface. This remaining grease is the media for receiving the printing ink. The grease is then removed with turpentine and thinner, leaving only a thin layer of grease on the block. The block is stroked with soft cloth dipping in red lacquer (as a media to receive the ink roller) in circular motion rapidly in order to fix the thinnest layer of chemicals on the block. The block is then wiped with soft cloth dipping in printing ink. With water soaked sponge, glue gunk, red lacquer, and excess ink are removed. The ink is then applied using roller to start the printing step. When moisten the block with water sponge, the water is retained in porous surface of the block. During ink rolling onto the plate surface of the block, the ink from the roller would stick to the grease drawn image on the plate surface, but not attach to the water bearing surface due to natural property of ink that the oil based ink would stick to the grease, but not the water. When placing the paper onto the block, and press with pressing machine with steady vertical force, the ink from the block would be transferred to the paper, creating the desired image.

From the above lithograph plate making process, it can be seen that various chemicals have been used to generate chemical reaction for image creation and receiving ink. This research focuses on red lacquer because currently, red lacquer is difficult to purchase and it is not domestically produced in Thailand. The import of such red lacquer makes it expensive for the study of printmaking. It also has strong chemical odor during operation.

4.3 Relevant Researches

In searching for ink receiving solution that has similar efficiency as red lacquer, we need to find the properties of the red lacquer used on aluminum plate in lithograph printmaking. Currently, there are 2 types of red lacquer including Eggen Lacquer (produced by Eggen) and Deep Etch Lacquer (produced by Pacific Chemical Co., Ltd.). The red lacquer used in Thailand is Fettgrund S produced by Hanns Eggen GmbH in Germany. Properties of the red lacquer are gathered from published books, documents, and research articles as provided below.

The book “The Complete Printmaker” by Ross, John published in 1972 indicates that varnishing red lacquer on aluminum plate helps extend the life of plate. The plate is more durable and can be used for multiple printing.

“Printmaking” in 2002 by Musashino Art University Printmaking Laboratory provides the properties of red lacquer that it strengthens the grease lines drawn on aluminum plate so that it is more durable for ink reception. The red lacquer varnished on plate is a thin film that enhances the details and the lines to be acid tolerated, the grease drawn details are more distinct, and it prevents the loss or expansion of line details.

In addition, the book “LITHOGRAPH” written by Kanya Charoensupakul in 2007 provides the properties of red lacquer that it is a chemical that builds the image on the base layer. It is a media for the grease drawn on the plate after acid etching to receive the ink from the roller as it helps increase the adherence between ink and plate.

From the books and articles relating to red lacquer in lithograph on aluminum plate, the properties of red lacquer are summarized as it helps strengthen the plate and enhance ink receiving capacity of the plate. The grease drawn lines is coated with red lacquer, making the

plate better for ink reception. Details and fine lines in particular would be more distinct and durable for multiple printing. Generally, the red lacquer is thinly coated as film all over plate surface. After let dry for a while, the plate is cleaned with water sponge. Red lacquer on the area without grease will fall off because it adheres only to the grease drawn area after acid etching. In addition, one of the components of red lacquer is volatile materials, water insoluble but soluble in thinner, which is hazardous to human health. It must be used carefully ie. only a thin layer of red lacquer must be rapidly applied in a well ventilated area. During the artwork creation of the researcher, it is found that red lacquer could be a media to transfer the ink from roller to plate. However, after applying red lacquer onto the plate, it must be wiped off rapidly because it contains volatile material so that it could dry off very fast and accumulated on the plate, thus cannot be washed off and could damage the plate. If the surface of aluminum plate is too fine, red lacquer might not be washed off at all. In addition, inhalation of the strong odor of red lacquer during usage could affect the health in a long run.

5. Research Method, Equipment, and Procedure

In the research "Finding effective ink receiver ingredient in image creation on aluminum plate to replace red lacquer in lithograph process", the author conducted a study, collecting data, and reviewed documents and research papers in relevant to the properties of red lacquer, both advantages and disadvantages. The objectives are to find raw materials and mixture that have comparable properties to red lacquer, and must be available in Thailand. The mixture that is an ink receiving media must have the following properties.

1) It helps increase the grease content of the image drawn with grease material on the plate.
2) It can be washed off by water and does not damage the plate.
3) It strengthens the plate and therefore can be used for multiple printing.
4) It does not have too strong chemical odor.
5) It's ingredients must be easily purchased in Thailand.

From the above properties, research procedure was set as follows.

5.1 From the study and data collection, wax or greasy chemicals that are available in Thailand include:

5.1.1 Soy Wax is the wax derived from the soy used for candle production. It is made of 100% natural materials; does not produce toxic smoke; can be easily wiped off without residue to damage surface; does not have odor; has low melting ability ie approximately 40-60 degrees, therefore, it is economical and contains no toxic substance.	 Figure 2: Soy Wax

5.1.2 Micro Wax or Microcrystalline Wax is the ingredient that makes candle resilient, not brittle; no odor; having more silky texture than other natural waxes due to the fact that microcrystalline wax is made of mineral, while other waxes are made of plant or animals (beeswax made from bees, while candellila wax and carnauba wax are made from plants).	 Figure 3: Micro Wax
5.1.3 Vaseline is petroleum jelly. It is a composition of natural grease and mineral oil. It is lightweight and transparent; no odor. It has the properties to coat the skin, contain moisture, restore the skin and relieve dryness.	 Figure 4: Vaseline
5.1.4 Black varnish is another greasy ingredient. It is a varnish mixture of oil extract and surface coating resin. Black varnish is appropriate for coating wood surface. It is tolerant to heat, strike, and acid-base chemicals. It has slight smell. From the mentioned properties, black varnish is therefore used as a main ingredient of ink receiving solution. In addition, it can be easily purchased in Thailand and not expensive.	 Figure 5: Black Varnish

5.2 In the search for greasy raw materials to be tested as an ingredient of ink receiving solution, the requirements are:

1) The raw materials must be purchased in Thailand, and the cost is not too high for teaching purpose.
2) The raw materials must have the least odor to prevent health impact in a long run.

From the requirements of ingredients searching for making ink receiving solution, 4 raw materials have been identified including black varnish, soy wax, micro wax, and vaseline. Black varnish, with its lacquer-like property ie being acid-base tolerant surface coating, easily be purchased, inexpensive, and available in Thailand, is therefore used as the main ingredient. It is mixed with soy wax, Vaseline, and micro wax and melted together with heat.

Figure 6: Melting equipment

5.2.1 Results of heat melting mixture of raw materials

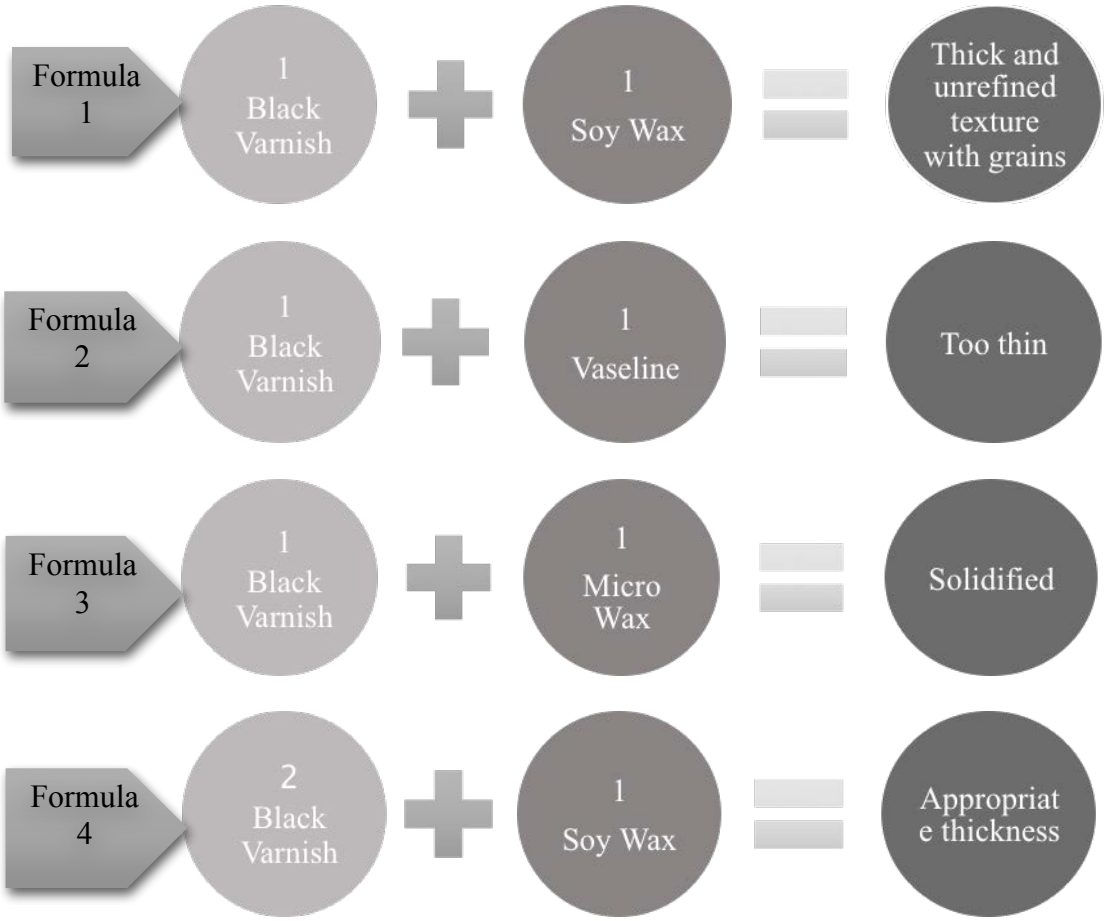

Figure 7: Raw material ingredients in 4 formulae

From the experiment of ingredients mixing as provided above, the results can be explained below.

Formula 1: Black varnish mixed with soy wax at 1:1 ratio
After heat melting, the resultant ink receiving solution was too thick. After cooling down, fine grains developed and the solution had slight odor.

Formula 2: Black varnish mixed with vaseline at 1:1 ratio
After heat melting, the resultant ink receiving solution was too thin. There was oil floating to the surface when reaching boiling point and the solution had slight odor.

Formula 3: Black varnish mixed with micro wax at 1:1 ratio
During heat melting, the mixture was in liquid state at boiling point, however, it solidified when the temperature gradually decreased. When reaching room temperature, it formed a solid lump and could not be further test as ink receiving solution.

Formula 4: Black varnish mixed with soy wax at 2:1 ratio
After heat melting, the resultant ink receiving solution had appropriate thickness, not too thin. After cooling down, the fine grains similar to those of Formula 1 disappeared. The mixture had slight odor.

It can be concluded that Formulae 1, 2, and 4 ink receiving solutions that were in liquid state could be further tested in lithograph process.

5.3 Testing the Application of Ink Receiving Solutions
The resultant ink receiving solutions from the experiment were tested in lithograph printmaking, ie replacing red lacquer by mixing the solutions with turpentine for coating plate after acid etching.

5.3.1 Applying ink receiving solution during lithograph printing
Lithograph print requires grease as a media for ink adherence. Grease drawing creates image using greasy material. The greasy area attracts the ink and becomes and image. After drawing aluminum plate with greasy material, the plate is ready for acid etching.

Figure 8: Plate drawing equipment that contain greasy ingredients

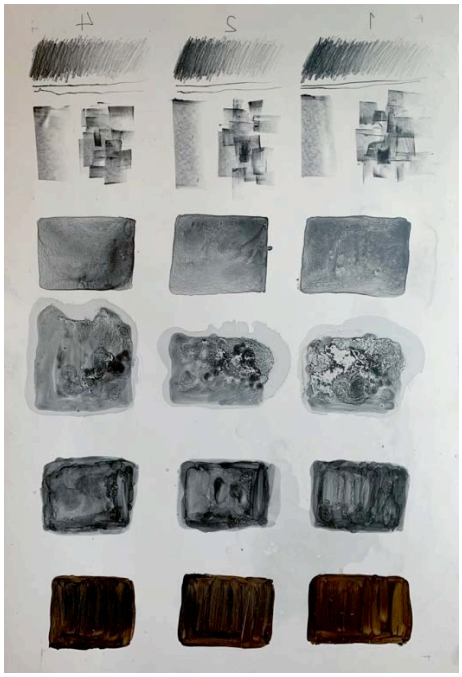

Figure 9: Drawn plate

Acid etching aimed to maintain the condition of grease. After drawing on aluminum plate, the plate was sprinkled with flour.

Gum mixture was then prepared by mixing pure gum and gum etch. The mixture comprised 8 oz. of pure gum and 5.6 ml. of phosphoric acid, or the ratio of gum etch to pure gum is 1:3, or as appropriate to the artwork. The gum mixture was spread throughout the plate for an appropriate period (ie approximately 5-7 minutes) before wiped off, leaving a thin layer of gum.

Pure gum was then applied to stop acid etching before wiping the plate with lint cloth to have the smoothest surface, and left for at least 30 minutes. **Second etching can be done to strengthen the plate to be durable for multiple printing (editions). The ink which had higher oil content replaced the greasy material already drawn on the plate surface.**

Figure 10: Acid etching

Turpentine was applied across the plate to remove all greases and soot. The plate was wiped clean with thinner. Only faded greasy lines remained on the plate.

Figure 11: Plate clearing with turpentine and thinner

The next step was replacing the grease with ink receiving solution. The mixture of ink receiving solution and small amount of turpentine was applied thinly and smoothly throughout the faded image until the ink receiving solution was adhered to the entire image and distributed evenly across the plate. After being left for approximately 1-2 minutes to allow turpentine evaporation, a required colored ink was applied thinly over the ink receiving solution using soft cloth.

Figure 12: Ink receiving solution application

Figure 13: Ink application over ink receiving solution

After that, a water soaked sponge was used to wipe the ink receiving solution, ink, and excess gum off the plate. When there was only a clear lightweight image remained, the plate was wiped with damp sponge. Ink was immediately applied using ink roller for further printing process.

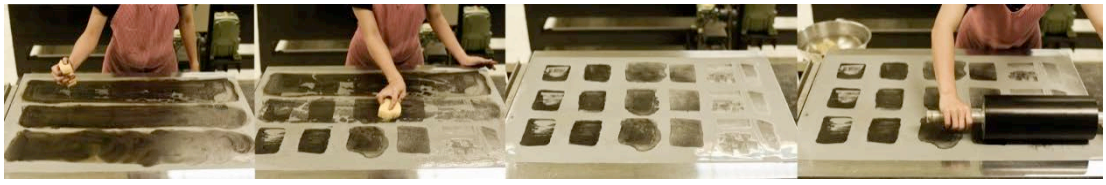

Figure 14: Removing ink receiving solution, ink, and gum

In printing step, the ink was rolled onto the plate. During this period, damp sponge was frequently swiped across the plate to prevent dry surface. After rolling and get the weight and details as required, a test printing was conducted before commencing printing the real artworks.

Figure 15: Printing

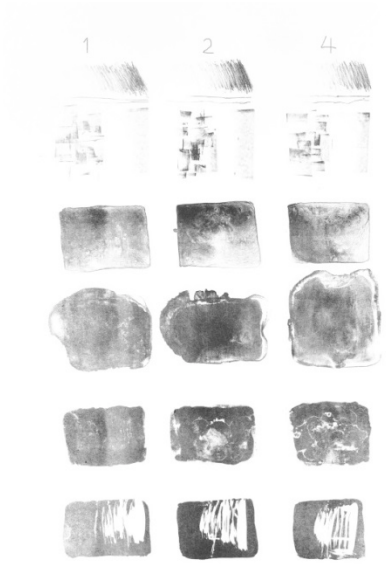

Figure 16: Test print Edition1

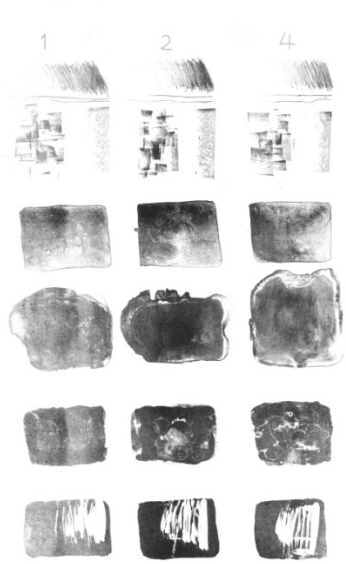

Figure 17: Test print Edition2

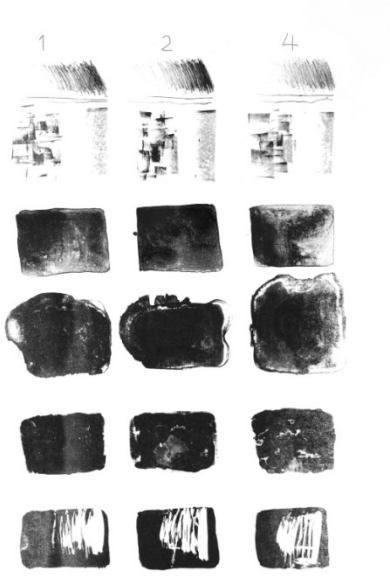

Figure 18: Test print Edition 3

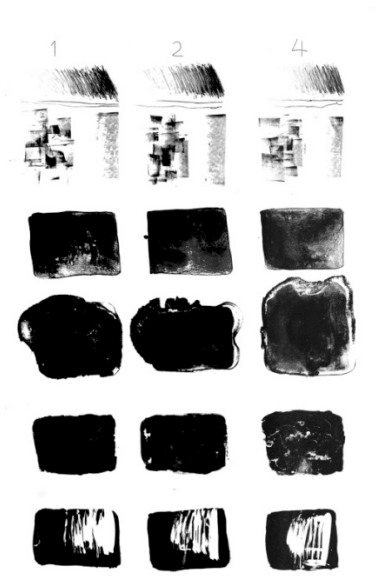

Figure 19: Test print Edition 4

6. Analytical Result of Ink Receiving Solution Ingredients

6.1 Analytical Results of Test Printing
Explanation of the result of lithograph printing using ink receiving solution

Drawing material	Formula 1 Black Varnish 1:1 Soy Wax	Formula 2 Black Varnish 1:1 Vaseline	Formula 4 Black Varnish 2:1 Soy Wax
Greasy stick	Lines grew slightly larger in Edition 3	Lines grew much larger in Edition 2	Lines were stable in size with appropriate

			weight in Editions 2, 3, and 4
Stick tusche and water	Weight grew dense but the details remained in Edition 3	Weight grew darkly dense in Edition 2	Weight and details were complete in Editions 3 and 4
Stick tusche and turpentine	Weight grew dense in dark area, while the details still remained in light area in Edition 3	Weight grew darkly dense in Edition 2	Complete weight and details in Editions 3 and 4
Stick tusche and thinner	Weight grew dense in dark area, while the details still remained in light area in Edition 3	Weight grew darkly dense in Edition 2	Complete weight and details in Editions 3 and 4
Black varnish and turpentine	Appropriate weight in Editions 3 and 4	Appropriate weight in Editions 2, 3 and 4	Appropriate weight in Edition 3 and 4
Number of editions	Able to print 3 editions	Able to print 2 editions	Able to print 8 editions

Formula 1: Mixture of 50% black varnish and 50% soy wax or 1:1 ratio.

The concentration of solution was appropriate, not too thin. However, turpentine was required to dilute the solution during plate wiping. Weight and details of the print were best in Edition 2, but the print in Edition 3 had darker image. The plate drawn by oily ingredient eg stick tusche and turpentine gave a darkly dense image, therefore, not durable for printing multiple editions.

Formula 1: Mixture of 50% black varnish and 50% vaseline or 1:1 ratio.

The solution was thin and washable easily. Lines and tusche marks remained on plate surface after applying solution. However, during printing on paper, adherence of the ink to the plate was not good. The print result in Edition 1 was indistinct, while Edition 2 had darker image or so called 'easily clogged'. The plate was not appropriate for receiving ink and weight and details of the lines cannot be controlled.

Formula 4: Mixture of black varnish and soy wax of 2:1 ratio.

The solution was thick, and additional turpentine dilution was required during plate wiping. The resultant image in Edition 1 had light weight, and Edition 2 had more weight. The images of Editions 3 and 4 had perfect weight with complete details. The plate of Formula 4 mixture can be printed for 8 editions and the weight of grease drawn lines was good with complete details. It can be concluded that the plate was durable and sufficient for printing multiple editions.

6.2 Using Ink Receiving Solution to Create Lithograph Artwork

After the test printing of all 4 formulae of ink receiving solutions, it can clearly be seen that Formula 4 (mixture of black varnish and soy wax at 2:1 ratio) gives a distinct image with proper weight of all details. The plate can be used multiple times, indicating that it is durable for ink reception.

After the well-proportioned solution was found, such Formula 4 solution was used during a printmaking class to create a complete print artwork. Example photos of the operation during artwork creation are provided below.

6.2.1 Application of ink receiving solution Formula 4 (black varnish and soy wax in 2:1 ratio)

Figure 20: Application of ink receiving solution for printmaking artwork creation

Figure 21: Final artwork

Figure 22: Final artwork

From the research "Finding Effective Ink Receiver Ingredient in Image Creation on Aluminum Plate to Replace Red Lacquer in Lithograph Process", the final artwork created from ink receiving solution Formula 4 indicates that such solution can be used for teaching purpose and creates artwork efficiently. The solution has appropriate thickness and can easily be washed off. The plate is durable for ink reception due to the fact that the ink receiving solution has a greasy component, when coating the grease drawn plate, it creates another thin film over the plate surface. This could be an ink receiving base that increases grease content to the plate, making the plate durable for printing multiple editions. The resultant print artworks therefore have an appropriate weight with complete details.

7. Discussion, Conclusion, and Recommendations

7.1 Discussion of Results

From the research "Finding Effective Ink Receiver Ingredient in Image Creation on Aluminum Plate to Replace Red Lacquer in Lithograph Process", the most effective ink receiving solution after printing on paper is the mixture of black varnish and soy wax at 2:1 ratio. The solution has appropriate greasiness that preserves all details and weight of the grease drawn lines after printing. It can also be washed off easily. The properties of the ink receiving solution are summarized below.

1. The ink receiving solution can replace red lacquer efficiently.
2. The chemical smell of the ink receiving solution is not as strong as red lacquer during usage.
3. The ingredients of the ink receiving solution are available in Thailand and inexpensive.

From the above properties, such ink receiving solution can be practically used for teaching and creating artworks. This therefore broadens educational development and can be an innovation of printmaking process in Thailand.

7.2 Recommendations

1) Due to the hot weather of Thailand, the greasy or oil ingredient is in liquid state. If used in cold weather, the solution might become solidified. It might be necessary to conduct further experiment to find appropriate proportion.

2) Ink receiving solution ingredients could be further developed for other usage, for example, use for plate drawing.

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