# THE INCORPORATION OF SILKSCREEN TECHNIQUES IN THE DECORATION OF RAKU-FIRED CERAMICS

PROBLEM IN LIEU OF THESIS

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By

James Franklin Allen, B. F. A.
Denton, Texas

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# CHAPTER I

## INTRODUCTION, PROBLEM, AND METHODOLOGY

For the past two years, I have been interested in the use of silkscreen techniques in decorating ceramics. I found it to be an extremely versatile printing method. My initial research in this area turned up commercial methods of silkscreening three-dimensional objects which could be modified to deal with ceramics, as well as isolated examples of individuals using a direct screening process on one-of-a-kind pieces. This led to experimentation with developing the specialized screens, mediums, and colorants.

The problem for this investigation was the further experimentation with the use of silkscreen techniques in the decoration of raku-fired ceramics.

The questions answered by this investigation are as follows:

1. Which silkscreens and stencils will work in screening flat and three-dimensional objects?
2. Which mediums and coloring agents will survive a glaze firing to produce an acceptable image?
3. How can the image be modified by screening during the different stages of a ceramic piece (wet, green, bisque, glazed)?
4. What glazes and glaze applications will be compatible?
5. Generally, what is the relationship between the image and the object?

I gathered the information needed to answer these questions by completing two series of ceramic pieces. A series of ten three-dimensional pieces, as well as ten two-dimensional pieces were executed. Each of these dealt with different aspects of the problem, requiring a different approach and yielding different results. During the work, I examined the available literature on the screening of objects, as well as other artists' attempts at screening ceramics.

## CHAPTER II

## PROCESS DESCRIPTION

The preparation of the silkscreen involved a number of steps beginning with the stencil. I used photographically prepared high-contrast stencils in this investigation, because I felt they best suited the subject matter.

After the image was chosen, a black and white photograph was taken. Kodak Plus-X film was used and processed as normal negatives would be. These negatives were then enlarged and printed on Kodalith Orth, Type 3 film. These were developed using a special developer, Kodalith A + B, and then standard stop and fix solutions were used. This resulted in a positive transparency. This served as the silkscreen image. In producing this image, or Kodalith, I used basic knowledge of black and white darkroom techniques as well as access to an enlarger and other photographic equipment. However, any camera shop or printing company can produce a Kodalith from black and white snapshots.

The next step involved preparation of the silkscreens and squeegees. Instead of silk, I used a 220 mesh organdy, which gave the same results for approximately one-eighth the cost. The organdy was stretched on frames made of $\frac{1}{2}$" x 1" wood molding. The size and weight of these screens were deliberately kept to a minimum, because I would be handling

them on irregular surfaces. In the application process, a suitable squeegee was required, and these were hand-made also. I found that I obtained excellent results using a standard square blade of medium flexibility. Several squeegees were made, ranging from 1" to 6". The comparatively small size made it easy to apply an even coating of screening medium over an irregular surface, as I could apply pressure where needed.

A light-sensitive coating was needed on the screen in order to transfer the image from the kodalith. Two options were available: the direct method and the transfer method. Having worked with both methods, I felt the direct method was the least expensive, easiest, and most versatile of the two; and I used it exclusively in this investigation. In the direct method a photo-emulsion is mixed, spread over the screen, then exposed and developed on the screen. The chemicals can be safely worked with in normal light while wet, and upon drying become light sensitive. The image is then exposed and developed.

For the screen coating, I chose Speedball PhotoEmulsion #4573 and Sensitizer #4574. I wrote to the Speedball Company in Philadelphia and received detailed instructions on using these chemicals and information about screening rounded surfaces. Mixing the chemicals together in the correct proportions, I applied two medium-thick coatings on the screen and dried it in the dark with a small fan.

For exposing the image onto the screen, I arranged the screen and kodalith in the following manner. First, a small platform of rubber foam was laid down and the screen placed over it so that it gave the screen fabric firm support from underneath. Then the Kodalith was positioned on the screen fabric right side down. A sheet of clean glass was laid over the Kodalith in order to press it flat and give complete contact with the screen. For the exposures, I used a 3200 K Photoflood bulb suspended approximately 18" over the surface of the screen and used an exposure time of ten minutes. The first efforts were not satisfactory, resulting in screens that either would not print or were not permanent. By experimenting with the thickness of the emulsion coating, I found that one extremely thin application gave the best results. I also found that an exposure time of six minutes resulted in a stencil that was permanent and that could be easily developed with a rinse of warm water. After developing, the screens were dried by the use of a fan and checked for any faults such as pinholes or thin areas which might allow printing medium through the screen around the image. These were touched up using Speedball Screen Filler #4530 to ensure a sharp printing.

With a screen prepared, I needed a printing medium that was the same consistency as regular silkscreen ink and that would have the ability to adhere to a clay surface and produce an image capable of surviving a firing in the

1500°-1700° F. temperature range. After unsuccessful experiments with water, clay slip, and glazes, I found that Permanent Pigments Perma-Gel gel medium was a close approximation. Using linseed oil to thin the gel medium I was able to produce a screening base which would pass through the screen just as silkscreen inks would. By applying it to clay pieces, it would adhere to the clay in the wet, green, and bisque steps, but not on a glaze-fired piece. Since the usual screen colorants would burn away with the medium during firing, ceramic colorants were used. Mixing these in different proportions, I achieved the following colors:

Green: 100 grams medium
2 grams red iron oxide

Blue: 100 grams medium
¼ grams cobalt carbonate

Yellow: 100 grams medium
4 grams rutile

Black: 100 grams medium
8 grams red iron oxide
6 grams manganese dioxide
1 gram cobalt carbonate
1 gram chromium oxide
1 gram copper carbonate

When I first used the screens, I found it difficult to achieve acceptable registration. In a typical screening operation, the screen frame is hinged to a board and the material to be printed can be secured so that no misalignment occurs. I found that the slightest movement gave a blurred print. By keeping the overall size and weight of the screens at a minimum, I found that, with practice, I was able to

position the screen with one hand and squeegee with the other. The very small squeegees could make several passes while allowing for high and low areas on the clay. After a number of trials, I found that I was able to reproduce an image on a two-dimensional clay piece. Handling a three-dimensional piece presented an entirely different set of problems. A silkscreen is designed to accommodate two-dimensional media only. All the available literature found up to this point dealt with screening flat surfaces. Even the few clay pieces with screen images found in publications consisted of flat-sided boxes and shallow platters. However, in Photographic Screen Process Printing by Albert Kosloff, I found a reference to a mechanical jig which would allow the use of a regular silkscreen to print directly on bottles, cans, and other round-surfaced objects. I wrote to the Atlas Silk Screen Supply Company in Chicago for information on this device. The illustrations I received showed a series of rollers which held the round object, letting it revolve as a screen pressing down on it from above moved from left to right. In this way, complete contact was made around the object. It occurred to me that the same results could be achieved by simply rolling the round object across a towel, which functioned as a cushioning device for the revolving pot, while pressing the screen across it by hand. Again, registration was a problem; but, with practice, I found

that I could reproduce an image all the way around a cylindrical object.

With the ability to print on either two- or three-dimensional clay forms, I then decided to experiment with printing on forms during the different stages of the ceramic process. The original experiments were done on bisque ware, that is, clay fired to about 1500° F, giving it a hard porous nature. The medium printed excellently on these pieces. Next, I used a clay piece which was dry, but still unfired, with similar results. Then I screened an image onto a still pliable wet slab of clay. The image printed very well, but I found later that upon drying and bisque firing, the resulting shrinkage caused separation in some areas of the print from the surface of the clay. I increased the amount of non-plastic filler, or grog, in the clay with the result of less shrinkage, and no print separations occurred. With the printing possible at this stage, I had the option of manipulating the printed clay into new shapes, and even the freedom of distorting the image in a controlled manner. Pieces past the last stage of the process, the glaze firing, would no longer accept a print. The oil-based medium refused to adhere in a sharp deposit and in firing did not form a permanent bond with the clay.

When I was ready to glaze, I found that I had two options available concerning the relationship between the print and the glaze. Since the printing medium was oil-based, any

water-based solution such as glaze, poured over it would immediately shed off the printed area. This worked to produce a very distinct difference between the print and the unprinted area. The glaze would be very smooth and stand out sharply around the edges of the print which would be very rough and matte finished like the clay underneath it. I could eliminate this tendency of the print to shed glaze by simply bisque firing after printing. This would burn out the oil medium, leaving the printed colorants behind. Then, a transparent glaze could be applied over the entire piece with the result of the print showing through the glaze from underneath. I tried various thicknesses of glaze and several different formulas. I wanted a white glaze which would be compatible with the black prints and capable of gray shadings or very bold craze lines. The following glaze was used:

| | |
|---|---|
| Colemanite | 80% |
| Nepheline Syenite | 20% |

In the first tests where I glazed over the print, I used a thick coating of glaze. When the pieces were fired high enough to get a glossy finish, the print underneath became blurred. This was due mostly to the iron oxide in the block printing mixture leaching into the glaze. From my research, I noted that others had obtained good results using large percentages of cobalt in their printing mixtures. A new formula for the black mixture was tried, eliminating

the iron and increasing the cobalt carbonate to 4 grams. This mixture, along with a thinner coating of glaze over the print gave good results. The leaching problem still occurred when I allowed the oil in the print to act as a resist. Even though the glaze did not cover the print, where the glaze and print bordered, colorants would leach into the glaze giving a blurred edge. The new formula helped eliminate this along with a thick to medium application of glaze around the print. I also found that by slightly underfiring the glaze, the prints always came out very sharp. The glaze would not pull out color from the print if underfired as it would when it was fired to complete maturity. This also gave a range of surface effects including areas of soft gray. This glazing method best complemented the print but was never completely controllable.

The final step in the raku-firing process is the reduction of the pieces. After the pieces were fired to the correct temperature, the kiln was opened and the red-hot piece taken out with tongs and placed in a container filled with combustible material. The container was then sealed off smothering the material which burst into fire as the hot clay piece was placed into it. This created large volumes of smoke which blackened all of the clay not covered with glaze. This gave the pieces their finished appearance. This step could be controlled by opening the container and exposing parts of the piece to fresh air, which weakens the

carbonization. This way the body could be made to range from deep black to gray and to white. The black printed areas could be made to stand out against the glazed background and fade into the black clay surface.

## CHAPTER III

## COMMENTARY ON SELECTED PIECES

My subject matter for this problem was derived from early American railroads, and I tried to make the clay assume some of the characteristics of these machines. I felt that the raku process of firing lent itself to this because of its coarse, smoky nature; and I tried to emphasize these qualities.

Piece #1. This was one of the first successful two-dimensional pieces. The surface of the clay was quite rough, and yet the image came out sharp. The unglazed clay areas are not quite dark enough to really give the appearance of the tracks disappearing into it which was the effect desired. The rough, pebbly surface takes on the appearance of grading under the tracks.

Piece #2. This was one of the first successful three-dimensional pieces. I found that the closer the three-dimensional pieces were to a perfectly round cylinder the easier they were to print. In this form I used the resist method of glazing. By pouring the glaze over the print and quickly running over it lightly with a damp sponge, the edges of the print came out very sharply. The glaze coating was heavier than I originally planned; but it resulted in a

large, patterned craze which complemented the print. With the raku process, this gave sooty, smoky cylinders similar to the boilers and smokestacks of early locomotives. I scratched lines in the clay on this form to emphasize certain parts of the machines.

Piece #3. On this cylinder, I modified the shape somewhat by closing the top in more and paddling the base to give it more of an elevated feeling. After viewing the finished piece, I felt these modifications were not successful. Although they added interesting visual elements, they really had nothing to do with the rest of the piece.

Piece #4. In this instance, I tried to resolve the problems in Piece #3. This was closer to the effect desired.

Piece #5. I tried for more of a formal composition with this piece. It was essentially a two-dimensional form; but the center area was similar to a plateau, raised about 1" above the border. I liked the idea of a piece that was flat but with volume bringing parts closer to the viewer. This made the piece stand out more and gave a stronger separation between the glazed and unglazed areas. This was the first piece in which I used impressions in the clay other than scratched lines. I wanted to make the clay interact more with the print. From a local hobby store I purchased toy train tracks, switch lights, etc., that I used to make clay stamps which would leave a raised impression in the

piece. This moved the viewer from looking at the illusion of the print into the surface of the form.

Piece #6. As in Piece #5, the formal elements were dealt with, but more exaggerated. Everything in this form seemed to work together better. The tracks did not seem to show up enough after looking at the finished piece, so they were touched up with silver enamel paint. This worked better; but it seemed as though the color was distracting, and the paint would have to be chosen with more care. The glaze application was thicker on the top giving a nice crackle. It was thinner on the lower areas which seemed to give a dark gray surface around some parts of the print. This suggested that along with slightly underfiring the piece, I could get areas of gray in a more controlled manner. I felt that the variation of white to gray was very important in giving the areas around the print more interest.

Piece #7. For this form I attempted to further exaggerate all the elements in the previous two pieces. The left half was elevated perhaps two inches while the right half was raised about one inch. The edges of these raised areas were paddled and carved to resemble strata that could be found in a road cut surrounding a stretch of tracks. The surface was then scratched with a saw blade giving a rough texture similar to grading. Three impressions were then made moving from left to the right. The first was very slight, the second somewhat more defined and noticeable, and

the third extremely detailed and very high in relief. This last impression extended out over the lower half of the piece. These impressions were then highlighted with silver and brown paint to simulate the rails and ties. Printed over this were repeated images of boxcars, themselves fading away at the edges. I hoped these devices would lead the viewer's eyes from the form to the print and vice-versa. The glaze on this piece was very thin giving mostly a gray tone. I feel this was one of the most successful pieces done during the investigation.

Piece #8. In this piece I reduced the size of the image and folded the edges of the clay form giving the piece a convoluted shape. The glaze was applied thicker than on the others resulting in a strong network of craze lines. This piece was presented as a window through which a distant image could be viewed. I felt this piece was quite different than the others and perhaps not as successful.

Piece #9. The scale of this form was increased making a larger image necessary. Since the screens were only half as large as the image needed, I decided to try printing one half on one screen and then matching the second half with another screen. By working this way, I could avoid having to handle a large, heavy screen which would have been too awkward for one hand. I used small dots of iron oxide as registration points and very lightly marked where the two prints would meet. The two matched very closely; and where

there was any misalignment, I touched it up using thinned printing medium with a fine brush. This was relatively uncomplicated because the images I was working with were high contrast. If half-tones--that is gray shaded areas--had been involved, the process of matching would have been extremely difficult. In glazing this shape I used a medium covering of glaze which gave a dull white color with some edges slightly gray. I covered the image with glaze letting either end vanish into the dark areas of the pot. The shape of this form matched the smokestack of the locomotive very closely.

# CHAPTER IV

## SUMMARY

Investigating the possibilities of using silkscreen techniques in the decoration of raku-fired ceramics was the purpose of this project. Although the questions have been dealt with during the process description, the following are more specifically directed toward the individual questions.

1. Which silkscreens and stencils will work in screening flat and three-dimensional objects?

The choice of screen preparation was based on the choice of subject matter, while the design of the equipment itself was based on the physical problems that I would encounter in transferring the images to irregular surfaces. Since the images were to be graphic reproductions of old photographs, I chose the photographic method of stencil preparation. This is the most common method because of its accuracy, versatility, and low cost. I found that I could produce screen stencils of excellent quality and that I could increase or decrease the scale of the stencil to accommodate the surface to be printed.

The design of the screens was based on my experience in handling full size screening equipment. Since I had to position the screen and transfer the image in very awkward

positions, I used the smallest and lightest frames and squeegees possible. The squeegees were kept very small--one being only one inch wide--so I could control the transfer of printing medium to the clay. I found that I could achieve a larger image by printing in sections which meant less limitations from the small screens.

2. Which mediums and coloring agents will survive a glaze firing to produce an acceptable image?

For a screen medium I chose a gel extender for oil paint. This is a common item and washes out of the screens with any standard silkscreen cleaner. I could control the consistency by diluting with linseed oil and found the mixture accepted ceramic colorants to produce a print that would bond permanently in the clay and withstand a high temperature firing. Other transparent bases could also be made to work, such as regular screen ink extender or acrylic extender. By mixing ceramic colorants it would be possible to achieve a wide range of colors suitable for printing.

3. How can the image be modified by screening during the different stages of a ceramic piece (wet, green, bisque, glazed)?

In printing during the different stages of a ceramic piece, a number of affects could be achieved. By printing on a wet form, the clay could be manipulated, distorting the form and/or the image. A printed part could be incorporated into the construction of a finished piece, resulting in a print which would otherwise not be possible (i.e., inside a

box). By printing on the green form, the piece could be bisque fired, burning out the oil base from the print and allowing a smooth unbroken covering of glaze over the printed areas. By printing on the bisque piece, the oil in the print could be allowed to work as a resist, resulting in a glaze surrounding the image but not covering it. Screening on the glaze-fired piece was completely unsuccessful. The prints were not sharp and refiring to fix the print only made it worse. I concluded that an entirely different type of medium would be needed and would not result in a better printing method than the first three options. Working during the bisque stage gave the most consistency and resulted in the sharpest image. Also, working while the clay was wet gave many possibilities.

4. What glazes and glaze applications will be compatible?

I feel that the choice of glaze and its application greatly influenced the image. Even limiting myself to a single glaze, I found a wide variety of effects possible which could enhance or completely destroy the effect desired. Glaze tends to dissolve any colorants it comes into contact with, and this had to be considered when choosing an application method. The best effects resulted from pouring a medium-thin coating over the printed area, allowing the print to act as a resist, and then quickly wiping over it very gently with a damp sponge. This cleared away any excess glaze that might overlap the print, giving a sharp

outline to the image and letting the glaze serve as a background. This type of application will work with any type and color of glaze as long as the glaze does not have a tendency to run when fired. When glazing over a print which has had the oil medium burned out, any glaze which is transparent will work, although a loss of detail should be expected.

5. Generally, what is the relationship between the image and the object?

As I printed images on the clay forms, I found myself changing the forms more and more from what I originally thought they should be. One of the biggest problems was the image overpowering the form. The most successful results came from incorporating devices that would work interest back and forth between the image and the form. The stamps seemed to help achieve this, as well as the modeling of the clay to complement the print. The relationship between the two is a very tense one unless all elements are tied together.

The adaptation of silkscreen techniques with clay forms has been very successful. The technical problems I encountered were solved satisfactorily to the point where I feel the process was controlled. These techniques opened possibilities for future work such as printing with glazes or simple colorants. There is enough versatility to offer many solutions to anyone wanting to incorporate a print on a clay surface. Once set up, a silkscreen can give many prints

with very little maintenance. The greatest difficulty encountered was the resolution of the use of a two-dimensional image on a three-dimensional object. One always seemed to be more important than the other, and it was difficult to make them work together as a single unit. I felt very deliberate devices were needed to bring the two together. This resulted in my use of incised lines, stamps, and in general manipulating the form extensively to accept the image. This changed the forms I used as well as my approach. Because of the versatility of the printing technique, I was able to progressively change the type of forms I used and still include the type of image I wanted. It is this, more than anything else, that convinces me of the success and adaptability of silkscreening in the decorating of ceramic forms.

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# APPENDIX

## SOURCES OF MATERIALS

Advance Silkscreen Supply
6440 Rampart, Houston, Texas

Brittains (USA), Inc.
56 Beaver Street, New York, New York

Hunt Manufacturing Co. (Speedball)
1405 Locust Street, Philadelphia, Pennsylvania