

ANALYSIS OF THE SALT-BISQUE TECHNIQUE, ITS EFFECTS UNDER
REGULATED CONDITIONS AND ITS EVOLUTION THROUGH THE
INTRODUCTION OF SEVEN SODIUM-BASED CHEMICALS

PROBLEM IN LIEU OF THESIS

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CHAPTER I

INTRODUCTION

The salt-bisque technique of firing clay was an effect inadvertently discovered by ceramist Paul Soldner in the early 1960's. He found that salt vapors had affected bisque-ware in his kiln and had turned the pieces a bright orange (7:56). Many ceramists have since continued to explore the potential of this vapor firing technique through the addition of various chemicals and also through smoking and fuming pieces in combustible materials to achieve new soft colors, textures, and dramatic surfaces on clay (7:56). Since the salt-bisque technique is a relatively new firing process, documentation is limited. The process is often learned from someone who has worked with it extensively or, more commonly, through trial and error methods. The textural qualities and warm colorings which make the technique exciting have also proven to make it frustrating. Overfiring burns away subtle colors and underfiring keeps the salt from producing vapors important for successful results.

Through experimentation, I have found that the salt-bisque technique can produce a wide variety of surface and textural effects. Patinas reminiscent of ancient artifacts, dry-eaten surfaces, and unpredictable blushings of color

from beige to dark purple are possible. These are qualities which I have been able to adapt and alter to meet my artistic sensibilities and clay concerns. The salt-bisque surface effects have enabled me to develop and integrate pottery forms with painting surfaces. As my work has progressed, the process of throwing and altering clay forms has become more familiar and decisive; the manner in which the surface is treated as a painting ground has become more expressive. The pieces explore the plastic qualities of both clay and paint through the manipulation of the form and the bold brush decoration. Through the salt-bisque technique, any harshness of color and form dissolves under the mist of salt vapors which attack open or exposed surfaces.

Statement of the Problem

This study examined the effects of the salt-bisque technique under regulated conditions and its evolution through the introduction of seven sodium-based chemicals. Regulation was attempted during the three decisive stages of my working process: the formative, decorative, and conclusive (firing kiln) stages.

Initial testing of the sodium-based chemicals began with the use of sodium chloride, sodium carbonate, sodium bicarbonate, and sodium borate because they had been used successfully in high temperature salt firing. Sodium sulfate, sodium hypochlorite, and trisodium phosphate were additionally used because these chemicals contain substantial

amounts of sodium and upon volatilization were expected to react favorably with the silicates in the clay body to form clearly visible effects. Questions answered in this study were:

1. Could the salt-bisque technique be better regulated through attempts made during the formative, decorative, and conclusive stages of the working process?
2. Would the sodium-based chemicals alter the clay surface enough to produce new effects in the salt-bisque technique?
3. If there was a change in surface effects, which effects would I adopt or reject?

Methodology

Seven series of tests were conducted so that the regulation and introduction of each sodium-based chemical could be examined and regulated.

In test series I, the seven sodium-based chemicals were added to the clay body in a specified proportion during the formative stage, using the line blend method. The clay and chemicals were mixed so that predetermined effects could be incorporated into a piece when it was initially formed. During the decorative stage, the chemicals were sprayed or brushed on the surface. By directly applying the sodium-based chemicals, effects which altered the clay surface could be more simply regulated for localized reactions. During the conclusive stage, the chemicals were put in pouches and placed in specific areas within the kiln to determine how well they could be regulated during a firing and to

discover the effects caused by each chemical on the clay surface. This chemical was also soaked in various combustible materials like sawdust and hay, again to affect a localized area and to expose the clay surface to the combination of sodium-based chemicals and combustible materials. Test samples were made from each chemical in the three stages mentioned. The test samples were controlled as much as possible by the use of saggars and finished pieces corroborated the effects of the test samples. Each of the following sodium-based chemicals was tested practicing the aforementioned procedures.

TABLE I
SEVEN SODIUM-BASED CHEMICALS TESTED

- (A) Sodium chloride
- (B) Sodium carbonate
- (C) Sodium bicarbonate
- (D) Sodium borate
- (E) Sodium sulfate
- (F) Sodium hypochlorite
- (G) Trisodium phosphate

Throughout the work done for this proposal, I used a white clay body. I found that this clay body accepted salt vapors effectively and was especially resilient under harsh firing conditions.

TABLE II

WHITE CLAY BODY FORMULA - CONE 010

10% Talc
31% Ballclay
10% EPK
41% Fireclay
8% Mullite
100% plus 2% bentonite

CHAPTER II

A DESCRIPTION OF THE PROCESS

TEST SAMPLE SERIES

For all test samples, bowl-shaped saggars were press molded from the white clay body. The uniform size of the saggars enabled them to be effectively sealed to avoid atmospheric contamination during firing. The open shape of the bowls also allowed the visual textures to be more easily examined and recorded after firing.

Procedure Series I

For the first series of tests, each of the chemicals was combined with the clay, using the line blend method of formulation. More specifically, all the dry ingredients were divided into portions ranging from four ounce lots to twelve ounce lots for the combined mixtures. The zero and sixteen ounce portions designated the beginning and end of the line. Lots were mixed according to the following table.

TABLE III

PROPORTION FOR LOT MIXING

	1	2	3	4	5
Sodium (oz.)	16	12	8	4	0
Clay (oz.)	0	4	8	12	16

Plastic bags were labeled and used for the mixing and storage of each batch. To make the compositions homogeneous, eight ounces of water was added to each batch and left undisturbed until the mixtures had absorbed all the liquid. The only exception was the sodium hypochlorite, which was used in liquid form; hence no water was needed.

When the mixtures had absorbed all the liquid, or the clay had softened (approximately twenty-four hours), the packages were opened and any excess liquid was removed. Using rubber gloves and a spatula, the clay was mixed further with the sodium-based chemicals. Test tiles were made from each sample. The samples were allowed to dry completely since all work would be fired green. Finally, each piece was marked and set in a saggar and fired.

Results of Test Series I

A. Sodium Chloride

100% The chemical volatized completely, leaving a large rough-textured spot which was dark brown in color. The sodium chloride saturated through the saggar and caused corrosion which was detectable on the exterior.

75% The chemical did not volatize completely; many granules of the sodium chloride were clearly visible in the sample. The composite was dull pink to dark rust in color.

- 50% The chemical volatilized completely leaving pits in the clay which were the same shape as the sodium chloride granules. The test sample was very dark brown in color.
- 25% The chemical volatilized completely, leaving no visible pitting. Textural qualities of the composite were similar to the original clay body except more porous. The color was bisque pink.
- 0% No change - clay body.

Conclusion Test IA

The sodium chloride affected coloration in all the Series 1A test samples. Flashing from the 75% and 50% samples was detected on the saggars under the samples. The 50% sample demonstrated the richest color with a dark brown, almost maroon, variation.

Though the color variations were interesting, I found that the sodium chloride/clay test samples were weakened by the addition of this chemical to the clay. Samples were easily broken under pressure and pitting left the clay too porous. The only exception was the 50% composite, which demonstrated nominal durability.

B. Sodium Carbonate

- 100% The chemical did not volatilize but remained in a white powdery stage. A light blue spot was detected under the powder.
- 75% The chemical did not volatilize. Since the sodium carbonate did not mix well with the small amount of clay, the test sample crumbled under minimal pressure. A yellow ocher color predominated in the clay sections of the sample and the chemical sections were powdery white.
- 50% The chemical did not volatilize. Though porous, the sample was stronger than the 75% composite. The test sample was grey in color with a white crust along the edges from the sodium carbonate.
- 25% The chemical did not volatilize completely. Pitting and pinholing caused the sample to appear volcanic in texture and the composite crumbled easily with pressure. The center of the sample was light pink in color and the edges were a powdery white.
- 0% No changes - clay body.

Conclusion Test IB

The sodium carbonate affected coloration in all the Series IB test samples. None of the samples demonstrated

a good variety of color and, because the sodium carbonate did not mix well with the clay at the tested temperature, it consistently remained in a powdery stage. The test samples were greatly weakened by the addition of this chemical and crumbled at the slightest pressure.

C. Sodium Bicarbonate

- 100% The chemical did not volatilize completely, but left a powdery residue on the bottom of the saggar which was light blue in color.
- 75% The chemical did not volatilize completely. Instead, it showed evidence of vitrification. The sodium bicarbonate was clearly visible as a powdery residue, but the amount of clay in the composite appeared to be fused into a hard mass. A blue cast of color was forming on the powder and the clay was bisque pink.
- 50% The chemical vitrified completely and fused with the clay in the test sample into a hard mass which was grey in color.
- 25% The chemical vitrified completely, although the surface had a powdery texture. The test sample was orange around the edges and grey-colored in the hard mass of the composite.
- 0% No change - clay body.

Conclusion Test IC

The sodium bicarbonate minimally affected coloration in all the Series IC test samples. The color range was limited to bisque pinks or dull greys. The test samples were strengthened by the addition of this chemical to the clay. The composites were resilient and extremely hard because of vitrification.

D. Sodium Borate

- 100% The chemical fused completely into a clear, transparent glass pool.
- 75% The chemical fused completely into a clear, crackled pool of glass, with dry specks of fired clay that were bisque pink in color.
- 50% The chemical vitrified completely. The test sample was fused to the saggar and the composite was very hard in texture, with large, bloated holes. It seemed similar to lava rock in color and texture because of the holes and the blackish color.
- 25% The chemical vitrified completely, fusing the test sample to the saggar. A sandy surface textured the composite, which was pinkish-grey in color.
- 0% No change - clay body.

Conclusion Test ID

The sodium borate affected coloration in all the Series 1D test samples, as well as altering the textures markedly. The test samples were strengthened by the addition of this chemical to the clay. Composites varied greatly in color and texture, yet were resilient and extremely hard because of vitrification.

E. Sodium Sulfate

- 100% The chemical volatilized completely leaving a large brown-grey spot. The sodium sulfate saturated through the saggar and caused corrosion which was detectable on the exterior.
- 75% The chemical did not volatilize completely. Test samples were powdery to the touch and were greyish-brown in color.
- 50% The chemical showed signs of vitrification. The clay was pitted and fused with the sodium sulfate into a hard mass yet, under the test sample, the saggar revealed a dark brown color. The test sample contained the most variety of color so far, changing from a dark brown in the center to grey and finally shades of orange on the edges.
- 25% The chemical fused completely. The clay was hard and fused to the saggar. Signs

of pitting were visible on the sample,
which was light orange in color.

0% No change - clay body.

Conclusion Test IE

The sodium sulfate greatly affected coloration in all the Series IE test samples. The composites contained the most color variety so far. The samples were strengthened by the addition of the chemical which made the clay resilient and hard.

F. Sodium Hypochlorite

100% The chemical volatilized completely leaving a light beige-orange spot.

75% The chemical volatilized completely. Since the sodium hypochlorite was added as a liquid ingredient with the small amount of clay, the test sample could not be shaped and was instead applied as a slip. The surface was cracked and pitted, but did not peel or flake from the saggar (see Figure 11, page 43). The sample was bisque pink in color.

50% The chemical volatilized completely. The composite was brittle and broke with a snap instead of crumbling. On the exposed areas the sample was bisque pink, and white on the unexposed bottom.

- 25% The chemical volatilized completely leaving no trace of color on the saggar. The composite was harder than the 50% composite, but crumbled into small particles. The test sample was light brown and white in color.
- 0% No change - clay body.

Conclusion Test IF

The sodium hypochlorite barely affected coloration in the Series 1F test samples. Composites displayed weak colors and minimal variation in shades. The samples were weakened by the addition of this chemical to the clay which crumbled easily, with the exception of the 75% slip composite.

G. Trisodium Phosphate

- 100% The chemical volatilized completely leaving a mat white spot with a medium orange-colored halo along the edges.
- 75% The chemical did not vitrify completely, but it fused the sample to the bottom of the saggar. The composite was porous and crumbled easily. For the most part, the sample was powdery white in texture with specks of bisque pink-colored clay.
- 50% The chemical did not vitrify completely, but again fused the test sample to the saggar. The TSP which bubbled to the surface of the

composite was easily crumbled though the center remained hard. The sample was white and powdery in texture and halos of beige to light brown were seen around the sample.

25% The chemical did not vitrify completely, but remained a white powdery surface on the test sample. The composite was hard and fused to the saggar; rings of color from orange to brown formed around the test sample.

0% No change - clay body.

Conclusion Test IG

The trisodium phosphate minimally affected coloration in the Series IG test samples. Composites were for the most part covered with a white powdery crust which remained consistent in each test. The samples were weakened by the addition of this chemical to the clay, which crumbled easily, though the center remained hard.

Conclusions and Summary of Test Series I

From this series of tests, I found that, for the most part, when the sodium-based chemical volatilized (A., F.) or remained in a powdery state (B., G.) the clay was weakened by the chemical. The sodium-based chemicals which vitrified or showed signs of vitrification (C., D., E.) strengthened the clay and made the composites more resilient.

Because the initial addition of the seven sodium-based chemicals reduced plasticity when they were mixed with the different proportions of clay, I found that they all would be unsuitable for use in the formative stage of my working process. Though the composites could not be thrown on the wheel, I found that several test samples (A.50%:C.25%:D.50%:E.50%:E.25%:F.75%) demonstrated original effects in color or texture and could be further investigated using methods other than wheel-throwing or as material incorporated as a decorative element.

Procedure Test Series II

In the second series of tests, the seven sodium-based chemicals were weighed into sixteen-ounce portions and mixed with sixteen ounces of water (except for the sodium hypochlorite, which was neither dissolved nor diluted because of its liquid state). The mixtures were then heated in a container until the chemical dissolved completely. Each solution was then stored in a glass jar and marked. Before firing, saggars were brushed down the centers with each of the solutions.

Results of Test Series II

A. Sodium Chloride

The saggar was marked by a medium to dark orange blush of color. Heavy saturated areas were obviously darker.

B. Sodium Carbonate

Only a very light white streak was visible.

C. Sodium Bicarbonate

A white to light blue streak with an orange halo was clearly visible. The texture was mat and slightly powdery to the touch.

D. Sodium Borate

A clear sheen to deep gloss was visible. The gloss was more evident in the heavy saturated areas.

E. Sodium Sulfate

The streak of chemical contained brown-grey sections where the chemical was heavily saturated and the same color was visible in the lighter areas, except speckled instead of solid.

F. Sodium Hypochlorite

A light brown to light orange streak was visible.

G. Trisodium Phosphate

The streak of chemical contained light brown mat speckles of color mixed with brown, with slightly glossy effects in saturated areas.

Conclusion and Summary of Test Series II

From this series of tests, I found that the strongest visual effects were caused by A., E., and G., the weakest by F. The coloration was not exceptional but, because the sodium-based chemicals were directly applied to the clay, I felt that many new options could be further explored in

the decorative stage of my working process. The deep gloss of D. could add a new dimension to the mat surfaces. The different effects can be controlled somewhat, depending on how much and where the chemicals were applied on a specific piece of work. Because of the serendipitous quality of the firing process, I found that this series of tests was valuable because it will enable me to have more control over final results due to the directness of the application.

Procedure Test Series III

In the third series of tests, each of the seven sodium-based chemicals was weighed and divided into one-ounce portions. Each portion was then wrapped in newspaper and sealed with tape to make a small bundle or pouch. Because the sodium hypochlorite was used as a liquid, it was placed in a plastic bag instead of newspaper. The seven pouches were then placed in marked saggars and fired.

Results of Test Series III

A. Sodium Chloride

The chemical volatilized completely leaving a dark brown spot which saturated through the saggars and caused large cracks.

B. Sodium Carbonate

The chemical did not volatilize, remaining in its original white powdery state.

C. Sodium Bicarbonate

The chemical showed signs of vitrification, though a white powdery residue was still evident.

D. Sodium Borate

The chemical fused completely into a clear glass pool.

E. Sodium Sulfate

The chemical volatilized completely, leaving a dark brownish-grey spot which saturated through the saggar.

F. Sodium Hypochlorite

The chemical volatilized completely, leaving a light brown-beige spot.

G. Trisodium Phosphate

The chemical volatilized completely, leaving a mat white spot with a light orange halo.

Conclusion and Summary of Test Series III

From this series of tests, I found that, though effects were consistent with previous results in test series I and II, the manner of putting the chemical in pouches localized the chemical too much, causing a more severe reaction with the clay. Cracks (A.), corrosion (A., E., G) and vitrification (C., D) were limited to the specific area where the pouch had been placed.

Procedure Test Series IV, V, VI, VII

In the fourth through seventh series of tests, each of the seven sodium-based chemicals was dissolved into a solution exactly as in series II. The subsequent solutions were then combined with various combustible materials, which were divided into the last four series of tests. The combustibles were IV-sawdust, V-cotton strips, VI-excelsior, and VII-hemp rope. Each of the combustible materials used was weighed into sixteen ounce batches. The combination of solutions and combustible materials was kept in plastic bags for twenty-four hours and turned often for uniform absorption. The soaked materials were then left out to dry fully. Small amounts of the soaked materials were placed in marked saggars and fired.

Results of Test Series IV - Sawdust

A. Sodium Chloride

The interaction of materials resulted in complete volatilization. The texture was mat and the chemical had saturated through the saggar. Dark brown areas with specks of beige colored the inside of the saggar. A light orange to beige halo bordered all dark areas (see Figure 1, page 38).

B. Sodium Carbonate

The interaction of materials resulted in noticeable vitrification. A semi-mat texture, with a light powdery residue from the chemical and ash, was detectable. Deeply saturated areas were light

turquoise white and less affected sections were dark brown or grey with strong orange halos.

C. Sodium Bicarbonate

The interaction of materials resulted in minimal vitrification, except around the edges. The texture was thick and powdery, but the residue had begun to fuse to the saggar in places. A light turquoise blue dominated affected areas and the vitrified edges were a transparent, glossy turquoise (see Figure 5, page 40).

D. Sodium Borate

The interaction of materials resulted in total vitrification. The texture was glossy and transparent with crackling throughout the surface affected. A light turquoise blue was the only noticeable color, and it was visible in heavily saturated sections (see Figure 7, page 41).

E. Sodium Sulfate

The interaction of materials resulted in total volatilization. The surface was mat and a raised pebbled texture was visible in less saturated areas. A dark brown color dominated the affected areas, and chemical saturation left a dark brown spot on the exterior of the saggar.

F. Sodium Hypochlorite

The interaction of materials resulted in complete volatilization. Only a light haze of beige color was noticeable in the saggar.

G. Trisodium Phosphate

The interaction of materials resulted in noticeable vitrification. The texture was semi-mat with specks of clear gloss. The ash residue, which was lime-green in color, fused to the saggar in places. Under the ash, the color was purplish-gray speckled. Around the edges, the color was rust brown.

Results of Test Series V - Cotton Strips

A. Sodium Chloride

The interaction of materials resulted in complete volatilization. A large, organic-shaped spot following the contours of the cotton was left in the saggar. The inside of the affected area was consistently medium rust-colored, with slightly lighter color variations where the ash residue had settled (see Figure 2, page 38).

B. Sodium Carbonate

The interaction of materials resulted in noticeable vitrification. A large, organic-shaped spot following the contours of the cotton was left in the saggar. The inside of the affected areas consisted

of a variety of mat colors, ranging from white to pink, light blue to dark blue specks, and finally a hard-edged halo of dark orange color (see Figure 3, page 39).

C. Sodium Bicarbonate

The interaction of materials resulted in noticeable vitrification. A small, organic-shaped spot within a larger, less defined shape, was observed. The small spot was whitish-blue in color and heavily pebbled in texture. The less saturated shape was predominantly blackish-grey. A clear glossy halo was detected around each of the two integrated shapes.

D. Sodium Borate

The interaction of materials resulted in complete vitrification. No clearly defined shapes were noticeable, but a brown-colored pool of glass was left. The glass pool was heavily crackled with a white residue of ash (see Figure 8, page 41).

E. Sodium Sulfate

The interaction of materials resulted in total volatilization. A dry, mat texture with a light ash residue was detected. A medium brown color dominated affected areas and a light brown color was visible under the ash (see Figure 9, page 42).

F. Sodium Hypochlorite

The interaction of materials resulted in complete volatilization. An uneven-shaped spot was left on the saggar. The inside of the spot was medium brown to rust in color. The inside edge of the spot was dark brown with a light yellow halo.

G. Trisodium Phosphate

The interaction of materials resulted in noticeable vitrification. The texture was semi-mat and no ash residue was detected. The color was a faint orange-beige haze with white, transparent lines towards the center of the affected area (see Figure 13, page 44).

Results of Test Series VI - Excelsior

A. Sodium Chloride

The interaction of materials resulted in complete volatilization. The texture was mat, mottled spots which were brownish-rust with light yellow halos.

B. Sodium Carbonate

The interaction of materials resulted in slight vitrification. The texture was mat, mottled spots in affected areas. These areas were light green to greyish-purple in saturated areas, and dark brown-rust color in less saturated borders.

C. Sodium Bicarbonate

The interaction of materials resulted in complete volatilization. The texture was mat with a raised, pebbled surface in saturated areas and noticeable vitrification in less affected areas. The pebbled areas were white in color and a clear, glossy halo defined the less saturated borders.

D. Sodium Borate

The interaction of materials resulted in complete vitrification. The texture was that of a clear glass pool, which was heavily crackled. A mat white area was noticeable where the ash had built up.

E. Sodium Sulfate

The interaction of materials resulted in noticeable vitrification. The texture was semi-mat with glossy areas where the excelsior ash had settled. A light brown color with a thin grey halo dominated the affected areas.

F. Sodium Hypochlorite

The interaction of materials resulted in complete volatilization. Faintly mottled beige and light beige colors were visible (see Figure 12, page 43).

G. Trisodium Phosphate

The interaction of materials resulted in noticeable vitrification. The texture was semi-mat with areas

of gloss. The chemical saturated through the bottom of the saggar and on the exterior of the surface was a transparent satin sheen. A milky white color dominated both the inside and outside of the saggar. A light brown halo bordered all edges of the affected areas (see Figure 14, page 44).

Results of Test Series VII - Hemp Rope

A. Sodium Chloride

The interaction of materials resulted in complete volatilization. Affected areas followed the shape of the hemp rope as it had been laid in the saggar. A dark brown color with heavy mottling of light beige from the ash residue was visible.

B. Sodium Carbonate

The interaction of materials resulted in noticeable vitrification. Affected areas followed the shape of the hemp rope as it had been laid in the saggar. A greyish-blue color marked the contour of the rope, followed by a white, pebbled line just inside the grey-blue. The most saturated areas in the center of the rope were heavily pebbled in pink to green colors. An orange halo outlined the entire shape (see Figure 4, page 39).

C. Sodium Bicarbonate

The interaction of materials resulted in noticeable vitrification. Affected areas also followed the

shape of the hemp rope. The center of the rope-shape was a powdery white mass of color, sharply contoured by a dark green halo, which was further outlined by a transparent, glossy line (see Figure 6, page 40).

D. Sodium Borate

The interaction of materials resulted in total vitrification. A transparent, glossy surface covered the bottom of the saggar.

E. Sodium Sulfate

The interaction of materials resulted in total volatilization. Affected areas followed the shape of the hemp rope. A dark brown color dominated the rope-shape and, upon removal of the ash residue, a lighter beige center was discovered (see Figure 10, page 42).

F. Sodium Hypochlorite

The interaction of materials resulted in complete volatilization. Affected areas clearly defined the shape of the hemp rope. The center of the rope was dark brown with bisque pink specks where the ash residue had settled. The contour around the brown areas was marked by a dark grey color, which was followed by a light orange halo that outlined the entire shape.

G. Trisodium Phosphate

The interaction of materials resulted in minimal vitrification. Affected areas followed the shape of the hemp rope, though the shape was less well defined than the other sodium-based chemicals tested. The colors were light grey to light brown.

Conclusion and Summary of Test Series IV, V, VI, VII

From these last four series of tests, I found that sixteen of the twenty-eight tests (B., C., D., G. VI-VII; E.VI) resulted in some type of vitrification taking place because of the interaction of combustibles with the sodium-based chemicals. The twelve tests that volatilized (A.:F.IV-VII:D.VI:E. IV,V,VII) were also affected by the interaction of materials as found in the ash residues which usually revealed lighter or speckled areas.

During the testing, I found that the size or shape of the combustible material was important to the type of control needed for specific effects. In test IV, the sawdust quickly absorbed the sodium-based chemical solutions and affected areas were usually deeply saturated (A,B,G) or heavily textured (C,D,E). Because of the concentrated effect produced, I used chemically soaked sawdust sparingly. The cotton strips in test series V. usually resulted in organic-shaped areas which vitrified when used with B.,C.,D., and G. Although the colors were interesting, I was careful not to place these strips between ceramic pieces that touched because of

vittrification. The excelsior in test series VI usually resulted in mottled or speckled areas which was an effect unique to this test. The textures and colors were varied, yet I used the chemically soaked excelsior carefully, depending on the chemical involved, such as D., E., and G. which caused vittrification. I found test series VII the most controlled of the last four test series because affected areas generally followed the shape of the hemp rope as it had been laid in the saggar. The only exception was D., which fused into a glass pool.

CHAPTER III

FINAL SUMMARY AND CONCLUSION

This study examined and followed the evolution of seven sodium-based chemicals as they were introduced into specifically defined conditions. The seven series of regulated tests resulted in a total of seventy-seven individual test samples. The purpose of this project was to further develop the potential of the salt-bisque technique so that desired effects could be better regulated and new effects discovered. This study more thoroughly regulated the effects of the salt-bisque technique by introducing sodium-based chemicals at the three decisive stages of my working process: the formative, decorative, and conclusive (firing kiln) stages.

Beginning with the formative stage, the seven sodium-based chemicals were mixed with the clay in test series I. The reasoning behind mixing clay and chemicals was that, if results were successful, thrown pieces would incorporate predetermined effects without having to depend on the salt-bisque technique solely. Though results were visually interesting and varied, I soon discovered that the mixtures, indifferent to proportions, shortened the clay body

noticeably. The composites were thus found unsuitable for wheel-throwing. For this reason, further exploration in the formative stage was eliminated. The test samples did, however, offer effects that could be further investigated in the decorative and conclusive firing stages. I found that the sodium-based chemicals which vitrified the clay could be broken and incrustated into freshly thrown ware. The chemicals that volatilized were for the most part ineffective because they weakened the clay body. The only exception was the sodium chloride 50% mixture which, when made into saggars, showed evidence of flashing on ware. Again, both developments would need further investigation to explore limitations.

In the decorative stage, the seven sodium-based chemicals were mixed into solutions and directly applied to the clay in test series II. Since sodium chloride had been the only chemical I was familiar with, I hoped that, by directly applying the chemicals, I could get a more controlled effect and, at the same time, evaluate the chemicals as they reacted with the clay surface. I found this series of tests the most successful in lending predictability to the salt bisque firing technique. The directness of the application resulted in effects that could be reasonably controlled, depending on how or where the solution was applied. Areas on greenware were stenciled off and sprayed with sodium chloride (see Figure 15, page 45). This chemical was used because the sodium chloride had produced the strongest visual effects

in testing. Solutions which were not used were discarded because results were dull in color with marginal textural effects. The only other sodium-based chemical I adopted for this procedure was the sodium borate. When sprayed on greenware and fired, the sodium borate produced a sheen which added contrast to an otherwise mat surface.

In the conclusive stage, the seven chemicals were taken through five different procedures from test series III, in which chemically filled pouches were placed on the clay surface, to test series IV to VII, in which combustible materials were soaked in the seven sodium-based chemicals, dried and placed on ware. The purpose of test series III was to localize chemical effects in an effort to predict the affected areas, to assure consistent results, and to again determine different visual effects on the clay surface. The pouches did effectively release the chemicals in the predetermined areas, but the concentrated amounts of the sodium-based chemicals caused cracking and excessive corrosion. Because the results were uniformly drastic, I found this procedure unsatisfactory for regulating purposes or for dramatic visual effects.

The purpose of the four final procedures was not only to localize effects with the placement of the combustible materials, but also to investigate the results which would be unique to the variety of materials and chemicals used in the tests. The samples did produce a varied and interesting

selection of results. I especially found the raised, pebbled effect caused by the interaction of the hemp rope and sodium carbonate noteworthy (see Figure 16, page 46). The hemp rope which was used as the combustible material in test Series VII resulted in the most reliable test because its shape was consistently reproduced in the saggars and similar results were found on fired ware.

After recording the results from series to series, a pattern began to develop as to the reaction of the chemicals to the procedures. The sodium chloride consistently volatilized, as did the sodium hypochlorite, though with less than dramatic effects. The sodium carbonate, sodium bicarbonate, and trisodium phosphate had a tendency to remain powdery in texture with noticeable vitrification. The sodium sulfate fluxed in test series I and volatilized in the rest of the series. Finally, the sodium borate consistently fluxed in all the tested series.

Though differences were found in color, texture, and results, the predictability of the chemical pattern enabled me to decide which of the sodium-based chemicals I would adopt for further research and which procedures were incorporated into my working process to lend the most predictability to the salt bisque technique and surface effects. Because the sodium chloride consistently volatilized and produced strong visual effects that were reasonably predictable, I adopted it for use in the decorative stage by spraying it

on the clay surface and in the conclusive stage mixed it with various combustibles, especially the cotton strips and hemp rope (see Figure 17, page 47). The sodium borate was also adopted for use in the decorative stage when a slight sheen was needed.

Through this analysis of the salt-bisque technique, I found that desired effects could be made more predictable; that the salt-bisque technique could be better regulated by introducing chemicals during the working process; and that new effects were found (sodium borate sheen), which I adopted.

The potential of the salt-bisque technique is unlimited because of the many sodium-based chemicals still available for research. This project has only scratched the surface of research into sodium-based compounds which could be introduced and tested using the salt-bisque technique.

Definition of Terms

Bisqueware--Unglazed low-fired ware.

Clay Body--The prepared materials from which any clay is composed.

Combustible Material--Any substance that ignites and causes reduction.

Firing--The process of conversion from clay to pot.

Flashing--The coloration and fusion which occurs when volatiles settle on pots.

Flux--A substance which promotes melting.

Form--The three-dimensional qualities of a pot or ceramic.

Fuming--The release of volatile fumes during the firing of pottery.

Fusion--The melting of different materials into a homogeneous liquid mass.

Greenware--Pottery that has not been bisque-fired.

Halo--A luminous area which encircles an object.

Hard--To be physically hard and difficult to scratch or cut.

Line Blend Method--A method of determining requirements in practical tests of materials.

Mat--A dull surface, not shiny.

Pinhole--An effect made by small bubbles of air which have burst.

Porous--Capable of absorbing liquids.

Saggar--A fireclay box which protects ware from the flame during firing.

Silicate--A compound involving silica as an important part. Specifically, the term implies that the ratio of silica to the other oxides is such that a crystal structure can be established.

Short--A body or clay lacking in plasticity.

Vitrification--The fusing of a clay body to become impervious, like glass.

Volatization--The action, under the influence of extreme heat of the kiln, in which elements turn from a solid to a liquid, and finally into a gaseous state.

Ware--In general, pottery, in either the raw, bisque, or glazed state.

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PHOTO COLOR SAMPLES - A. SODIUM CHLORIDE

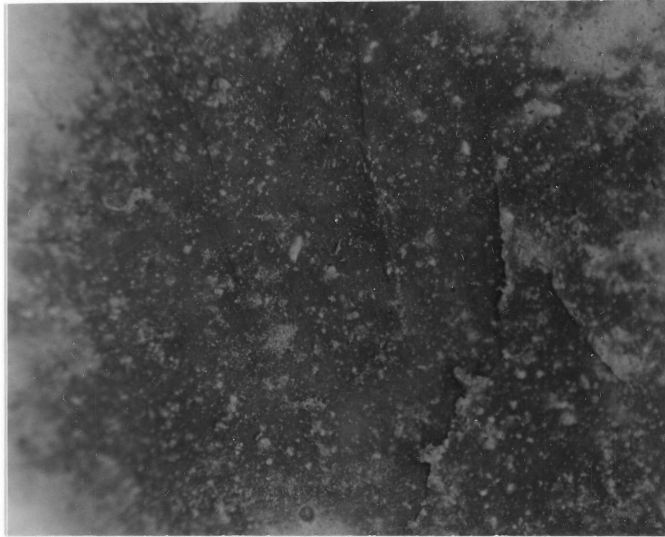


FIGURE 1
TEST SERIES IV - SAWDUST



FIGURE 2
TEST SERIES V - COTTON STRIPS

PHOTO COLOR SAMPLES - B. SODIUM CARBONATE

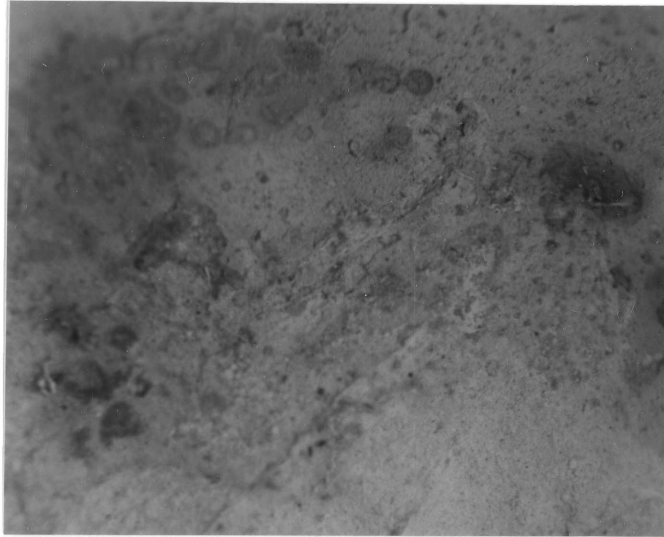


FIGURE 3
TEST SERIES V - COTTON STRIPS

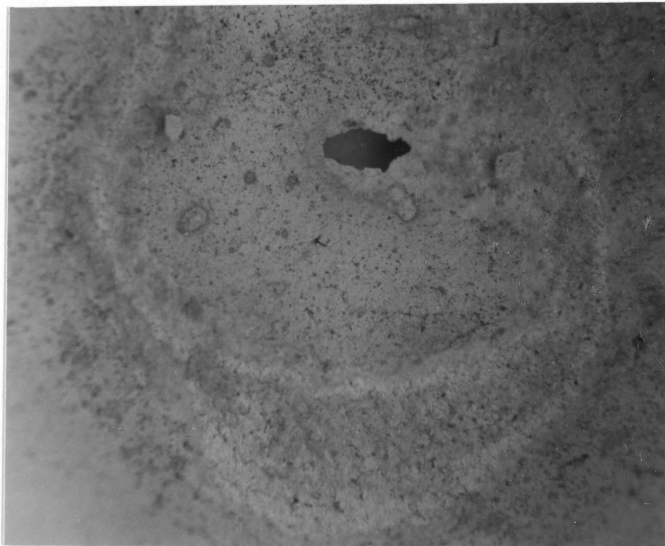


FIGURE 4
TEST SERIES VII - HEMP ROPE

PHOTO COLOR SAMPLES - C. SODIUM BICARBONATE

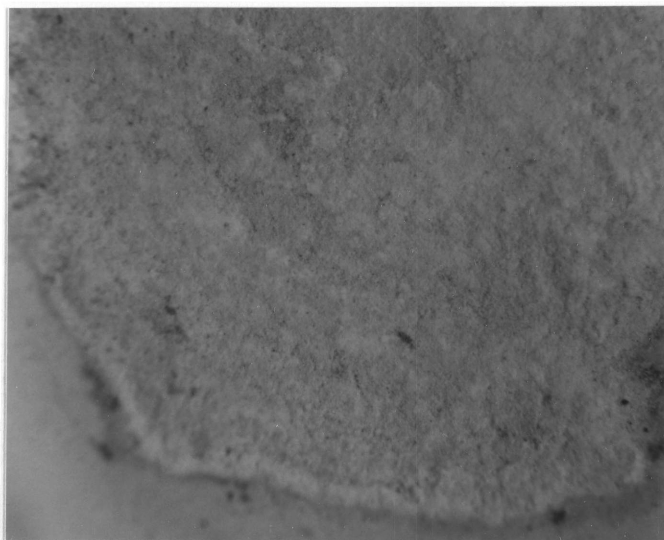


FIGURE 5
TEST SERIES IV - SAWDUST

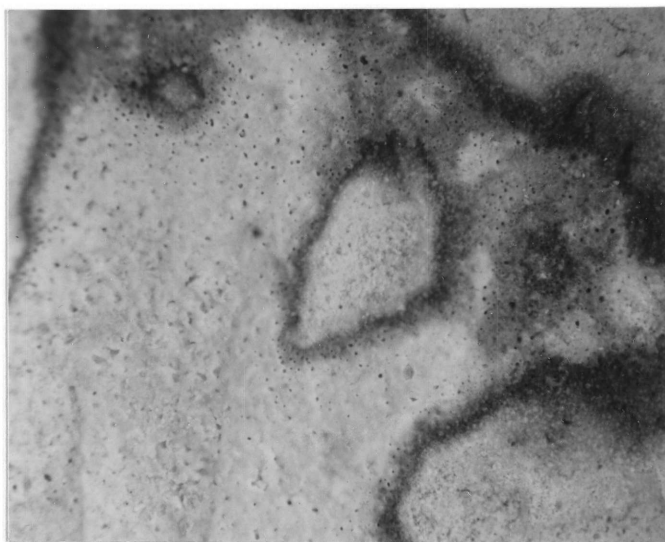


FIGURE 6
TEST SERIES VII - HEMP ROPE

PHOTO COLOR SAMPLES - D. SODIUM BORATE

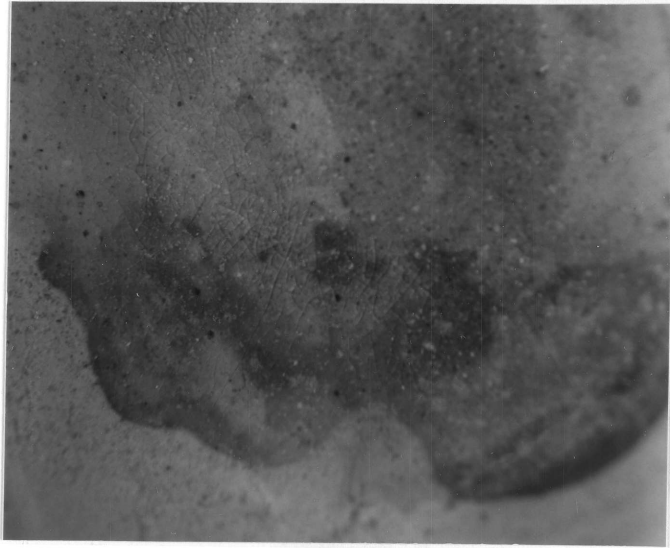


FIGURE 7
TEST SERIES IV - SAWDUST

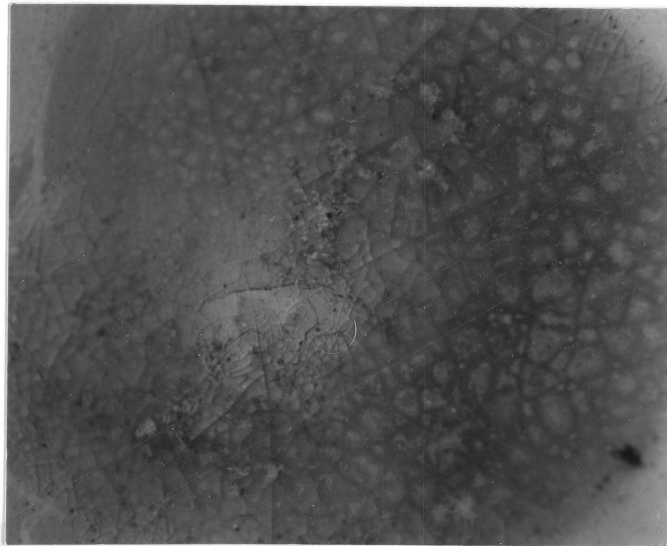


FIGURE 8
TEST SERIES V - COTTON STRIPS

PHOTO COLOR SAMPLES - E. SODIUM SULFATE

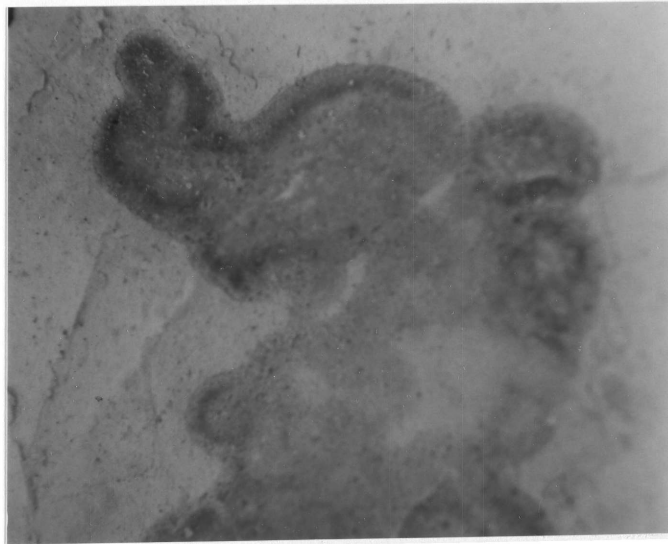


FIGURE 9
TEST SERIES V - COTTON STRIPS



FIGURE 10
TEST SERIES VII - HEMP ROPE

PHOTO SAMPLES - F. SODIUM HYPOCHLORITE

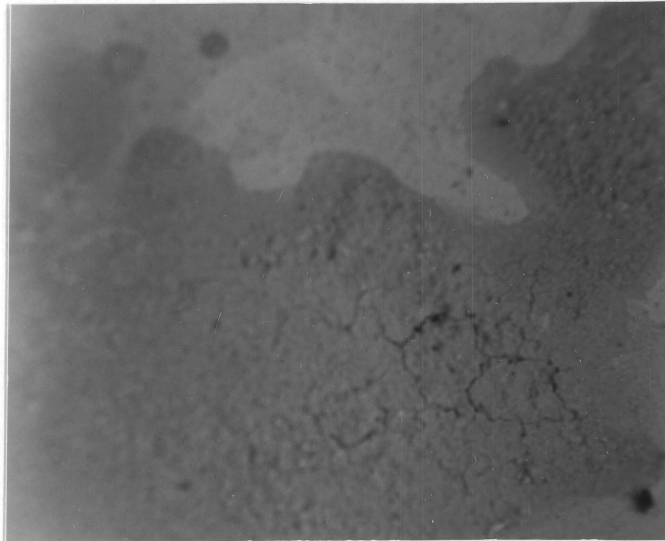


FIGURE 11
TEST SERIES 1E - F. 75%

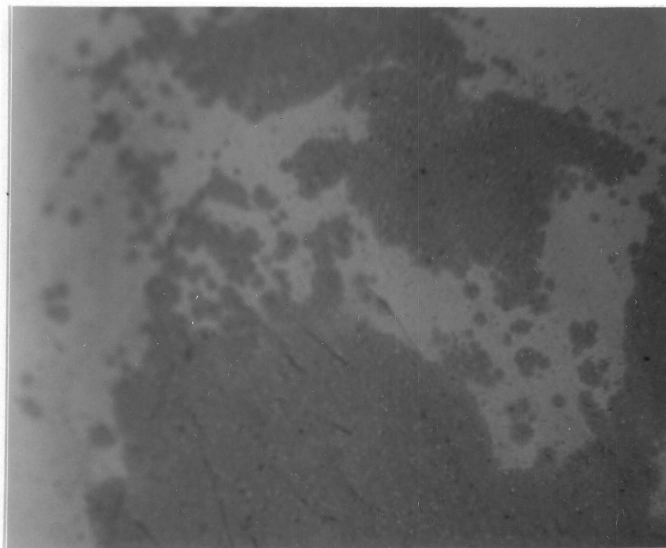


FIGURE 12
TEST SERIES VI - EXCELSIOR

PHOTO COLOR SAMPLES - G. TRISODIUM PHOSPHATE

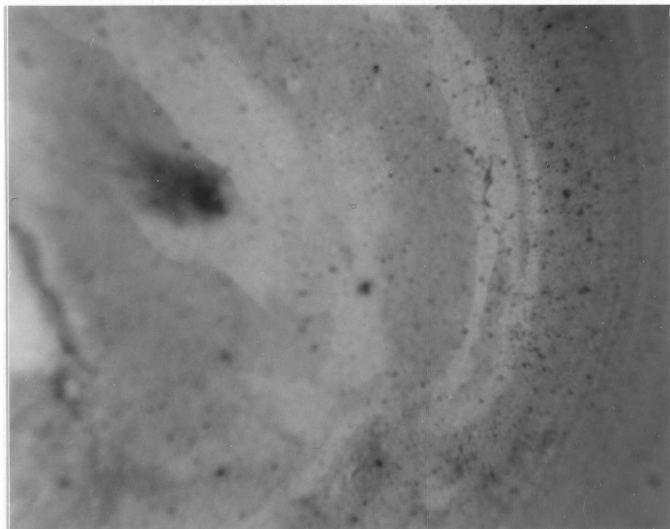


FIGURE 13
TEST SERIES V - COTTON STRIPS

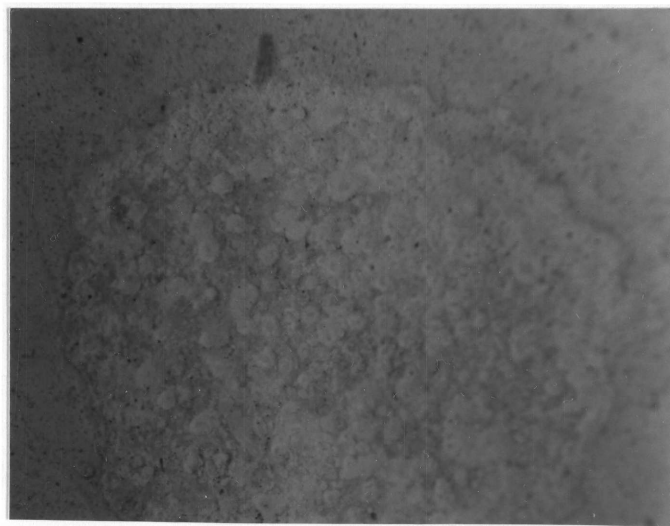


FIGURE 14
TEST SERIES VI - EXCELSIOR



FIGURE 15
SODIUM CHLORIDE SPRAY

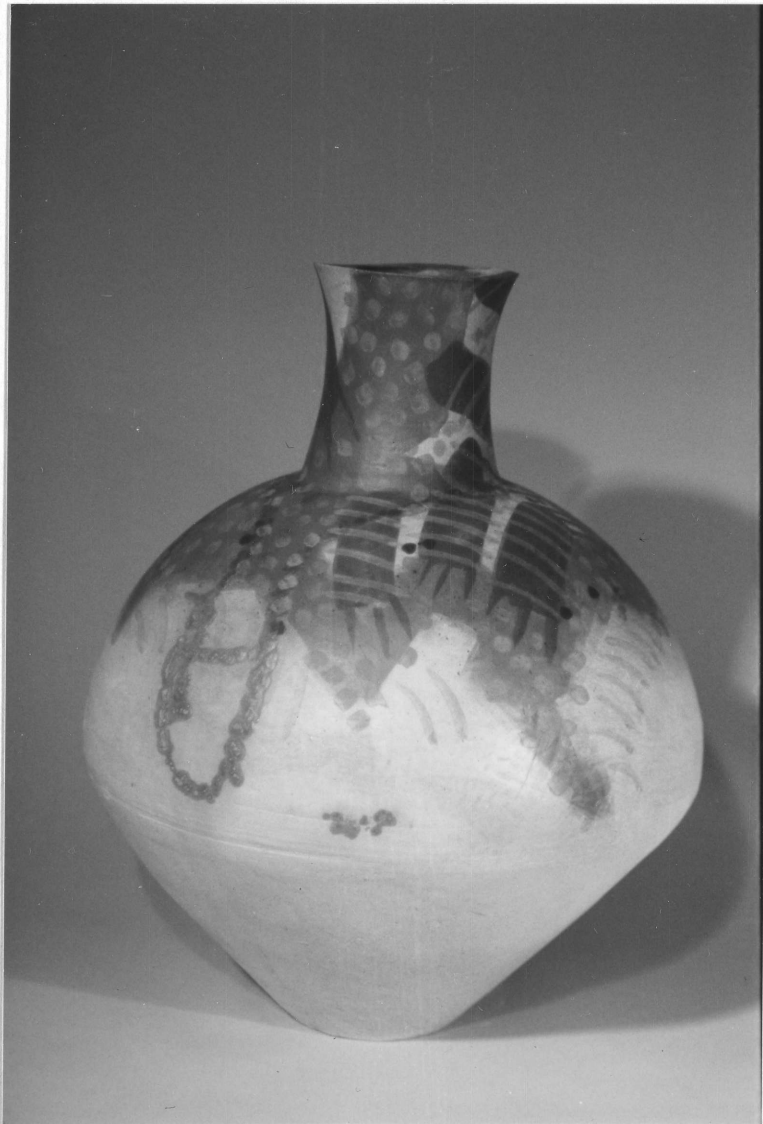


FIGURE 16
SODIUM CARBONATE SOAKED HEMP ROPE



FIGURE 17
SODIUM CHLORIDE SPRAY AND COTTON STRIPS