



Spread and Distribute

Ferrofluid Materials as Expanded Printmaking

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Abstract. There is one distinct stage that can only be found in the working process of the lithography printing technique among other printmaking techniques, which is when an image that has been chemically treated on a stone surface is erased until it is clean but in the end, the image can reappear due to the principle of repulsion between water and oil. This snippet of the process sparked the author's idea of creating a work of art whose visuals can appear and disappear on their own without leaving physical traces of printmaking materials. The pattern of appearance and disappearance has similarities with the phenomenon of human ability to perceive and interpret the information value of artistic traces of printmaking in the context of screen culture. By understanding this expansion of printmaking conventions, the author discovers a broader printmaking mechanism by utilizing a matrix created from ferrofluid material, a liquid material that can respond to magnetic forces so that its physical form can change. The unique properties of this material are able to transform conventional imprints into a visual printmaking work which is characterized as time-based art, where the image matrix can appear and disappear on its own, forming a repetitive pattern of unique black-and-white visual text influenced by the action-reaction of the magnetic field and ferrofluid.

Keywords: *Expanded medium, Ferrofluid, Printmaking, Screen culture, Time-based art*

1 Introduction

Based on the experience that the author found in the process of creating printmaking works using lithography, there is a part of the process that seems to only be found in the experience of working with this technique, which is the repulsive reaction between water and oil as a way of producing images on the print matrix. This artistic experience gives the author a new perspective in understanding the process of image-making both in the realm of printmaking and the creation of artworks in general, so these findings

become a stepping stone to producing an artwork with an expanded printmaking medium.

The expansion of the printmaking medium that the author applies in this research utilizes the exploration of the material (ferrofluid) that the author tried to develop during his master's study at the ITB printmaking studio as well as the utilization of the matrix principle as a print reference and image generator in printmaking, especially lithography. Ferrofluid is a material with liquid characteristics composed of magnetic particles, so when it is given a reaction in of a magnetic force, its shape will change. The author projected this interesting phenomenon on this material as an idea to create an artwork that can visually appear and disappear on its own-as a representation of the screen culture phenomenon. The author assumes that the expansion of the medium in the creation of this work can articulate a more appropriate view of today's phenomenon of image-making and its distribution in screen culture, instead of presenting it in the form of conventional printmaking works. The usage and exploration of ferrofluid materials into the idea of printmaking expansion is an application of the concept of transmateriality considering the crossing and utilization of knowledge between several scientific fields.

This research has the scope of the problem on the phenomenon of information distribution in digital format in people's daily lives. The problem is narrowed down to the question of how far humans are able to understand and process information consumed every day through personal devices every day. The medium of printmaking in the creation of this work is also developed, especially in terms of material (the use of ferrofluid), and the utilization of working principles (printmaking).

2 Method

Please note This art creation-based research uses the practice led research method, considering that the creation of a work of art is done according to the needs of the artist (researcher). As explained by Carole Gray, the definition of practice led research is First, it is research that is initiated in practice where questions, problems, challenges are identified and formed from the needs of practices and practitioners. Second, that the research strategy is delivered through practice, using the dominance of specific methodologies and methods known to us - the practitioners [1]. The practice led research conducted by the author starts from the material experimentation process in the printmaking studio. The results of these experiments were used as a reference to start the synthetic material (ferrofluid) process. In the final stage, the materials that have been obtained are applied to a contemporary artwork which has the working principles of printmaking.

3 Ferrofluid

The idea for the work began when the author was processing in the studio. A container of photocopy toner that had been dissolved with turpentine turned thick and viscous after being left unintentionally for several days. This solution was originally used for the exploration of paper coloring. The author's observation of the thick solution visually and texturally reminded me of a fictional character named 'Venom' who appears in Marvel comics and movies. The image of the fictional character led the author to an imaginative question: Can Venom be synthetically created in the real world? This curiosity led to the author's search for a liquid material that has similar visual features and characteristics, namely ferrofluid. Simply put, ferrofluid is a liquid that reacts to magnetic attraction, this is because ferrofluid contains magnets on the nanometer scale (one billionth of a meter). The reaction to the magnet causes a change in shape on the surface (texture) of the liquid into a spiked pattern (cone) instantly.

Ferrofluid was invented in 1963 by Steve Papell, a scientist at the United States National Aeronautics and Space Administration (NASA). This liquid material was originally developed for rocket fuel utilization, where fuel from the tank can remain well distributed into the engine even in zero gravity conditions [2].

3.1 Material synthesise process

As a practice-led research, the material synthesis stage was conducted as the first step of the research. This was due to the fact that there are no parties that distribute ferrofluid as a commercial product in Indonesia. By synthesizing this material independently, the author expects a more in-depth observation of the character of ferrofluid material so that it can be adjusted to the needs of the work.

Ferrofluid is composed of magnetic particles coated with surfactants, both of which are then mixed until finally dispersed in a carrier fluid. In the making of ferrofluid by Neil Braun in a video on his Youtube channel, the ideal composition of ferrofluid is 10% magnetic particles, 5% surfactant and 85% carrier fluid, with a note that the surfactant coats the magnetic particles in the stirring process. The ideal ferrofluid has magnetic particles of 10nm [3]. To make a simple ferrofluid, the authors used two different types of materials. First, the author uses pure magnetic particles (Fe_3O_4) or commonly called magnetite. Second, the author also tries to use photocopy ink powder (toner) because this material is more affordable, while for the solvent the author uses motor vehicle engine oil.



Fig. 1. (a) photocopy toner-based ferrofluid; (b) magnetite-based ferrofluid

From the experiment above, it can be seen that both respond to magnetic force, but the shape of the sharp 'spike' pattern is more clearly visible in the experiment using magnetite. While the experiment using photocopy toner produced a pattern like a slab shape. These results indicate that particles in magnetite are more appropriate for use in simple ferrofluid manufacturing experiments.

From the experimentation that the author has done in the ferrofluid material synthesis process, the author uses a ferrofluid with a composition consisting of 55% magnetic particles (Fe_3O_4 magnetite powder), 10% surfactant (oleic acid), and 35% carrier fluid - kerosene. This formula produces a ferrofluid with viscous characteristics - different from commercial ferrofluids and Neil Braun's version which the author used as a reference in the material synthesis stage. This is because the surfactant does not coat each magnetic particle, but is only mixed in the manufacturing process (because the author does not have access to adequate laboratory facilities). In addition, magnetite on the market also still has a fairly large size of 200 nm, or 20 times larger than the particle size in commercial ferrofluids (10 nm). This causes the ferrofluid produced by the author to be not very stable, in the sense that there will be a process of separation between magnetic particles and carrier liquid gradually when this ferrofluid reacts with magnetic forces. But on the other hand, the results obtained in the ferrofluid that the author did have a visual advantage. The appearance of sharp spines in the ferrofluid reaction with magnetic force is more clearly visible when compared to commercial ferrofluids in the form of blobs. This uniqueness is ultimately utilized as a visual in the making of the work.

3.2 References of ferrofluid as artistic necessity

Material synthesize process Sachiko Kodama (born in Japan in 1970) is a pioneering artist who utilizes ferrofluid as a medium in her artworks. Her first project using ferrofluid titled 'Protrude, Flow' in 2001 (in collaboration with Minako Takeno) featured an interactive installation. 'Protrude, Flow' is a series of ferrofluid-filled vessels that react to electromagnetic forces that can be modified with sound waves [4]. The sound waves that the audience gives such as shouting or clapping sounds can give certain additional reactions to the ferrofluid form. There is also a video projection highlighted onto a wall around the work area that acts as a visual magnification of the ferrofluid interaction.

The use of ferrofluid in Kodama's work is a visualization of the imagination of human desires (artists) who have been trying to create visual physical materials that seem to be alive, such as moving images. Instead of presenting it as a mere visual illusion, the idea can be realized into a material concept that can dynamically shape its own form.

Zelf Koelman is a product designer who studied at Eindhoven University of Technology in the Industrial Design department. In 2015 through his journal published by the International Symposium of Electronic Arts (ISEA), Koelman published his invention called Ferrolic. Ferrolic is a ferrofluid-based digital display device [5]. This device has a tendency to display visuals vertically, meaning that the display will resemble a two-dimensional work that can be viewed from one direction. Koelman's Ferrolic follows the working principle of an LCD (Liquid Crystal Display) screen, which is a flat field consisting of a collection of dots (pixel units) that form the information (visual). In an LCD, each pixel produces a certain amount of light. If configured systematically, the color will display an image, while in Ferrolic the pixel unit is an electromagnetic field with a round surface. If the electromagnet surface is activated, it can be used as a ferrofluid base and if the activation can be configured in such a way through a mini controller device, the ferrofluid can display certain visuals. In this Ferrolic made by Koelman, the vessel screen displays a digital clock [6].

4 Expanded Printmaking

This research begins and focuses on the technique of lithography as a form of printmaking expansion apart from the other three main techniques—relief print (woodcut, linocut), intaglio (drypoint, etching) and screenprinting. Lithography is a printing technique that uses limestone as a plate to draw the matrix, the matrix is drawn using an oil-based medium because the limestone will bind the traces of grease that are etched on its surface, then the image that has been drawn on the surface of the stone will go through a chemical process so that the image will capture the ink applied by the roller and will finally be printed on paper. [7].

The expansion of printmaking is an approach to the artistic practice of the author, who is also a printmaker, in addressing the position of the printmaking medium in the contemporary art era so that it continues to have an equal place with other forms of work. This was also explained by Aurora Arazzi in her article entitled 'Printmaking Expansion by The Other Form of Presentation' in 2021.

“..New media art expressions (installation and performance) in the contemporary art scene, successfully progressed with their sophisticated technology, which can offer more stimulating aesthetic values. Because of that, the printmakers are challenged to criticize and respond to these conditions so that printmaking will constantly exist, evolve, and contribute to the contemporary art scene, which is increasingly dynamic and progressive...”[8].

The theoretical expansion of the art medium has been proposed by Rosalind Krauss in her 1979 article 'Sculpture in Expanded Field'. Although the discussion begins from the starting point of the phenomenon of the sculpture medium, the same pattern can also be found (or applied) to other mediums. Krauss began his analysis of the medium's expansion from the perspective of the phenomenon of the late 60s and 70s when many works with displays such as; narrow corridors with TV monitors at the end, large photographs documenting rural hikes, mirrors placed at odd angles in ordinary rooms, and so on were called sculpture. In her paper, Krauss presents a diagram to illustrate the expansion of the sculptural medium:

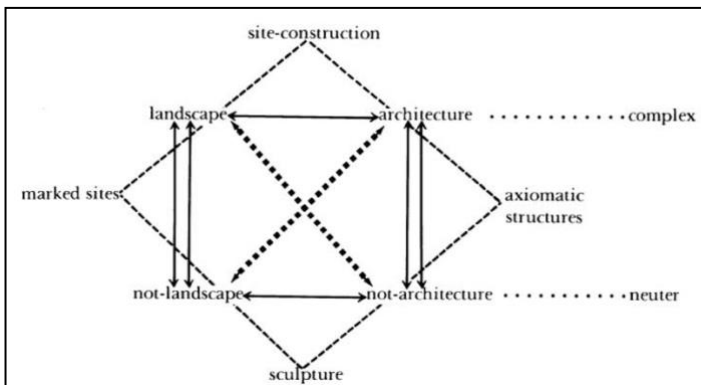


Fig.2. Expanded field diagram by Krauss (1979)

The 'X' field in the center of the diagram is an area called the expanded field. In the diagram, it can be noted that sculpture is no longer the term at the center, but rather one of the shaping variables alongside other terms with seemingly similar associations (marked sites, site-construction and axiomatic structures).

“..From the structure laid out above, it is obvious that the logic of the space of postmodernist practice is no longer organized around the definition of a given medium

on the grounds of material, or, for that matter, the perception of material. It is organized instead through the universe of terms that are felt to be in opposition within a cultural situation...It follows, then, that within any one of the positions generated by the given logical space, many different mediums might be employed..”[9].

Through the structure of the diagram, it is explained that the practice space of post-modernism is no longer organized around the definition of a particular medium based on material (material perception), but is organized around various terms that are perceived as conflicting in cultural situations. Therefore, in one of these positions many different mediums can be used.

Another view on the expansion of printmaking was also presented by Maria do Carmo de Freitas Veneroso, a lecturer and researcher from Universidade Federal de Minas Gerais in her scientific journal entitled "The Expanded Field of Printmaking: Continuities, Ruptures, Crossings, and Contamination" in 2014. According to Veneroso, starting from the 80s and 90s, there was an interesting trend in printmaking, with some artists staying committed to traditional techniques and others expanding their boundaries beyond what is commonly accepted. For example, for artists whose artworks were conceptually based, printmaking became a medium that was used in a more experimental manner [10].

The expansion of printmaking discussed by Veneroso in his journal focuses on the development between traditional printmaking and printmaking as a mass media for commercial needs, which is also related to technological developments.

“The rise of new media - seen by some as a threat to the future of printmaking – has just expanded the options available. Just as the invention of lithography did not let woodcut and engraving redundant, and photography not spelled the end of traditional graphic media, digital technologies also did not replace other technologies, but extended options and possibilities” [11].

The emergence of new media, which is seen by some as a threat to the future of printmaking, actually helps and expands the choice of working practices of printmakers. For example, the increasingly accessible digital print is slowly being applied to artists' works as well as the utilization of numerical matrices in addition to the pre-existing physical matrices.

4.1 Matrix in printmaking

The creation of the work in this research focuses on the utilization of the matrix principle in printmaking. According to the Print Center New York website, printmaking is basically image-making from a matrix. A matrix is a cross-section/plane surface that is processed in such a way that it can finally be filled/holding ink. Usually, the matrix is able to print the same image repeatedly [12].

The identity of the matrix can be seen from three functional factors, which are: trace carrier, intermediate form and automatism of marking. The trace carrier function means that regardless of the material, as long as its structure allows for impressions, it can be utilized as a matrix. The carrier can be anything as long as it has a fixed form or sequence that is not linked to essential or accidental changes during the marking process. The second function as an intermediary form means that the matrix is not a product or an end result. The content in the matrix must be able to move to other fields. Third, as an automatic marker, everything contained in the matrix can be reproduced. In this case the matrix is like a vessel, the liquid material will automatically fill the existing shape or field [13].

5 Result

This research resulted in a work in the form of a water vessel object that has dimensions of 75 x 29 x 17 cm with landscape orientation. Inside there is a ferrofluid material with a solid black color that slowly moves and visualizes the text that reads "shared". After the text 'shared' is clearly formed, a few moments later the text (ferrofluid) transforms into an illegible form because it is no longer attached to the vessel wall and the material deconstructs and falls to the bottom of the vessel. But moments after the text 'disappears', the ferrofluid material reattaches to the vessel wall and slowly re-forms and displays the "shared" text, looping continuously.



Fig. 3. 'Spread and Distribute: Shared' by Adi Sundoro (2023) (a) Forming Process; (b) Display

The ferrofluid material applied to this work is considered by the author to be able to accommodate ideas on the phenomenon of today's information dissemination (especially those based on visuals), which is the life of modern society that on a daily basis, either consciously or unconsciously, is in a situation of a sea of information (image). This acceleration produces overlapping information that is produced quickly and even lost or replaced rapidly, so that the meaning or essence of the information cannot be fully received by humans.



Fig. 4. Disappearing process of ferrofluid on vessel display

In the glass vessel, there are several elements configured to represent this phenomenon. Ferrofluid as the main medium in this work is an oil-based material, which naturally will not mix with the water in the glass vessel so that it can be utilized to provide visual impressions. The ferrofluid sticks to the surface of the glass vessel wall, and slowly moves up and down to form a text that reads "shared" within 37 seconds. The movement and process of forming the ferrofluid into text is because the ferrofluid is a material that reacts with magnetic force. The magnetic force is generated from a pattern arrangement of neodymium magnet modules behind the vessel configured with an electronic-based mechanical device (Arduino). The pre-set movements of the device assist in the formation of the text pattern while also detaching it. The operating system of the device is set up in such a way that it can run continuously on the shared text 'appearing-disappearing' pattern.

The text 'shared' as the main visual in this work is a representation of the concept of how information is shared. There will be no reaction if there is no action, this also applies to information, which will not be consumed if it is not shared. With this phase of information distribution, a culture is created in which the screen becomes the main intermediary in the mode of information dissemination, called the screen culture. This form of culture has become a part of modern human life every day perceived by the sense of sight through the screen. With the experiential process of enjoying the formation of images in physical form and directly present in the work, the author tries to slow down the process that we have not realized in the information circulating, with the presentation of the slowing down process the author tries to convey about understanding or extracting value is something more important than the acceleration phenomenon that has been happening.

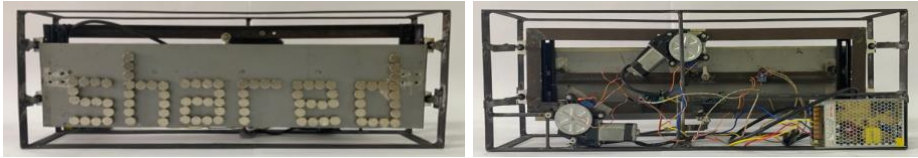


Fig. 5. (a) *Neodymium pattern as matrix;* (b) *Electronic installation with Arduino and motors*

As Marshall McLuhan once explained in his 1964 work "The Medium is the Message", a message or information is not just the content it contains, but the media itself is the message. In this paper, the definition of media referred to by McLuhan is defined as "any extension of ourselves" - any form of "extension of the human hand" [14]. So the definition of media is not limited to mere mass media such as magazines, newspapers, television. In fact, technological sophistication and devices are also included in the definition of media. This understanding is one that the author believes in the use of ferrofluid material in the work, which is a synthetic material that can be tangible and move like an organic substance, which can depict something intangible such as the concept of distribution and digitalization into a tangible form.

Printmaking is one of the important variables in the creation of this work, firstly, printmaking is the artistic modal experienced by the author during his study and work in the field of fine arts. Through experience with this medium, the author was eventually inspired and found ideas for the artwork by expanding it to a newer and more personal understanding. The magnetic pattern composed of neodymium magnet modules is likened to a matrix in printmaking, the ferrofluid material on the one hand is a substitute material for printing ink, and the mechanical system that drives the magnetic pattern is a substitute for a printing machine that helps the ink transfer process on the media in printmaking.

6 Conclusion

The medium in fine art is an intermediary that bridges between the ideas of the artist and the image of the physical form of a work. The specific use of medium in the era of contemporary art - in particular - may no longer be too relevant considering that art can be constructed from anything (anything goes). The author, whose work process departs from the traditional medium (printmaking), tries to reinterpret the meaning and utilization of the principles that already exist in the conventionality of the medium, so the author feels that expanded printmaking is the most appropriate corridor to define the method of work done and articulate the context of the ideas in the work.

The use of ferrofluid material in the medium of the work that the author did still has some shortcomings, especially regarding technical matters and issues related to the material synthesis process. For example, instead of using electromagnets in the work that can actually produce a more efficient systematic work, the author still uses

conventional magnets so that the idea of the work can still be realized. In addition, the author realizes that the ferrofluid produced through a simple synthesis process in the work is structurally unstable, so it does not produce a material that is truly liquid (fluid). Ferrofluid is a material studied in the field of nano technology, while nano technology is an interdisciplinary field that brings together several sciences such as physics, chemistry, biology and so on. Therefore, a deep understanding and interest in these sciences (outside of art) is necessary for artists who will attempt interdisciplinary works in the future.

Through the creation of this work, the expansion of the printmaking medium, which can ultimately be seen through the perspective of intermedia art, raises an additional aspect, which is the dimension of time-considering that the work presents a durational process of material formation through a moving mechanical device. Based on this, the author provides a view to further elaborate on the application of the concept of time-based art to the creation of this kind of work-using ferrofluid material-in the future.

Acknowledgements

The author would like to thank Center for Higher Education Fund (Balai Pembiayaan Pendidikan Tinggi) Ministry of Education, Culture, Research and Technology of The Republic of Indonesia and The Indonesia and Endowment Funds for Education (Lembaga Pengelola Dana Pendidikan) Ministry of Finance of The Republic of Indonesia for funding this research paper.

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