Making Ones Own Waterless Positive Plates
An improved method developed in 2001,
even more improved for March 2003

Nik Semenoff

Update

Since starting my research into making ones own positive plates, I have tried many things that worked reasonably well, but my search has been to make plates that can compete with commercial products in quality of images. Will this be the final method or can I develop even simpler techniques to get perfect results? I suppose I will constantly keep doing research into my processes to find better methods, but look upon this as a major step into making positive plates.

Background

Positive litho plates are becoming more and more common amongst fine art printmakers because of the ease of doing editions and the assurance that an edition can still be completed if a plate is lost for some reason. Registration of Mylars with the use of a pin registration system will produce editions of better quality with much less trouble. I have used three brands of commercial positive plates and have found all of them to be of high quality, though there were slight differences in their characteristics. It is very easy to use these commercial plates with my waterless process and only the developer need to be purchased when placing your order. After exposure and development, a coat of silicone is applied to the plate and later the image is washed out with the acetone/retarder solution - or some cases alcohol.

Since my present series of lithographs have required a large number of plates because of the many colors I use in the edition, the cost of plates started to put a restriction on the number of editions I printed. I do not use positive plates for all the colors I need, but used this more expensive component as required. I had found a way to use the back of the common ball grained plates (see paper of reusing plates), which I used for toner washes and flats drawn with Sumi ink. I also use many of the cheaper smooth commercial offset plates for direct imaging, but there were many images that could have used Mylar positives. With the knowledge of reusing plates, I decided to find a way of making my own photo emulsion coating for the plates on hand. My first experiments were directed to making a plate that could be used similarly to the commercial Toray plates that some printmaker use. This required that an ink rejection silicone layer be place over the emulsion before the exposure of the plate. I found this not to be satisfactory with the materials at hand. In the end, I had a system that was easy to control, but only gave me flats, line and coarse textures, but would not reproduce the fine tints of toner washes. I have come much closer to my goal and have been able to get the delicate tints of toner washes, as well as halftone photographs made with opaque silver emulsions.

Theory behind my early research

While taking my apprenticeship as a graphic artist in a printing plant in the early 50's, I learned many aspect of lithography as part of my training. We made two types of litho plates, depending on the quality of printing job on hand. The fastest and cheapest were the plates that used ammonium dichromate as the photo sensitizer for egg albumin. The other type was a deep etch plate that used gum Arabic for its colloidal protein content. This type of plate was more expensive to make, but produced superior results. Amongst the many protein-containing materials that I tried for my positive plates were egg albumin, fish glue, casein, polyvinyl alcohol and gelatin. While I had used egg albumin many years before in doing printmaking at my home studio, I had used a whirler system to apply an even coat to the much smaller plates I was using at the time. I intended to find a coating system that was simpler, yet effective enough to be used at schools and small print

shops. I tried foam sponges and a pad of velvet cloth to spread an even coat over the larger plates I now used - unfortunately, egg albumin has a tendency to froth, leaving me with bubbles and pinholes, and an imperfect plate surface.

My first successful results came by using casein made from low fat cottage cheese that I mixed with ammonia. This was sensitized with ammonium dichromate and mixed with diluted screen emulsion. I had tried using screen emulsion alone, but results were not encouraging. The complicated method of obtaining casein was too much for printmakers and results could be very unpredictable for most. In the spring of 2000, I decided to take another look at the process to see if I could improve and simplify the technique. My latest work has been done with the following method, which still depends much on the deep etch method I learned many years ago at the printing press.

A modified deep etch plate

Because of my apprenticeship experience in helping the plate department make offset printing plates, I understood how to make positive plates, so I decided to adapt the procedure, but replace the materials. The deep etch process uses any number of different sensitized colloids exposed to a positive. This hardens the background areas and allow the image alone to be removed with appropriate developers. After the image was released, the plate was then washed with anhydrous alcohol to make sure no water damaged the stencil. The image was etched into the metal with a weak organic acid, then Deep V lacquer was rubbed into the image, which was reinforced with developing ink and rosin/talc mixture. Next, the plate was placed in water and soaked until the hardened emulsion came off. The plate was then gum etched and sent to the pressroom.

Finding a better emulsion

I had tried the Kiwicol screen emulsion we are presently using at printmaking, but for some reason I did not get good results. The emulsion was very sticky and could not be spread evenly over the surface of a large plate. At that time I rejected the Kiwicol product as unusable and tried MagnaCure because it had a consistency which allowed me to produce a smooth film on the plate.

When the university changed over to Kiwicol screen emulsion many years ago, we were left with a number of gallons of MagnaCure in the storeroom. Later it was decided to dispose of the outdated emulsion, which I saw as a possible resource to make positive litho plates. After sitting around for five years, the emulsion had become quite viscous, but could be worked into a smooth solution with addition of water. At first I used it with casein as I had done with other emulsions, but because I had so much of the product, I decided to increase the amount of diazo sensitizer and dilute the emulsion to more workable viscosity. It turned out that the viscosity of the emulsion is very important in getting the right thickness unto the plate surface. It is also important to find a good method to spread the emulsion evenly over the plate surface.

The coating method as perfected in 2001,
using Kiwicol emulsion

Controlling the viscosity of the emulsion

Having the right viscosity is the secret of making the screen emulsion work for this process. The Kiwicol product is extremely sticky because of the materials used in manufacturing the emulsion and even my first attempts at diluting it were not successful. After gaining the experience of using MagnaCure, I decided to try the Kiwicol again. By trying different proportions of water, I realized that the spreading mechanism had to be improved (more on that later). First I developed a special spreader that helped in laying down the film, then attacked the viscosity problem.

Viscosity flow meters are known within the manufacturing community, but these are very sophisticated machines. I devised a simple method that should work for most emulsions printmakers may use. It consists of timing a predetermined amount of diluted emulsion to flow

through a calibrated restriction. Other emulsions may require different viscosities to what I have found satisfactory with Kiwicol.

Note in March, 2003

When I went to throw out the long expired Magnacure emulsion, I found some buckets were still fluid just as when new. I decided to see if this emulsion might work as well and proceeded to coat some plates. To my surprise, I got good results after having to adjust the exposures. This means that there can be many other emulsions that should work after one finds out the best viscosity and exposure times. Maybe you can even get some outdated emulsion for free. Good luck.

Making a simple flow meter

I first suggest using a thin plastic sheet that can be formed into a simple cone shape and held together with an appropriate adhesive. It made a cone with a 90 degree shape and a hole the diameter of a regular pencil. To have a known amount of fluid in the meter, it is necessary to have a fill line marked inside the cone. After some experiments, I found a method that produced results, but having to make the cone measuring system was a severe draw back for others. I started to find a better method

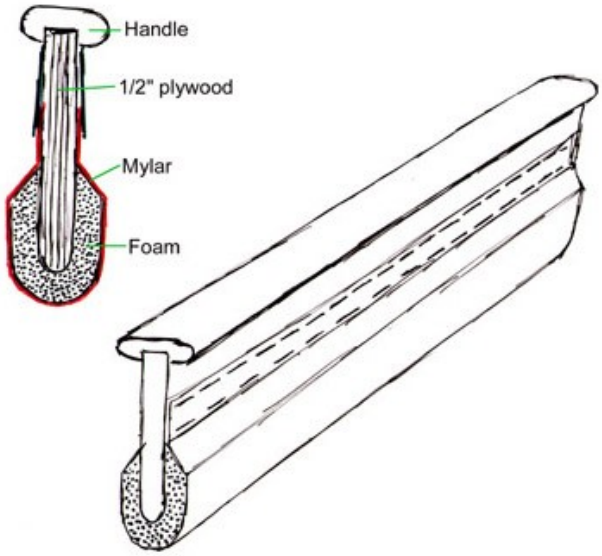
There is on the market large syringes made for the large animal veterinarians practices. They should be available from farm suppliers inexpensively; you do not need the sharp needles. First remove the plastic molding meant to hold the needle and file the surface smooth. Next enlarge the hole to 1/8th of an inch (or 3.17 mm) with a drill, making sure the hole is clean and smooth.

When using the flow meter, fill it with diluted emulsion up to the 2 ounce (or 60 ml) line while holding a finger over the hole. Use a stop watch to time the emptying of the flo meter. Since the temperature of the emulsion will have a great deal of influence on the rate of flow, use some constant to get accurate results.

For the Kiwicol emulsion I have found the follow flow rate to give the right viscosity for coating:
22'C (72'F) = 17:00 seconds

Building a spreader

The diameter and resiliency of the spreader edge has a lot to do with proper application of a smooth film. The spreader is much like a squeegee, but with a larger curve on the blade. By selecting a diameter of around 3/4 of an inch, I got good results. To make a spreader, start with a 1/2 inch piece of plywood about 5 inch wide and a bit longer than the width of the plates you will be using. Round one long edge to get a radius of 1/4 of an inch, making sure it is true along the entire length. I recommend a router to get the best results.



You will need some firm foam urethane to glue to the rounded edge. I found a 1/2 inch thick blue foam that is used as a ground sheet to be perfect for the application. Cut a strip 3-4 inches wide and a bit longer than the plywood. Apply contact adhesive to the plywood edge and high enough to accommodate the foam. Apply the adhesive to the foam and let both dry to the touch. Hold the plywood over the foam and carefully press it along the centre of the foam strip. After good contact is made, roll the plywood over first to one side, then the other, to bring the two materials together. Make sure there is a good bond between them. Trim the foam so that is parallel to the edge and even on both sides. I would suggest putting a bevel to the foam so that the Mylar used to cover it will fit better on the spreader. Trim the ends flush with the plywood.

Take a strip of clean Mylar that is longer than the spreader and about 8-10 inches wide. Lay it over the spreader and staple it along the edge of the foam at very close distances. Take some silicone and spread a small bead just at the end of the foam. This will prevent emulsion from finding its way between the Mylar and the foam. Turn the spreader over and stretch the Mylar over the foam so that is as tight as you can get it; then staple it in place. You should have a smooth straight rounded edge at this point. Trim the excess Mylar, making sure that silicone seals the foam at both ends. Now staple and secure the rest of the Mylar to the plywood so that it will hold securely under use. I suggest putting some wide duck tape over the edge of the Mylar and the top of the spreader to help keep the plastic in place. I put a rounded piece of wood along the top to give me a better grip on the unit. It might be a good idea to use some wood strips to hold the Mylar tight against the plywood as this gives better support to the plastic covering.

Applying the emulsion film under a yellow bug light

I use my siliconed subplate as the base for applying the emulsion because it rejects the material so well. Use polyethylene sheeting that is stretched reasonably tight over a smooth table surface as an alternative base. To prevent spilling emulsion when you come to the end of the coating stroke, I would suggest making a trough like arrangement to catch the excess. Take a piece of plastic pipe

used to plumb a home for a central vacuum system, slicing it in half lengthwise. On each end, glue a half of an end cap to enclose the trough. To make it easy to attach to the coating platform, find a piece of similar plastic sheet and cut a section the width of the trough and about 6-8 inches wide. The trick will be to put a bend in the sheet about half inch from one edge, running the full length of the trough. There is equipment for bending acrylic sheets available but one can use a simpler technique. I heated a sheet of copper used of etching and about 4 x 6 inches and used this to soften the thin styrene sheet along a line I had drawn. As the plastic became soft, I lifted it up to form an angle of around 120'. This lip was glued inside the trough with the cement used for the vacuum pipe assembly.

After coating a number of plates, you will find the trough full and difficult to empty. To help I suggest putting a plastic threaded bottle cap at one end at the bottom. Find a suitable bottle that can be glued to the trough or use a polyethylene bottle so that a heat gun can bond the two together. Cut the cap off and fit it to the curve of the trough. Attach it according to the plastic selected and let it cure. Using a sharp thin blade, cut out the hole and apply more adhesive on the inside of it to make sure of a good bond. To prevent some of the emulsion from creeping up under the coating slab, I suggest attaching a thin strip of dense foam right at the top of the trough. Slide the sheet edge under your slab, letting the trough hand down just at the end of the coating stroke and over the end of the table. You are now ready for making plates.

Using a gravy fat remover, apply a bead of emulsion along the top of a clean plate that has been treated with sodium silicate or metasilicate. This is necessary as we are dealing with diazo sensitizers that become impotent when coming in direct contact with aluminium. Use firm pressure to evenly draw the bead of emulsion down across the plate and off into the trough. It should leave a nice smooth film on the surface. I use an expired credit card that has the profile of the rounded spreader edge cut into one side. This is used to remove the emulsion left on the spreader before it starts to dry. It is extremely important to have a clean spreader for each draw-down, so immediately wash off the spreader edge with water and dry it before taking off the plate to dry. The emulsion on the poly can be left there for the next plate or two if they are being coated at once. When the residue of emulsion gets to be a problem, use a window squeegee to put it back into the supply container. Keep the table surface clean as the emulsion dries very quickly and can leave particles that will cause streaks on the plate. Because of the thin coat, the plates dry very quickly; you can also use a hot air gun to harden the film. I store plate face to face in a cupboard where I keep my paper stock and have used them up to six months later.

Exposure of the plate

To my surprise, I found that the screen emulsion took much less exposure to produce a proper litho plate; it also had a greater latitude of exposure. Flats and many textures can be easily reproduced, making these plates an inexpensive way to apply colors to your editions. I use a UV point source with a vacuum frame, and keep a record of formulation and exposure times for use in future editions. I have a light integrator for precisely controlling the exposure of plates, especially where tints are concerned. The finer detail required of toner washes and other delicate images, calls for a more accurate exposure than flat areas.

A fast way to determine an exposure

When confronting new emulsions or exposure units for the first time, it could take tremendous effort to find the perfect time. I learned this method years ago and pass it on for its' simplicity.

From your past experience, take an educated guess on what the exposure should be. Give the entire plate one half this amount. Somehow indicate where the plate is divided into five equal sections. Using a large masking sheet, give four of the sections one quarter of your estimated time. As an example, if you thought the plate might take six minute of exposure, you would first give the entire plate three minutes. On four of the sections you would give each one and one-half minutes, leaving the last with the original three minutes. What you have is a plate with five different controlled exposures. The middle one would be the six minutes you estimated. On each side would be a 50% over and under exposure. At the ends you would have exposure 100% over and under. With this plate processed, you can have a better picture on fine tuning the next test, using the same proceedure. This method works on all photo sensitive materials and usually requires only two tests.

Development of the emulsion

Under yellow bug lights or subdued incandescent bulbs, pour cool water over the surface and spread it with a soft pad. I use a very soft plush fabric to gently go over the image until the metal is clear of any material. By not rubbing hard, make sure all the loose emulsion is off the plate surface,

as it can cause failure later. If the emulsion you use leaves a contrasty enough definition of the image, then no dye is needed in the developing water. If one is desired, the best dye to use is Eosin Red that will stain the protien in the emulsion, making it easy to see the image and the development taking place. Other dyes may also work. A properly exposed plate will take quite a bit of rubbing with a gentle fabric, but can be damaged with a heavy hand. It is important to make sure that no residue of the emulsion is left in the image area so flush the plate well with water. A pad made with scraps of fake fur or Velux blanketing works fine for gently developing the exposed plate. Use a rubber band to hold the fabric on a small piece of scrap 2 x 4 lumber.

Flush the developed plate with cold water and tip it to pour off as much water as possible. If the emulsion is properly exposed, you may get away with using a window squeegee to get rid of most of the water. Use sheets of unprinted newsprint to blot the remaining water off the surface. Let the plate dry to allow the emulsion to become firm.

Masking areas that have no emulsion

Before the lacquer is applied, it is possible to mask areas with a simple water-soluble glue solution to prevent the lacquer bonding to the metal surface and creating an image. This procedure may be necessary if you missed some areas in you emulsion application, or dust and other blemishes become visible. If you use color separation positives produced from your computer, you will probably use some form of registration marks to assemble the Mylar overlays. These will show up after the development of the plate, but can be eliminated at this point by covering them with some water-soluble glue mixture.

The vinyl lacquer

As a better substitute for Handschy lacquer, I have found that Ink Dezyne GY-157 Royal Blue Vinyl ink, plus GY/MV-182 solvent, made a good mask for the image. The GY/MV-182 retarder solvent was chosen as it retarded the drying of the fast curing vinyl ink. I used the color blue as it turns out to be the strongest to show me the image in the very thin layer being used. Dilute the ink 1:2 or 3 with the solvent and you will have a solution that is easy to spread and produce a nice thin coat in the image. Make sure that the layer of vinyl ink is not too thick as you will not be able to remove the exposed emulsion mask - or too thin as that will allow silicone to break through to the metal.

The above lacquer dries very fast and is hard to spread an even coat over a large area. At one time I used to mix about 30% Handschy vinyl lacquer to retard the drying but since then have found a better method. To get the perfectly smooth even coating was one of the major problems but a small buffing pad solved it all. A block of wood 2 x 2.5 inches is covered with a soft plush material first, then with a couple layers of plastic from a grocery bag. This should be stretched smooth. To use the pad, take a facial tissue and fold it into quarters and fit it over the smooth side, holding it on with a rubber band.

Ink Dezyne has been taken over by Nazdar, but I have been told by the local supplier that they will keep the ink dezyne vinyl line with the same numbering but probably under a different name. I have found that this vinyl lacquer also works just as well as commercial Deep V types on traditional plates.

Apply in the lacquer

Using the pad, apply the modified vinyl lacquer, spreading it to a thin even layer. Since there is a tendency to leave a thicker film along the edge of an application, move the edges farther from the image to make things easier later on. I prefer to use a paint stripping heat gun to quickly dry the lacquer. You will see the change in the lacquer surface as it dries.

Removing the hardened emulsion

Use sodium metaperiodate, the generic stripper for most screen emulsions. I use a Velux covered wooden block and go over the entire surface where there is emulsion. The lacquer will protect the emulsion for a while longer, but in a minute or so it will react. If your emulsion is of the right formulation, the lacquer will start to come off fairly quickly. It may take more rubbing where the lacquer is thicker along the edge of your application. The color of the image will show against the metal and allow you to see how you are progressing. Flush off the stripper with water and use a squeegee to get rid of it. One can see if all the areas are clear of emulsion as these will show as a darker stain or a dull misty area; reapply stripper to those regions. I have found that a much less concentrated solution of the expensive metaperiodate powder is needed than for screen-printing. To make sure that no emulsion remains, give the plate a wash of diluted acetic acid as this will strip off any the has not been removed. **All the emulsion has to be removed**, **otherwise silicone will not be able to bond to the metal so it will lift to cause problems.** It is advisable that you apply a very diluted wash of sodium metasilicate over the bare metal to allow the caulking silicone to better bond to the surface. If too strong of an alkaline is used on the surface, it may damage the lacquer and destroy your image. Flush off the silicate after a few seconds and dry the surface. Look for any thin emulsion stains on the bare metal as these can be better seen on the dry plate. Remove them. It is now ready for coating with silicone.

Checking the vinyl image

All should be well, but it might be a good idea to carefully examine the image. You should be able to see the coloring on the reflective metal surface and notice if the lacquer is missing for some reason. Use the same Sumi ink and glue mixture I recommended for covering emulsion blemishes, or use a solution of shellac in alcohol or a Sharpie marker. The plastic solutions are easier to remove when it comes time to washout the image.

Applying silicone

I dilute my silicone much more for this process than what I recommend for drawing on grained plates. Since the smoother surface has very shallow depressions when compared to ball grained plates, less silicone would cover the surface well enough. Buff the silicone to a smooth layer and allow to air dry, since it will take very little time for curing in such a thin layer. A second coat can be applied but is not always necessary. Be careful not to rub too hard in spreading the new silicone even after allowing sufficient time for the first layer to cure. I use a folded piece of facial tissue to apply the a second silicone coat as I have found it superior to the foam rubber, which as a tendency to act like an eraser on the first layer. Let the plate cure as long as possible before attempting to develop (wash out) the lacquer in the image. A very smooth surface allows me to use less viscous ink and get better detail in the toner images. Take care in buffing the surface so that it is as smooth as possible.

Development of the image

Use an acetone/retarder solution for taking out the lacquer to reveal bare metal. If your lacquer was not as thick as it should have been, there may be areas in the image that will not take water as well when you wash the plate. Go over these areas again with acetone, taking care not to harm the silicone. Some strong industrial cleansers containing citrus thinners may also help to retrieve these areas, but remember the silicone is still not well cured and easily damaged. When the entire image takes water, which you can see as a reflection, the plate is dried and ready for printing.

I have found that a good retarder for acetone is a DOT 3 brake fluid. All common DOT 3 and 4 brake fluids are made with polyalkylene glycol ether, which is a non-toxic material. About 5-10% added to acetone which prevents the solvent from flashing off to and redepositing the lacquer. Soapy or clean water can be used to remove plastic residue before it dries. The MSDS information puts this product as the safest retarding chemical I have found so far.

Printing

The plates are just as robust as my other waterless plates and print large editions. If you encounter areas that want to take ink, these can be blinded with a very diluted solution of caulking silicone in white gas. This allows the solvent to quickly evaporate, leaving a very thin silicone coating. Apply with a facial tissue and let stand for a minute then buff with a dry section of the tissue. Heat can be applied if the area is away from the image.

If you are not careful in preparing and handling the metal surface, surprises can appear as tints, smears or lines, just like in ordinary lithography. Keep the area you work as clean as possible to prevent contamination of any kind. I have found that it takes very little of a water-soluble material to become an image or put blemish on your plate, if you are careless in handling it.

Reclaiming the plate for reuse

This is the nice part of this technique - the continued reuse of the plate. Because the silicone layer is very thin, the silicone stripper can be very diluted as well. First remove any ink with acetone, or detergent for water soluble ink, making sure the surface is free of oil. In Canada there is a commercial product meant to refresh cedar lumber siding and decks. The main ingredient is phosphoric acid, but it also contains some sort of surfactant that prevents beading of the stripping fluid on the silicone. This gives an even surface without the beading marks where a straight acid mixture first attacked the silicone. Using plain diluted phosphoric acid has always left beading marks. The product is called Simple Deck, manufactured in Canada but sold thought the USA also.

Add a few grains of ammonium bifluoride or some "Armour Etch" to get some action to attack the silicone rubber. If mixed properly, the mixture can require as little as 0.35% of bifluoride molecules to give you a clean plate.

It should be very easy to reclaim the plate as long as the silicone was not applied too thickly or ink has been allowed to dry in the image. Use the same recycling methods as I have recommended for all waterless plates. Apply sodium silicate solution, then flush the surface with water and dry. The plate is ready for reuse for direct drawing or as a positive plate.

Using this process for making plates from negatives

I have had mixed results using this emulsion for negatives instead of diazo wipe-on emulsion. The same positive emulsion mixture was applied on plates and allowed to dry. The exposure was made through a good negative and developed in plain water. This left the hardened emulsion in the image area. Silicone was applied over the entire plate and buffed down as for a normal plate. After the silicone cured, the plate was developed with the same sodium metaperiodate solution used for making positive plates. I have experimented in trying this process on the back of used plates, in the hope of saving money and getting rid of the toxic diazo developer. It would be important that the plate be subcoated with diluted silicate solution before coating with silicone, to better hold the rejection layer. I must admit that the commercial diazo material produces and holds superb fine detail.

By using this method, one would eliminate the toxic solvents in the diazo developer supplied with the commercial process. Plain water is used to develop the plate and metaperiodate to release the image from the cured silicone. Neither is dangerous in comparison to any other commercial material used for negative systems. Once the silicone is bonded to the metal surface, the plate would be as robust as any waterless plate.

Because of the uncertainty of success with this technique, I continue to use the supply of diazo material I have on hand. As time permits, I will do more research by trying different emulsion formulations and try other methods. My aim is to eliminate the toxic developer now used with commercial diazo wipe-on plates.

Conclusion

Some may consider making ones own plates taking things too far, in view of the many excellent commercial plates on the market. These commercial plates are intended to be used only once and can become a major expense if a large number are needed in an edition. Today, the packaged product is considered the ultimate choice because of high standards of production, but this entails a price many may not want to pay.

Positive plates and use of images on Mylar is now an accepted part of printmaking. Most of the successful printer/publishers are using them for a good reason. I have found printmaking faster, easier and cheaper, especially when using these 'home-made' plates. While I still think commercial plates produce the best fine detail from toner washes, these plates are perfect for many of the plates I need in an edition. Flats, coarser textures and line images work well with these plates, reducing my plate costs to a fraction of what it was before. I have had excellent results using positives made on an Epson 3000 and Azon clear film. Since my latest work has utilized over 20 plates for each edition, there is no way I could afford this many commercial plates to get the effect I want.

You will have to first perfect the recycling of plates as covered in my other paper, before attempting this process. You can also try thicker commercial aluminium sheets as longer lasting plates, as these are less likely to crease and cause minor problems when coating with a spreader. Making ones own photo plates was a standard operation when I started my lithographic apprenticeship in the early 50's, and was just another part of the craft that one learned. We are supposed to be masters of this "diabolical craft", controlling all aspects to get the best image possible. While different, this is no harder than producing editions from grained limestone by traditional lithography.

Nik Semenoff
Artist-in-residence
Department of Art and Art History
University of Saskatchewan
Saskatoon, SK. S7N 5A4

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