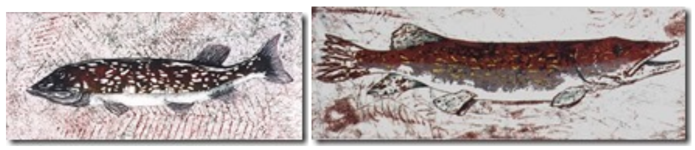
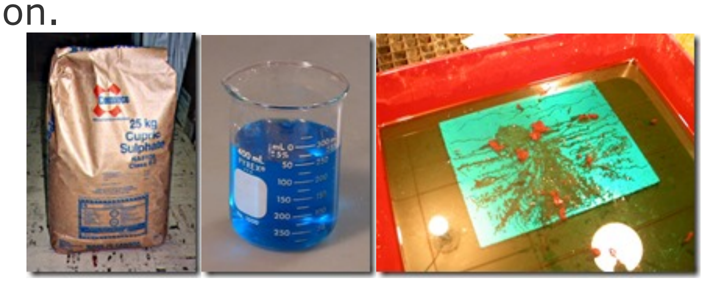
Regeneration of Copper Sulfate Based Mordant

I have found that more etchers are switching to using my basic copper sulfate mordant for aluminium and zinc; while a few might have discovered that copper can also be effectively etched with a modified version of the original formula. One of the most important features of these copper sulfate based mordant is the possibility of regenerating the bath with the introduction of oxygen in some way. That seems to be overlooked by most and only a few serious etchers have been experimenting with these safer methods.



These two prints are done on aluminium by Calvin Burns in one of my classes. They are quite large and he used a larger tray

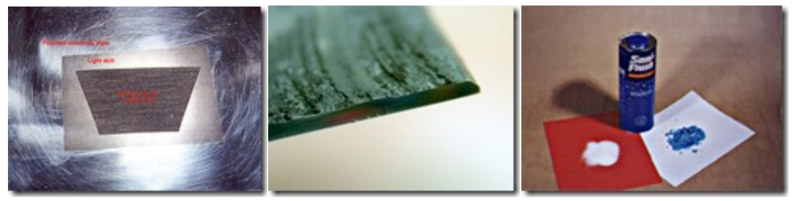
I have published my research into regeneration along with the general use of cpper sulfate on my blogsite at: http://www.ndiprintmaking.ca/?paged=3. There are other articles about using copper sulfate on previous sections of the blog and also there is information on my university server at: http://homepage.usask.ca/~nis715/. Find Intaglio mordant paper on left index column ; the university has secured a new server and for some reason some images for it donâ€™t show up even though they seem to be sitting in my website folder â€“ but you will not be missing much information.



Copper sulfate can be purchased in large quantities to make if less expensive. The copper floats to the surface by the hydrogen in the lines.

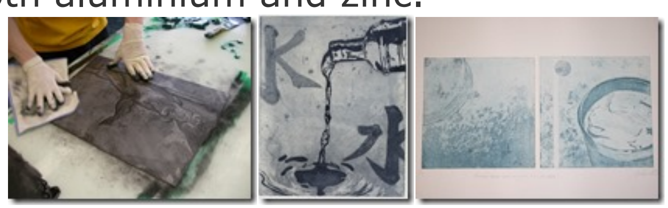
I discovered the use of copper sulfate in 1991-2 and had an article published in the refereed journal for the arts LEONARDO (Vol 31, No2, pp, 133-138, 1998), after it was first accepted in

1994 but then rejected because of fear the copper compounds would get into the environment. Assuring the editors that none should get into the sewer system if the etcher followed my advice, it was finally published after a second set of reviewers went over the article.



Aluminium etched with copper sulfate, salt and sodium bisulfate. The metal produces as rough surface and need not be aquatinted

Since etching is not my chosen print medium, I did the original research for the sake of saving money for my students by using aluminium instead of more expensive zinc. My research originated from my lithographic attempts of copper plating plates with cupric chloride, the experience of mixing copper sulfate with hydrochloric acid in place of the expensive cupric chloride that I didnâ€™t have, produced corrosion instead of copper plating. This knowledge was recalled when a student asked if a cheaper metal than zinc was possible to use. In time I found that a strong enough hydrochloric acid can be made from salt and sodium bisulfate that made the copper sulfate into a very effective and safer method of etching both aluminium and zinc.

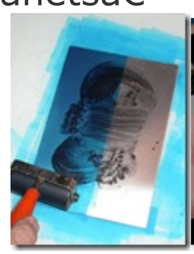


Students printing from aluminium. Yoko Imabayashi has produced the last two images. Many etchers have taken to using this soft metal

By leaving a tray of cuprous chloride open overnight after doing some research late one evening, I was surprised to fine the light green bath had dissolved all the copper particles that come from etching aluminium, to have a good green bath and no particles. It was obvious to me that oxygen played a part in regenerating the mordant and I then understood why the large plastic containers left at the printmaking department to be taken away for safe disposal, had turned dark green with various amounts of white precipitate at the bottom. As a photographer, I had discovered that developer stored in plastic allows oxygen to permeate the polyethylene and spoil the solution. I found that as long as there was some color left in the bath, it would accept oxygen to regenerate the solution by the amount of oxygen presented.


With enough salt, the mordant turns green. Air permeates the plastic containers to regenerate these bottles slated for disposal.
Ferric chloride cannot be regenerated and one has to pay for more of it and also the disposal charges.

As my teaching at the university showed up the small problems with this new safer mordant, I was able to refine the process over the many years, mostly for the sake of etchers and to be able to etch copper and not the more dangerous ferric chloride. Regeneration of the bath not only saves money but is better for the environment and the planetsâ€™ future.



I preferred to use toner images on which I rolled thin shellac that has be colored with dye. Turpentine removes the toner and does not touch shellac

I have noticed that some etchers found regenerating an interesting and important feature, but had not found my articles and research. They somehow had found the regeneration suggestions used by the circuit board manufacturers of electronic equipment. There one finds some companies using chlorine as one of most effective methods, but restricted to stiff control on using this dangerous chemical. This is not necessary for the average etching facilities in studios and teaching institutions. I had found an Australian electronic hobbyist who had a wonderful website explaining how scrap copper, hydrochloric acid and hydrogen peroxide could start a copper etching solution that could be regenerated with the addition of peroxide and sometime more acid. The solution became more potent over etching more copper circuit boards. Unfortunately, this site is now restricted for some reason, but it contained much valuable information on the chemical reactions.

A mix of HCl and peroxide forms cupric chloride that will etch copper. I chose to make HCl from salt and sodium bisulfate

Since my original formula for the copper sulfate mordant contained common salt and sodium bisulfate required to keep aluminium hydroxide from forming, I only had to add some oxygen containing material to etch copper plates and regenerate the bath. This I started to research in 2007 and finally published something in 2008 on my Internet sites and Printmaking Today (Vol.18, #2, summer 2009). It was followed up in the next publication of Printmaking Today, an article on it use by Alfons Bytautas, with whom I had worked on his reaction to this surprising discovery.

Bisulfate is in many products but the best supplier is swimming pool and hot tub shops. Sani-flush it no longer available.

Slowly my discovery has been increasing in use by the more progressive etchers, even some burin engravers have started to use and promote this safer method. Fabiola Mercandetti, an engraver in Rome has found my site and we have been corresponding for many months now about her efforts to make Italian etchers more aware about safer mordents. I really appreciate her efforts to make my methods as being the source for renamed processes that originate with my earlier publication as far back as 1992.

Heating the toner image over camp stove; the above pictures of this plate being processed. More pictures of removing toner with turpentine

For some reason my efforts have been completely overlooked by most etchers and they either donâ€™t use my discoveries or refer to others who have renamed my original research. I did not realize that Goya might have used copper sulfate alone to etch his zinc plates. Fabiola has been doing wonderful research into what materials were used by early etchers for their plates, revealing many common chemicals were being used by some etchers instead of nitric acid, which might have been hard to get. While these household materials would etch most metals somewhat slower than my process, they certainly would be safe to use on the common plate metals. She holds workshops on safer etching and use of a burin as well in many Italian cities â€“ which I wholly support.

Solids can be filtered out and the liquid can be poured down the drain. Copper particles – aluminium hydroxide and zinc silicate are white

On my blogsite, in previous articles, you will find how to remove all toxic materials if you decide to no longer etch plates. I explain how to remove the copper, aluminium and zinc compounds by precipitating the metals and then filtering them out. The liquid can be put down the drain as metals have all been removed. In my original articles, I had stated that bisulfate was not needed if zinc was the metal being used, but I have found that the bath cannot be regenerated as bisulfate is required for all metals to keep in acidic in nature.

Metasilicate or sodium silicate are used to precipitate the metals from mordant that is to be disposed by the etcher

I must also add that table salt is not the best salt to use because it contains calcium silicate to keep it from clumping in damp weather. This forms calcium sulfate, which is insoluble Plaster of Paris used for making molds etc. The sodium bisulfate is best bought from a shop that caters to swimming pools and hot tubs. It is a mild sulfurous acid (H_2SO_3) used in many other crafts where a less dangerous acid is required. I chose it because salt and the bisulfate are both dry chemicals and only need to be mixed in water as needed; keeping dangerous liquid acid off the studio shelves. To precipitate zinc, one should use sodium metasilicate or plain liquid sodium silicate, also known as Waterglass. It is available from pottery suppliers, but you must know that it dries to be waterproof if spilled. The metasilicate comes as a powder and is always dissolves it water, so the best to use. I used to get it as s TSP substitute, but it no longer seems to be available in the large hardware chain in North America.

R*egenerating mordant that etched copper plate. Tule is used instead of tarlatan as it can be washed if waterbased in mixed with etching is used.*

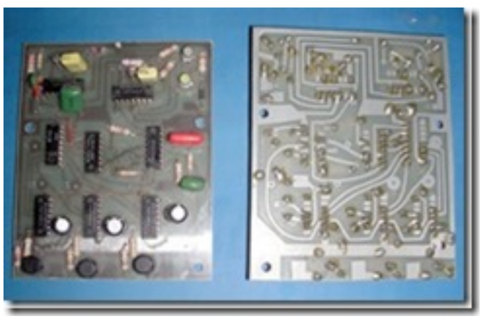
One can make their own waterbased in from Lascaux screen base, a retarder and dry pigments.

In one of the recent e-mailsâ€™ from Fabiola, she told me about a stone lithographer friend of hersâ€™ who tried using a mix of salt and sodium bisulfate instead of nitric acid for the gum etch in traditional lithography. The first attempts were not perfect, but in the end he got good results and I would like to hear more about his research. My prediction is that there forms a thin layer of calcium sulfate (Plaster of Paris) on the stone surface, which would be more hydrophilic that calcium nitrate. I wonder how far

that research will go as I no longer have any stones and only print using waterless lithography.
You should go to previous entries on my blogsite as there is information on copper sulfate mordant as well as other interesting articles. They go back to 2007.

Etching Copper Plates with Cupric Chloride

October 30th, 2008



I was surprised to discover that several amateur electronic workers were etching their copper circuit boards with cupric chloride instead of ferric chloride like in the past. It turns out that this chemical can be regenerated easily with the addition of oxygen from hydrogen peroxide or other oxygen containing chemicals. The electronic industry had taken to using this technology as it is cheaper than ferric chloride that had to be purchased, then discarded through costly disposal fees. While electronic amateurs had found the process, I was amazed that intaglio printmakers had not. Since it seemed to be a continuation of the copper sulfate mordant I discovered in 1992, research into this technology seemed the natural thing for me to do.

At one time in my research into using copper sulfate, I discovered that by adding enough sodium chloride to the bath so that it turned green, indicating a change from sulfate to a chloride compound. To my astonishment, I found that this bath in time would dissolve the fine copper particles left after etching aluminium or zinc and return to a bright green state for reuse in etching more metal.

After the universities printmaking department continuously discarded many gallons of used (but regenerated mordant), it was decided to recycle the spent bath using a large plastic barrel with a spigot some distance above the bottom of the container, so that clear mordant could be drawn off when needed. I have learned that a number of American universities were recycling mordant after I made it known on my university website. Although the copper chloride mordant etches both aluminium and zinc as I first published in LEONARDO, it would had no effect on copper, which many printmakers preferred. Research was certainly needed to introduce this new exciting technology to printmaking, so I started in earnest to find more about it.

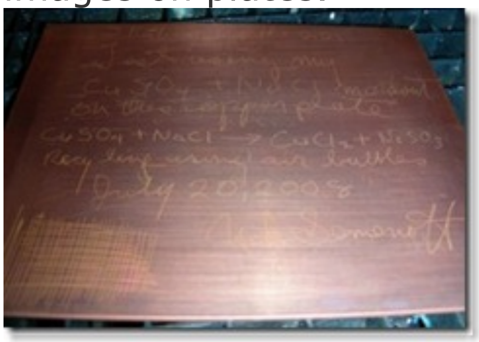
Cupric chloride is expensive and not readily available locally or even from some chemical suppliers. The electronic workers have found that a bath can be produced from a starter solution of hydrochloric (cheaper Muriatic acid) and hydrogen peroxide into which a piece of copper was added for the chemical reaction. As they etched their circuit boards, the cupric chloride would increase and make it more active until a critical point was reached and etching eventual stopped . By adding more hydrogen peroxide, the bath would regenerate immediately so etching could continue. There was no need to discard the mordant as only oxygen, and a small amount of acid might be required from time to time.

There is on the Internet a very good article by Adam Seychell, http://members.optusnet.com.au/~eseychell/PCB/etching_CuCl/index.html., in which he describes many aspects about making and using cupric chloride. Since his explanation is excellent, there is no need for me to go over that information.
Because of my search for safer materials in the classroom and studio, I decided to find a substitute for the dangerous hydrochloric acid or Muriatic that was suggested. Hydrochloric acid was discovered by medieval Islam when salt was added to sulfuric acid. Since I was already using a weaker form of sulfuric acid in with my copper sulfate mordant, along with common salt, I already had the basic ingredients for farther research. By adding

3% hydrogen peroxide from the drug store, I found the solution corroded a test piece of copper very well. I had found a purer form of sodium bisulfate at a store supply chemicals for swimming pools which was very inexpensive – so materials seemed easy enough to find locally. While 3% peroxide worked, it diluted the bath each time I regenerated it, so a stronger solution had to be found if possible. Health food stores sell a 35% solution, but the local ones have had an impossible time to acquire it lately. I had potassium chlorate and found this worked very well, but I don't know how much of the residual potassium compounds would affect a well used bath.
To make research simpler, I made up a saturated solutions of salt

and potassium chlorate and a
weaker one of bisulfate. These I could mix in various proportions to find which worked the best; while taking pH and specific gravity readings in all tests. Pieces of copper where weighed to .01 grams and attempts were made to get the specific gravity with each regeneration cycle. I even went into titration to get more accurate information on acidic content than what I could get with my pH meter. I found there was much leeway in compounding the mordant, depending on what metal one would be etching. I found that solutions close to 2 pH worked well enough and not that dangerous to handle. One interesting observation was the greater chemical action at the point where the long strip of copper would enter the bath. Air obviously had greater effect there and soon the strip would part into two pieces before the series of regeneration tests were fully carried out.

As the copper was dissolved and went into solution, the color would change from a light green to dark brown, when etching would basically stop. By adding oxygen, the test could continue to see how many cycles the 100 ml bath would take before contamination took place. After ten cycles and continued good corrosion of copper, I decided it was time to try actual test images on plates.



Finding a few small sheets of scrap copper in my workshop, I applied various grounds to see the quality of simple lines when printed. The time it took seemed to be slower than what ferric chloride is supposed to give, but I had no experience etching images with it for comparison. Because of the affect of air on the copper strips, I decided to make a simple air agitation system using an old aquarium air pump.

Using a porous stone that was enclosed within a plastic tube, I was able to produce a gentle circulation of the mordant over the plate and remove the Cu^{1+} ions that are not soluble in water. The other thing I found is that it is best to use a rather large bath so the concentration of these ions take a longer time to build up. Instead of suspending the plate with tape, I enclosed a sheet of plastic unto which I put a piece of double faced tape, on which the plate was stuck, using the contact vinyl adhered to its' back surface. The plates printed better than expected, so on to what finer textures like aquatinting might produce.

Because I had earlier developed a technique using toner washes that is basically a "sugar lift" like process, I felt this would be a tougher test for both mordant and metal than an aquatint. This technique requires the use of Ferstman ground (Graphic Chemical waterbased relief ink) as first described in my university website. Toner can be applied directly to a plate or transferred from Mylar as it would be for lithography. The ground is rolled on with a small brayer, making sure that the first application is pressed well into the areas between the toner particles that had been already bonded to the plate. After heating the ground until it starts to smoke a bit, it becomes very tough and can take much abuse during washing out of the toner with turpentine and a soft brush. This leave bare metal in place of the toner, so that mordant can attack it easily. The results were as good as expected and much better than on aluminium.
For etching copper I suggest a bath with specific gravity of 1.2 or greater, and a pH of around 2. Some of my test baths were as low as 1.5 pH, which etched faster. Consider this in relation to

your knowledge of chemistry and how you feel about using a stronger solution. As for etching zinc, I would stick to the simpler copper sulfate and salt formula as I suggested in my Leonardo article published in 1998; but with more salt added to make the bath green in color. Aluminium is best etched in the same bath with bisulfate added to keep aluminium hydroxide from forming. While this new process will etch both zinc and aluminium in a diluted solution, there is no reason to use a bath which is more acidic than the original mordant turns out to be. It was the electro chemical action that makes the original process so interesting and safe.

I had sent the information on my research to Alfons Bytautas at Edinburgh Printmakers, where he teaches etching. While giving a workshop there on my waterless process, I saw the plates Alfons had etched with his formulation using the basic data. He used an open tray with a bright green solution that seemed to etch well within the time reserved for ferric. I also introduced the process to printers at Black Church and Graphic Studio in Dubin, Ireland. The solution was put together without carefully measuring materials, but the copper plates with numerous test lines etched quickly and cleanly in both cases, using only a tray.

While I may not have created a completely new process, by removing liquid acid from the studio, it may be of some help to make it safer. It seems to be a continuation of my basic etching process developed in 1992 and made available to printmakers shortly after that. Why it took sixteen years to get this far puzzles me.

Posted in Research | 1 Comment »

A History of Me Developing the Copper Sulfate Mordant

October 26th, 2008

In 1991-2, I was teaching a first year printmaking class, eventually getting to intaglio in February. When I asked the students to purchase a sheet of zinc from the bookstore, a girl came to me very upset as she could not afford the metal at this time of the school year. Was there some cheaper metal that could be used instead? I thought of iron and aluminum, but felt the latter would come with a smoother surface and require little polishing before applying the hardground. Besides I didnâ€™t like the farther use of nitric acid for iron, so chose aluminum for the small editions required in my class. When I suggested the change to the department head, he rejected the use of ferric chloride, one of the possible mordants other etchers had used. While stannous chloride was a possible alternative, it was hard to get and very expensive when the charges for shipping dangerous materials was added.

A few years earlier, while I was demonstrating my toner process for use with positive lithographic plates, the masterâ€™s student, Christine Christos had become interested to see if the technique could be used on intaglio photo plates as well. While she succeeded to expose and etch a zinc plate, I became interested in getting nitric acid out of the classroom, so started to work on using electric current to remove metal. We worked together and eventually published an article in Leonardo, Vol. 26. #4, 1991. This technique was now available for our students with the power supply unit I assembled for the department, but only a few students chose to use it, even though it could etch any hard metal for very large editions. It worked well on aluminum, but having only one power supply unit for a large class, did not allow many etchings to be made in any given period, so another method had to be found.

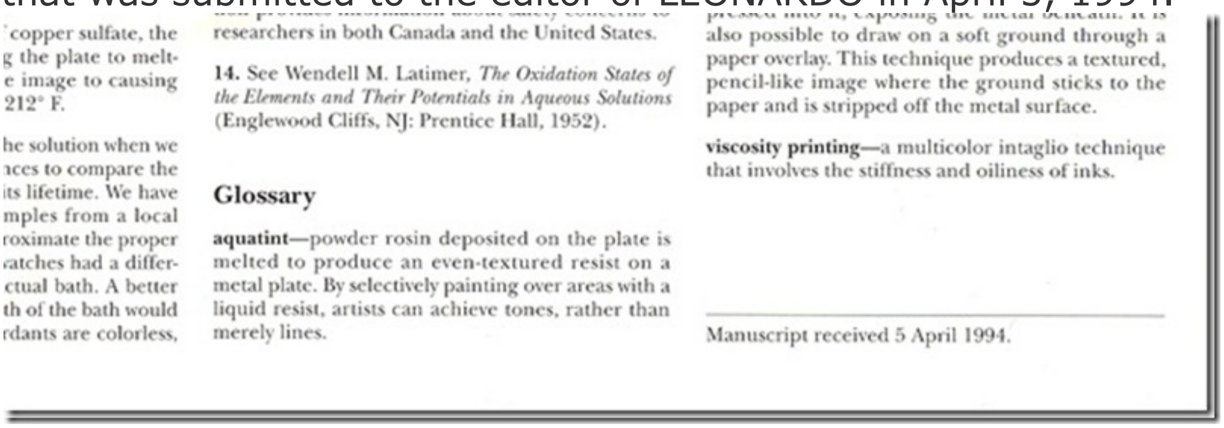
Years earlier, as a lithographer who wanted a better ink base on aluminum plates, I tried a formula used by platemakers for deep etch plates in the offset printing industry. Itsâ€™ major active chemical was cuprous chloride (which I didnâ€™t have) along with hydrochloric acid; so hopefully I tried copper sulfate and the acid to see if it might work. When I tried the solution, there was no copper plating on the aluminum surface, but corrosion where the liquid was applied. After a few varied attempts, I gave up the idea, but this unsuccessful research had stayed in my mind. Was it possible to use this chemical reaction to produce good images on aluminum, I asked myself?

I had some thicker aluminum at home that was used on other projects, so I immediately started to do research with copper sulfate as a mordant. I was able to get good results to find it worked well on aluminum and zinc, so I started to experiment its

use in the class – with one bath for both metals.


In the spring of 1992, the university hosted an international conference **â€œNew Directions in Printmaking; the technical sideâ€**, in which new safer techniques were featured. As the etching mordant was not fully developed, we only had the bath in the print studio with information about it for those who were interested; but not put into the official program. I recall discussing the technique with a number of etchers who where fascinated in the blue solution. Later I discovered that the bath corroded both metals by just adding common salt instead of hydrochloric acid, so introduce that process into teaching the summer session class that year. I soon found that the acid had kept the formation of aluminum hydroxide at bay, which forms a gel-like solution that makes the bath unsightly and reduced it effectiveness. What was needed is an acid that would not interact with the aluminum, just constantly removing alkalinity so the hydroxide would not form. While either sulfuric or nitric acids would work with oxygen in their composition, I did not want to use dangerous acids if possible. The answer was sodium bisulfate; a weak form of sulfurous acid that I was accustomed to using in my goldsmithing practice. Since this material was harder to acquire, a cheaper and perfect alternative turned out to be Sani-Flush, available in grocery stores across North America; used as a toilet bowl cleaner.
Recently, while looking through my research notes for another reason, I ran across the work I was doing to see how much aluminum would be removed for a given weight of copper sulfate. These tests are dated November 12 and 13th, 1992, not quite a year after my first experiments. I had just retired from faculty, but appointed as artist-in-residence; still having access to the resources at the university. Because the process was working so

well, I decided to submit a paper to LEONARDO, the international refereed journal in the arts; where I already had other articles published. To better appreciate the chemical reaction, which was now beyond my basic understanding of chemistry, I contacted the department of chemistry for their help. Dr. Bader accepted the challenge, along with some other professors, who in turn involved their students in the project. The students were asked to figure out exactly what was happening and try to explain it to their professors; then give me an explanation as well. From Dr. Badersâ€™ and the students account, I put together the article that was submitted to the editor of LEONARDO in April 5, 1994.



copper sulfate, the g the plate to melt- e image to causing 212° F.

he solution when we ices to compare the its lifetime. We have mples from a local roximate the proper ratches had a differ- ctual bath. A better th of the bath would rdants are colorless,

researchers in both Canada and the United States.

14. See Wendell M. Latimer, *The Oxidation States of the Elements and Their Potentials in Aqueous Solutions* (Englewood Cliffs, NJ: Prentice Hall, 1952).

Glossary

aquatint—powder rosin deposited on the plate is melted to produce an even-textured resist on a metal plate. By selectively painting over areas with a liquid resist, artists can achieve tones, rather than merely lines.

also possible to draw on a soft ground through a paper overlay. This technique produces a textured, pencil-like image where the ground sticks to the paper and is stripped off the metal surface.

viscosity printing—a multicolor intaglio technique that involves the stiffness and oiliness of inks.

Manuscript received 5 April 1994.

I told the editors that the article was already being distributed by mail as I had Xerox copied my papers for universities across the continent, sending it along with other printmaking information. Printmakers in other countries were now also in contact with me by e-mail, seeking information on the toner and waterless process I had developed earlier. I canâ€™t remember exactly when I put up my website on the university server, but that reduced the cost of copying and mailing large bundles of paper. As the copper sulfate mordant became better known with this move, I started to get more inquires for that process than the others I had developed. To this day the copper sulfate mordant paper on my university website gets the most attention.

The article was accepted by the referees, but I was informed by the editor that there were now some concerns within the LEONARDO office in San Francisco, where copper sulfate was the cause of pollution problems in the bay area from the wine growing valleys nearby. I explained that there was no reason for anymore copper being released into the water than from etchers using nitric acid on their copper plates, or even the copper pipes used for plumbing. Probably even less; if care was taken in handling materials. A second set of referees where chosen and the review process started again. Finally the article was published in LEONARDO, Vol. 31, #2, 1998.

Because etching is not my major printmaking media, I have done much less work with it after my initial research. In my later summer session classes, I started to use larger amount of salt to produce copper chloride, which was much more active than suggested in my first publication. Now I called for enough salt to be added until the solution turned green. I also discovered in my own research at home, that this solution would redissolve the free fine copper particles produced during etching, when left overnight. While this process could not likely go on indefinitely, it could continue a long time if the aluminum hydroxide could be removed as it settled in a resting container. The university has installed a large plastic barrel with a spigot a bit off the bottom, so that the alumina could settle, allowing the reclaimed green mordant to be put back into service.

Because of the price of zinc plates, they are seldom if ever used by our students, as large sheets of aluminum are precut into 24 x 32 inch sizes for sale to them at a fraction cost of zinc. Unlike the zinc and acid etchings, the size of the printed images has greatly increased, demanding a special tray just for the very large plates being used by some of the students. The characteristic of aluminum is the crystalline structure within the metal, which is revealed by the copper sulfates action. This means there is no need for aquatinting to get solid color or lighter tints of any hue.

In our etching trays, we have plastic grill work, coming from discarded fluorescent lights, which is raised off the tray bottom to allow any sediment to rest below undisturbed.

Action of copper sulfate on crystalline structure of aluminum

I have presented the process at a SGC conference and included it when ever I was asked to give workshops at universities across North America on my other innovations. Copper sulfate has become very popular in Europe for etching zinc under the name of Bordeaux and Saline etches. It is considered to be much safer on zinc than ferric chloride, which can produce chlorine gas as it is very reactive with that metal.

When I started to do my research into using copper sulfate, I had no idea that Goya might have used it in some of his zinc etchings. This only became known to me by what Cedric Green had said about Bordeaux etch, after I became aware of his website. I wonder how many times the wheel has be reinvented?

Anyone wanting more technical information on this process, you can find it on the University of Saskatchewan website at: http://

homepage.usask.ca/~nis715/.
Nik Semenoff
Posted in Research | No Comments »

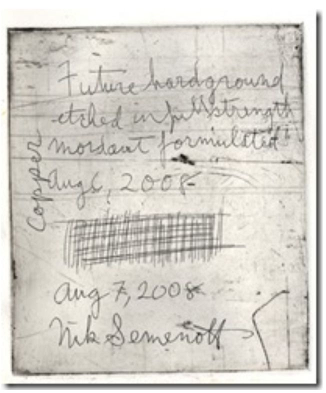
Results on New Mordant Tests

August 14th, 2008

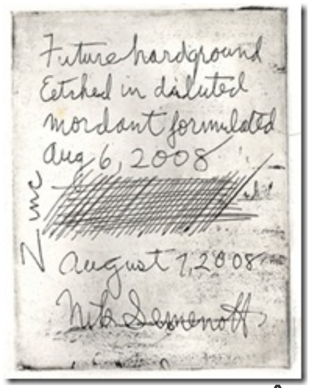
Results have been encouraging with the new mordant I have working on.Â It etches the three common metals used by printmakers, with zinc dissolving the fast and copper the slowest. While there seems to a number of ways to mix a suitable mordant, I have decided to make a stock solution that will work best for copper, but too strong for the other metals – but diluting them to suit the image.

Again I have used toner washes to find out the limits of a mordant as the fine detail the particles can give really tests both the etch and metal.Â In all cases, I donâ€™t apply blockout to the plate beyond the image as I want to see how well the ground has stood up against a mordant in the very thin layer, so bear with the breaks in the background. The toner copper plate was etched in a small vertical tank where the solution is gently recirculate by air bubbles. The remaining plates were etched in trays.
These plates are not made as works of art but for important information about depth of etch and quality of edges etc. The copper plate is a piece of scrap I was able to acquire, but it has seen days at one time. I didnâ€™t need to take the time to polish the surface for these tests.

Zinc etches the fastest producing very fine bubbles that keep the lines clean, but not big enough to block the etching action â€“ no need for feathers.Â This plate printed thin toner brush lines, just like in lithography, but without the very fine detail of waterless lithography images. The ink was Daniel Smith Standard Black that was modified with their DS relief ink, or with a water soluble ink I ground myself. This makes wiping easier but produces more background tone.



This copper plate was etched in a tray, using Future floor polish as a hardground. This copper plate also came from the same scrap heap and contains deep scratches that donâ€™t take away from the information I hoped to get. In the tray this plate took over 1/2 hour to etch, but it still not as deep as I would like. The image has been flipped horizontally to make it easier to read the text.



This zinc plateÂ also had a Future hardground, which was not applied carefully, but etched in a diluted version (75% water) of the stock solution used on the copper plate.Â Etching took only about 7 minutes and I believe I would dilute the mordant by even more next time.Â The used mordant was regenerated quickly or could have been kept to do it by itself over a couple of hours. When I finish all my research and get some feedback from a few dedicated etchers who have agreed to test the mordant, I plan to publish in the international refereed journal LEONARDO; as I have with all my other innovations. Hopefully, once the manuscript is sent to the publisher, I will reveal the formula and method of working.

Posted in Research | No Comments »

Research into a Safer Mordant for Copper Plates

July 28th, 2008

I have been testing my new mordant for copper plates and here are some results. I have gone through the usual line work using Ferstmansâ€™ hard/soft ground that is on my university website. That all worked fine, but the true test is the use of toner washes that print as a positive, just as drawn on the plate. At one time I used diluted shellac until I was shown the hard ground made from Graphic Chemical Ink Co; developed by Gerald Ferstman at the university in Lexington, Kentucky. It is a waterbased relief ink that uses emulsified shellac as the binder, so reacts to heat in much the same way as diluted shellac.



The toner wash is applied in a thinner manner than for waterless litho because the darker areas will print solid color from the aquatint effect of wiping the plate. The toner is set with heat to make sure it is bonded very well to the plate, then cooled. The ink is modified with a bit of softer plastic material as shellac become brittle when dried with heat in this technique. The ink is rolled out on a slab into a very thin film, which is easy to judge by the color intensity, then applied with firm pressure over the toner image to make sure the ink contacts the metal between the particles of toner. Roll the ink on from many directions to make sure all areas are covered, but do not build up a thick layer of ink, especially in the image area.
To harden the ink, I use a propane camp stove as I do not have a hot plate, but even most of these are not quite hot enough to change the shellac into a horn-like surface that will stand up to any mordant. The ink has to get above 150 degree centigrade for this effect to take place.
After the plate cools, I take turpentine and short stubby brush and start to dissolve the toner through the shellac film. At one time I used a coarse stencil brush, but found a short softer one used to apply facial makeup, which seems to work better. Take

your time and gently washout the toner image, leaving bare metal for the mordant to attack.
While a tray bath works well, I have found that bubbling air through the mordant speeds up etching, but I devised a system so that there is a more gently flow of mordant against the image, producing a more even tints across the entire plate. The plate was etched for about 30 minutes in my first test, but I found that was not enough after pulling a proof. To get a better bite, I cleaned the plate and when I was doing more research, I applied a very thin film of the waterbased ink as before, making sure the depressions were not filled with ink. This plate was re-etched to produce a darker image. Compare the two image above.
For another test, I repeated the toner wash on a new copper plate and etched it for about 45 minutes. This is not an accurate test as I had modified the mordant a number of times between the above plates and this one, so activity would certainly be different. Such things as specific gravity and pH are a factor that were not always recorded or taken into account.

This was an old piece of common copper in my workshop, which had seen better days, so it was hard to remove the blemishes and scratches on the surface. While the dark area looks fine, this plate could be improved by using the rolled on ground again to etch the left side image, but block out the dark image after the ink had been hardened with heat. Future floor polish works fine as a blockout.
The hard ground it removed from the plate with sodium metasilicate in most cases, but the ink could be hardened enough with high heat that it doesnâ€™t want to come off easily. For copper you could use a strong chemical such as sodium hydroxide and let the plate sit in a solution for some time. In very severe

cases, I have had to place a facial tissue on the plate, wet it with lacquer thinner, then place another plate about the same size on top to prevent fast evaporation. That has always done the job.
The ink I used was Daniel Smith #7 Standard Black Etching that was modified with their waterbased relief ink to soften it; instead of using Easy-Wipe. On drying, the proofs are completely waterproof as with regular ink. The nice thing about this feature is that the plate is washed out with sodium metasilicate or a commercial waterbased grease remover. No solvent is required for any reason. I also use Tulle fabric, instead of expensive Tarlatan, which can be washed out with soap and water after a printing session.
So what is the mordant formula? Keep in touch as I will disclose it and other mordants I have been working on for aluminium and zinc – after I submit it to be published it in a journal in the near future.
By-the-way, this toner wash technique works well on zinc and aluminium with my copper sulfate mordant; as well as on copper plates with your favourite etching bath.
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Formula for Common Metals

Formula*

Salt NaCl	1000 ml	SP - 1.200	Saturated
Sodium bisulfate $NaHSO_4$	1000 ml	SP - 1.130	Not saturated
Potassium chlorate $KClO_3$	400 ml	SP - 1.145	Saturated

Add $CuSO_4$ to turn fluid green
Add H_2O to get SP - 1.200

Backlight photographs show how adding hydrogen peroxide to a mordant after it etched a copper plate, will regenerate the bath for more etching. The heavy copper ions sink to the beaker bottom and only the top area was disturbed when the peroxide was poured in. Slight stirring intermixes the peroxide as it takes effect on the copper ions and more stirring completely regenerates the bath. An addition of salt or Muriatic acid would produce a greener solution, making it more effective.

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*Used on copper as stock solution. Regenerate with oxygen bearing compounds.
*Dilute by 2/3 with water for aluminium. Regenerate by stirring rapidly or let sit in opened tray. Oxygen and acid may be needed.
*Dilute by 3/4 or more with water for zinc. Regenerate by stirring rapidly or let sit in opened tray. Oxygen and acid may be needed.
Add enough Muriatic acid or salt to turn the solution from blue to green. At some time adding more sodium bisulfate might be needed to supply the acidic content.