Developing the Waterless Lithography Printmaking Process

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Abstract:
Since its invention in 1990, waterless lithography has been promoted as a safer alternative process to traditional stone lithography however with the examination of the waterless lithography process it is found to involve the usage of several toxic materials including but not limited to Acetone, Thinner, and spray paint. The extended exposure to those chemicals poses significant health risks to printmaking students, teachers, and artists. In addition, the traditional waterless lithography process has its limitations in terms of the size of the plate that can be produced and the poor quality of photo transfer. This research paper aims to develop a waterless lithography process so that it becomes easier to execute, less toxic, and safer. In addition to the advantages of the developed process as an easier and safer process, it allows us to create larger scale prints and to have better quality photo printing results. This research paper is a result of experimenting for a period of 9 months in an attempt to develop the traditional waterless lithography process. During that experimental phase, the researcher has successfully modified a silicon-based coating that can be applied to a regular paper or heat resistant paper. The modified silicone coating allows direct drawing on the paper surface as well as transferring images via laser printing. Utilizing the developed lithographic process, the researcher conducted several mark-making experiments using different materials including oil-based, pigment-based, and toner-based materials and as well as laser printing and he produced several prints utilizing the developed waterless lithography process. In the following the researcher discusses in detail the disadvantages of the traditional waterless lithography process, the advantages of the developed process, and the materials related to the developed process. Objectives: My main goal of this research is to simplify the waterless lithography process. Even though the waterless lithography process is much simpler and less time consuming than traditional stone lithography, it still requires a certain degree of technical proficiency - To make the Waterless Lithography process safer to use by printmaking artists and art students. This research aims to limit the chemicals involved in the making of waterless lithographic plates. To make the Waterless Lithography Process more accessible to the majority of visual artists. By publishing the research and its results, the researcher aims to disseminate the knowledge about the progression of waterless lithography. Significance: This research paper is an attempt to advance the waterless lithography process and revive lithography art and art education. This research is an attempt to transform water lithography to a safer printmaking process and minimize the health risks for printmaking students and teachers and artists. In addition, this research may assist in disseminating the needed knowledge and form as a link in the progression of Lithography printmaking art. Visual artists, printmaking students, and academic printmaking programs may benefit from the findings of this research.

Introduction
As a major printmaking process, stone lithography has been practiced around the world for more than two centuries, however, since its invention in 1796 by German author and actor Alois Senefelder, Stone Lithography has not witnessed major developments in terms of the materials or the process in general.

In 1990, Nik Semenoff, a Canadian Artist and Art educator invented a new lithographic process and he titled it (Waterless lithography), due to the absence of the usage of water in the process. By early 21st century, Waterless Lithography was gaining acceptance in both the academic and professional art arenas in North America and in Europe. That new process allows printmakers to

Keywords:
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make lithographic plates from common aluminum plates by using ordinary caulking silicone. The main advantages of Waterless lithography over traditional stone lithography were reliability and simplicity of the process. While traditional stone relies on the principle that grease and water do not mix, waterless lithography employs the discovery that silicon material repels lithographic ink. As an artist, I was introduced to the waterless lithography process in 2002 during a workshop with American Master printmaker Ross Zirkle who dedicated his research to develop a safer lithographic process for students and artists. Unfortunately, Ross Zirkle passed away in March 2007 due to health complications that could be associated with his career as a master printmaker and prolonged exposure to printmaking chemicals may have contributed to his health condition. Since 2007, I have been experimenting with different waterless lithography materials, and in 2008 I have received a Fulbright Scholar Grant to the Department of Painting and Printmaking, Virginia Commonwealth University, where I experimented for 9 months in attempt to continue the development of the waterless lithography process. My main concept to develop the waterless lithography is to utilize the principles of the process while avoiding its main disadvantages.

**Objectives**

1. My main goal of this research is to simplify the waterless lithography process. Even though the waterless lithography process is much simpler and less time consuming than traditional stone lithography, it still requires a certain degree of technical proficiency.

2. To make the Waterless Lithography process safer to use by printmaking artists and art students. This research aims to limit the chemicals involved in the making of waterless lithographic plates.

3. To make the Waterless Lithography Process more accessible to the majority of visual artists. By publishing the research and its results, the researcher aims to disseminate the knowledge about the progression of waterless lithography.

**Significance**

This research paper is an attempt to advance the waterless lithography process and revive lithography art and art education. This research is an attempt to transform water lithography to a safer printmaking process and minimize the health risks for printmaking students and teachers and artists. In addition, this research may assist in disseminating the needed knowledge and form as a link in the progression of Lithography printmaking art. Visual artists, printmaking students, and academic printmaking programs may benefit from the findings of this research.

**1- Disadvantages of Waterless Lithography**

**1.1- Prolonged process:**

In the waterless lithography process, the plate preparation takes some time, first the design or the drawing has to be transferred to the aluminum plate by direct application in case of a drawing or by toner transfer technique in case of using a laser printer. Then the design has to be cured with a heat gun. Then the plate surface should be covered with 2-3 coats of silicon because the silicone is very thick as it comes from the cartridge, the silicone should be diluted to the consistency of proportion of 30% silicone to 70% thinner. Subsequently The silicon coating has to be cured with heat gun, and then the design is uncovered by using a solvent in accordance with the drawing or transfer material. Then the plate must be dried using a heat gun before then the inking and printing process takes place. Of course the process of waterless lithography is briefer than the process of traditional stone lithography, however in the researcher's opinion it is still a time-consuming process.

**1.2- Materials Toxicity:**

Although the waterless lithography process is definitely less toxic than the traditional stone lithography, several hazardous chemicals are still involved in the making of waterless lithography plates including but not limited to, Acetone, spray paint, and solvent thinner. These chemicals pose a considerable risk to the health of the artists and art students.

According to the Canadian Center of occupational health and safety, Inhalation of Acetone can irritate the nose and throat. At high concentrations: can harm the nervous system. Symptoms may include headache, nausea, dizziness, drowsiness and confusion. Severe exposure can cause unconsciousness. [https://www.ccohs.ca/oshanswers/chemicals/chem_profiles/acetone.html](https://www.ccohs.ca/oshanswers/chemicals/chem_profiles/acetone.html)

The utilization of spray paint also has very serious health consequences including asthma, allergic contact dermatitis, lung cancer, and 'painter's syndrome' which characterized by brain damage, damage to the reproductive system, and kidney or liver damage. In addition, prolonged exposure to solvents may cause skin disorders and dermatitis. Some solvents penetrate the skin, enter the blood circulation, and may cause damage to the liver, kidneys, heart, blood vessels, bone marrow, and the nervous system.
system.

1.3 -Limited potentials:
Waterless lithography is a process that has its limitations in terms of size of the plate, possibilities of corrections or adjustments of the design, and poor quality of photo transfer. Waterless Lithography plates are usually executed using recycled aluminum offset plates, which limits the size of waterless plate to the size of the recycled empty areas of the used offset plate. In addition, once the waterless plate has been developed it is very hard to do any corrections on the design.

As in most cases, improvements are not without some sacrifice and this process is no exception. While the technique has problems, they are of a different nature than gum/water lithography and have to be overcome. The most important concern is the loss of making changes to the plate; by adding or changing the character of the image. Because the silicone layer holds so tenaciously to the metal, it is very difficult to remove the materials to re-sensitize an area for changes.

https://www.polymetaal.nl/beguin/mapw/waterlesslitho01.htm

2-Advantages of the developed process

2.1-Shorter process:
The Main concept of the developed waterless lithography process is to create a silicon-based coat that accepts drawing and printing of the design and meanwhile repels the lithographic ink. That coat can be applied to a paper substrate and then printed on with laser printer or drawn on directly with different drawing materials. The new waterless lithography process is shorter as the step of recovering the design in the original process will be eliminated.

2.2-Safer Materials:
Although in general the materials of waterless lithography is safer than the materials of traditional stone lithography, the waterless lithography process still involves the usage of some hazardous materials including Acton and Thinner, those both toxic chemicals could be very poisonous if used in enclosed print-shops or studios. The developed waterless lithography eliminates the need to use those to caustic solvents and as a result, the new process is much safer to execute.

2.3-Creative Potential:
The developed waterless lithography process has a great advantage in terms of plate size, the plate can be executed on any size paper size. In addition, corrections or adjustments of the design can be made either by adding drawing to the design or by removing parts of the design by adding Silicone. Unlike the traditional waterless lithography process where the drawing or the printed design has to be covered with a layer of Silicone and then recovered, in the developed process the design set directly on the surface of the paper plate, consequently the quality of the design is not compromised.

3-The Process

3.1-Applying silicone toner mixture coating
The researcher has experimented extensively with different modifications of the silicon coating and found out that a mixture of 60% Silicon to 40% laser Toner yields the best results either in direct drawing with oil-based materials or in laser printing. The paper substrate surface should be covered with 2-3 coats of the silicon-toner mixture, the coats take about 24 hours to be completely dried. The distribution of the mixture should be consistent, for the best results a rubber roller can be used to apply the mixture to the paper surface. The coating layer should be even and not too thick. Too thick of a layer of silicone is the cause for the loss of fine tints, producing high contrast images. Although printing can proceed immediately, leaving the plate to cure overnight is highly recommended.

3.2-Using Drawing Materials
The design can be drawn directly on the surface of the coated paper with different oil-based or, toner-based, or pigment-based drawing materials including but not limited to (permanent markers, litho-pencils, pigment pens, oil inks and any other grease based materials). Since some artists prefer the effects of traditional tusche washes and grease crayons. These drawing materials among others can be incorporated into the developed waterless lithography process. Ordinary marking pencils with high wax content and felt markers are also all candidates as drawing materials.

fig 1. Shows a drawing-based experimental print using an 70% Alcohol-30%Toner solution on the developed waterless lithography plate. fig. 2 shows the printing effects of drawing with different dawning materials including markers, pigment pens, litho pencils, and toner alcohol solutions.

3.3-Using Laser Printer
The design can also be digitally prepared and printed directly on the coated paper via a laser printer, after several experiments the researcher found out that the ideal resolution of the printed design is 150PPI , higher image resolution does not yealid preferable results.
If the design to be printed digitally on the coated paper the weight of the paper should not exceed 220gm, heavier paper may get stuck in the laser printer or damage the printing heads.

fig. 3 shows the printing results of using digital design printed directly of the developed waterless lithography plate.

fig. 1. Drawing-based experimental print using alcohol toner solution on the developed waterless lithography plate.

fig. 2. Drawing-based experimental print using different dawning materials including markers, pigment pens, litho pencils, and toner alcohol solution.

fig. 3 Digital print-based experimental print - developed waterless lithography process.

3.4-Curing the design
Either after drawing the design or printing it on the silicon-coated paper, the design has to be cured with a heat gun so that the pigment in the drawing material or the laser toner of the digital print melts and adheres strongly to the coated silicon layer.
During this phase fumes may rise as a result of the heating of the design, consequently the heating step should be administered only in open areas or in well-ventilated studios. After the heating step, the design is ready for the printing stage.

3.5 Inking and Printing

Printing the developed waterless lithography plate can be conducted in the same fashion of printing waterless lithography plates. The researcher has printed several prints using regular lithographic inks and rubber rollers, the ink should not be modified with oil as it may damage the silicone coating. If the ink is too stiff, it can be warmed a little on a hotplate. During the inking phase the movement of the roller should be in only one direction starting from one edge of the paper plate to the other edge. After the plate is completely inked it can be printed using a printing press or manually. The researcher has successfully printed several prints manually. Depending on the nature and the resilience of the paper substrate, the edition size of the printed design can range from 5 to 20 prints.

4 Early Prints

After the initial technical experimental phase, the researcher attempt to produce series of small scale prints utilizing the developed waterless lithography methodology. The first series is titled Urban Chaos fig. 4, fig. 5, fig. 6. The images of that series are created by manipulating several digital photographs in Adobe Photoshop, and then printed via a laser printer on the developed waterless lithography plate, and then printed manually in the previously explained manner. By early 2009 the researcher produced another series of prints titled Browsing for Target, fig. 7, fig. 8. Those prints were created by incorporating digital photos with manual drawings via Adobe Photoshop program and then printed on the developed waterless lithography plate and then printed manually in the previously explained manner.

fig.4. Urban Chaos 1- developed Waterless Lithography – 21x29cm – 2008

fig.5. Urban Chaos 2- developed Waterless Lithography – 21x29cm – 2008
fig.6. Urban Chaos 3 - developed Waterless Lithography – 21x29cm – 2008

fig.7. Browsing for Target 1 - developed Waterless Lithography - 26x38cm - 2009.

fig.8. Browsing for Target 1 - developed Waterless Lithography - 26x38cm - 2009.
Conclusion Since its emergence Printmaking has always been the art of exploration where art, science, and technical skills merge, and this research has been a link to that quest of exploration. In this practical research, the researcher has attempted to evolve the waterless lithography process by analyzing its main shortcomings to address them. After extensive experimentations, the researcher has been able to develop a waterless lithography process is shorter, safer, and offers more creative potentials than the traditional waterless process. The researcher has been able to print several prints incorporating various image-making techniques utilizing the developed process, which has been proven to be successful.

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Research Interest:
Non-Toxic Printmaking, Experimental Printmaking, Mixed Media and Graphic Design.

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