RESEARCH PAPER

VARIOUS MATERIALS APPLIED TO POLYSTYRENE FOAM FOR SURFACE TEXTURE WHEN FULL MOLD CASTING SCULPTURE

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INTRODUCTION

The process of casting sculptural form in metal dates from antiquity. Today both the lost wax and sand mold processes are used, each having its own advantages and disadvantages. The choice of one process over another depends on the results desired by the artist. The sand casting process offers the following advantages: (1) speed of mold preparation (2) ease of breakout and (3) minimal clean up of the casting. When these advantages are combined with the use of rigid foam in the patented full mold process, an added advantage to the artist is the opportunity to control the final form during the mold preparation. This process which allows intimate contact between artist and piece during what would otherwise be a strictly mechanical and possibly uncontrolled operation is to some a better media for artistic expression.

One of the disadvantages of full mold casting is the piece having the same surface as the pattern material. This paper reports on the results of application of various materials to rigid foam as one method of transcending this disadvantage. These test results may offer the reader uses and directions with rigid foam as a pattern for sculpture that he may not have been aware of.

A background in the sand casting process as it applies to the use of rigid foam as a pattern will also be covered so that those not familiar with this method of casting may evaluate the test results in a proper frame of reference.

Suggestions or references to specifics of the process appear in the text in an effort to explain the state of the art of sand casting with a styrofoam pattern for sculptural form as practiced at Colorado State University.

In addition to processes this paper will give a small overview of the materials (sand and rigid foam) which are basic to the process. These are given only as a basis for understanding since a thorough report on these subjects is beyond the scope of this paper. If the reader wishes a more thorough coverage of any subject, he is referred to the bibliography.

To have a process that is as flexible as the artist's mind, thus freeing him from some of the drudgery of the manufacturing situation, allows him to be concerned with the most important consideration, the idea.

MATERIALS

1.1 Polystyrene Foam

> "Polystyrene foams are of recent origin, having first been made in Great Britain in 1943. Expandable beads were introduced in the United States by Koopers Company, Inc., in 1954."[1]

The material used to make foam is given in capsule form by Ferrigno as follows:

> "The liquid styrene, containing a foaming agent and polymerization catalyst, is dispersed in an aqueous medium with agitation. The suspension is heated with agitation for several hours until the styrene is essentially completely polymerized to a high molecular weight. The beads so formed are filtered and washed to remove all polymerization agents which alter or interfere with foaming."[2]

This material is then pre-expanded and ready to be molded. The material does not lend itself well to on-the-site processing and at this time is only mass produced in factory situations.

The main ingredient in most foam molding operations is steam. There are, however, some operations in which an autoclave, dielectric or chemical heating, is used. The pre-expanded material is put into a mold and through the use of heat and pressure expands to fill

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[1] T. H. Ferrigno, Rigid Plastics Foams (New York: Reinhold Publishing Corporation, 1967), p. 207.

[2] Ferrigno, p. 209.

the mold and adhere to itself.

The shaping of styrofoam is a relatively simple process because of its cellular structure and low melting point. Foam can be easily cut with knives and woodworking tools; it may also be cut, shaped or textured with a hot wire or heated utensils. As Lawrence states, this is the easiest and most efficient way of cutting rigid foam.[3] If power tools are used to cut the foam, extra care should be taken to remove the dust from the air because this is, as Ferrigno points out, very irritating to eyes, skin and lungs.[4]

1.2 Sand

The ingredient that controls the whole sand casting process is sand. This most versatile mold material has long been used because of ease of use and reuse. Today the formulation and control of sand is a science in itself.

Sand, as with other naturally occurring surface deposits, is a product of erosion. Those sands that are used in this country for foundry work are usually a breakdown of crystalline rock such as granite. When the only factors acting on the rock are frost and rain, etc., the

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[3] L. L. Lawrence, Polystyrene Foam Craft (Pennsylvania: Chilton Book Company, 1974), p. 6.

[4] Ferrigno, p. 246.

size of the grains varies widely, and the grains are all mixed together. To obtain a fine size of relative consistency, one must move sand from its place of origin. This process is usually accomplished by the action of flowing water.

> "If, instead of being suspended in still water, the sand grains had been suspended in a current, the coarser grains would reach the bottom before traveling very far, and the fine grains, remaining in suspension for a longer time, would travel a longer distance before settling out."[5]

As the breakdown of the parent rock continues, the three materials deposited that are important to the foundryman are quartz, feldspar and mica. Quartz is unaffected and becomes the main body of most foundry sands. The feldspars and mica eventually decompose and form clays of the Kaolinite group. Feldspar decomposition varies widely so that sand may contain from 0% to 20% clay. Mica, however, because of its susceptibility to chemical attack and fracture is usually completely broken down.

Because of the varying conditions in breakdown, it is possible to have foundry sands differing in three important factors: (1) the presence or absence of clay

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[5] W. B. Parks, Clay-Bonded Foundry Sand (London: Applied Science Publishers Ltd., 1971) p. 55.

(2) the uniformity of grain size and (3) the amount of feldspar remaining. These factors mean that in the foundry there are two basic groups of sand, those that are clay free silica sand, and those clay bearing sands known as natural or green sand.

1.3 Clay

The clay in foundry sand is of extreme importance. As Parks states,

> "The function of clay is to hold together the compacted sand grains from the time ramming is complete until after the casting has solidified. The properties of the compacted sand must be such that it retains its shape (1) while the pattern is rapped or vibrated, (2) when the support of the pattern is withdrawn (3) when the stream of metal is entering the mold and (4) when the mold is full of liquid metal."[6]

As Palmer also points out, the advantage of reuse of the sand must be facilitated by ease of breakdown after the casting.[7] Also, reprocessing with water should result in a uniform mixture free from dry aggregates of sand.

The main requirements of foundry sand--green

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[6]Parks, p. 95.

[7]R. H. Palmer, Foundry Practice (New York: John Wiley and Sons, Inc., 1929) p. 304.

strength, toughness, deformation, adhesion, wet strength and dry strength are all properties of clay. Molding sand, as DeGarmo states, contains about eight to fourteen percent clay.[8]

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[8] E. Paul DeGarmo, Materials and Processes in Manufacturing Third Ed. (London: Macmillan Company, 1969) p. 224.

TESTS FOR FOUNDRY SAND

Clay in the dry state has no adhesive properties. A mixture of dry sand and clay is only a combination of materials and not a usable product to the foundry until water has been added. There are no set rules as to what is optimum moisture content. In industrial situations where the full mold process is not used, several factors vary with the moisture content; and a compromise of those factors must be reached for any given mold situation. The two test factors that are a direct result of moisture content are green strength and the shatter index. Green strength is the ability of the sand to hold the pattern shape. This relationship is expressed by the ratio between the amount of presseure in pounds per square inch required to deform a test piece and the percentage of moisture in the sand/clay mixture. The shatter index is the ability of the mold to retain its shape during and after pouring.

Green strength is low at first and rises as the moisture content increases. At a certain point of moisture content (depending of the type of clay) an optimum of green strength is reached. This strength then begins to decrease as the moisture is increased.

The shatter index, or toughness of the sand, increases also with the rise of moisture, however it continues to gain when green strength begins to decline.

The shatter index will also begin to decline once the optimum amount of moisture is passed, but its rate of decline is much slower. The relationship of these two properties is shown in the Graphs from Parks 2-a and 2-b.[9]

> "The need for systematic evaluation of the working qualities of molding materials under foundry conditions has led to the developement of a wide range of tests, the work of many committees and individuals."[10]

Specific tests an apparatus for conducting those tests exist for practically every aspect of sand molding. Some of these tests are for permeability, measurement of green strength, measurement of dry strength (both in compression and shear), a shatter test and a test for moisture.

The effect of moisture on the sand as a mold material and on the casting produced is probably the most critical of all the variables. Low moisture content of the sand yields a material that has a low dry strength which can cause inclusions and erosion scabs. Too high a moisture content leads to high and extensive gas

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[9] Parks, pp. 106-107.

[10] P. R. Beeley, Foundry Technology (New York: John Wiley and Sons Inc., 1972), p. 141.

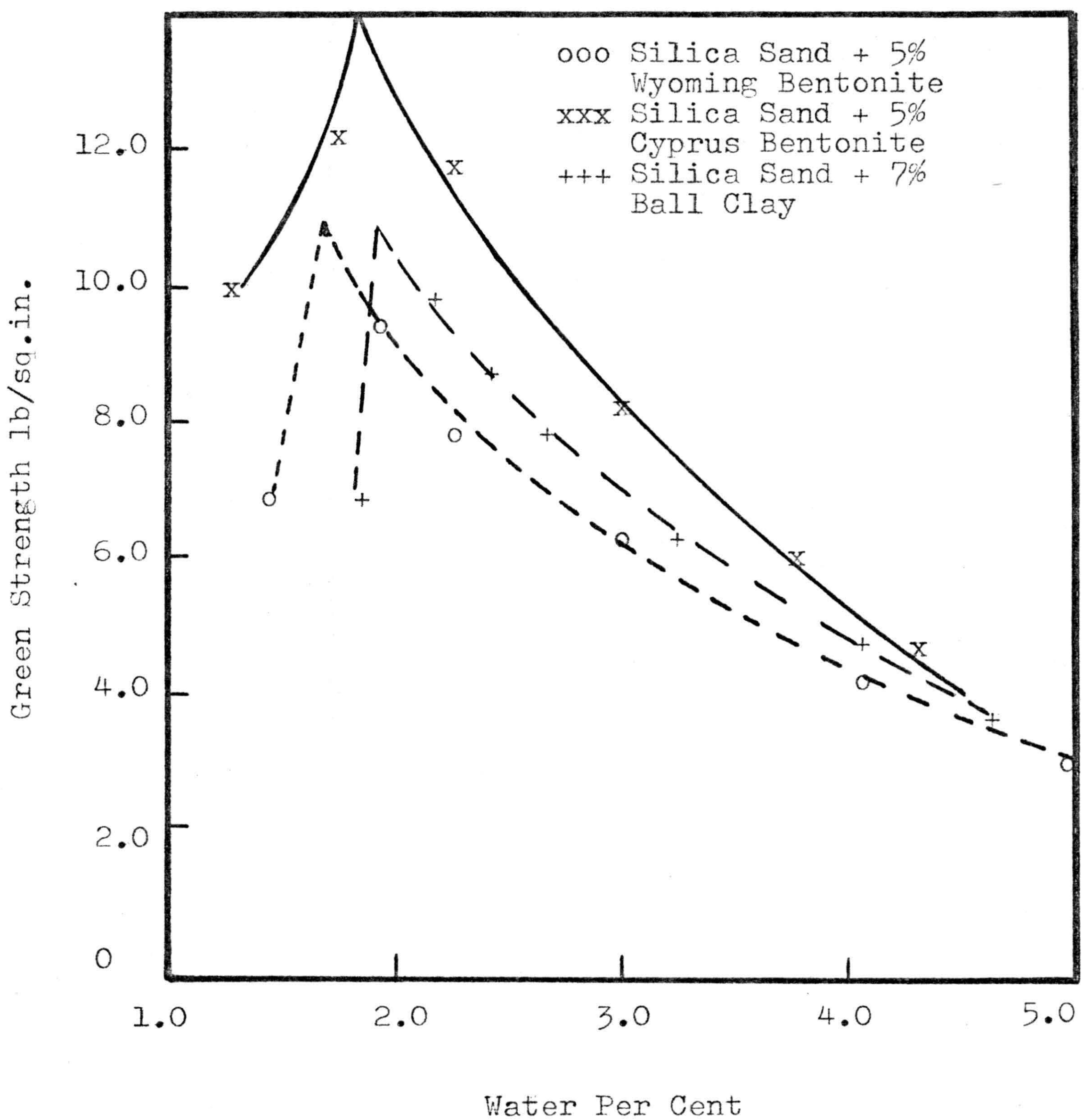

Figure 2-a Green strength of synthetic sands.

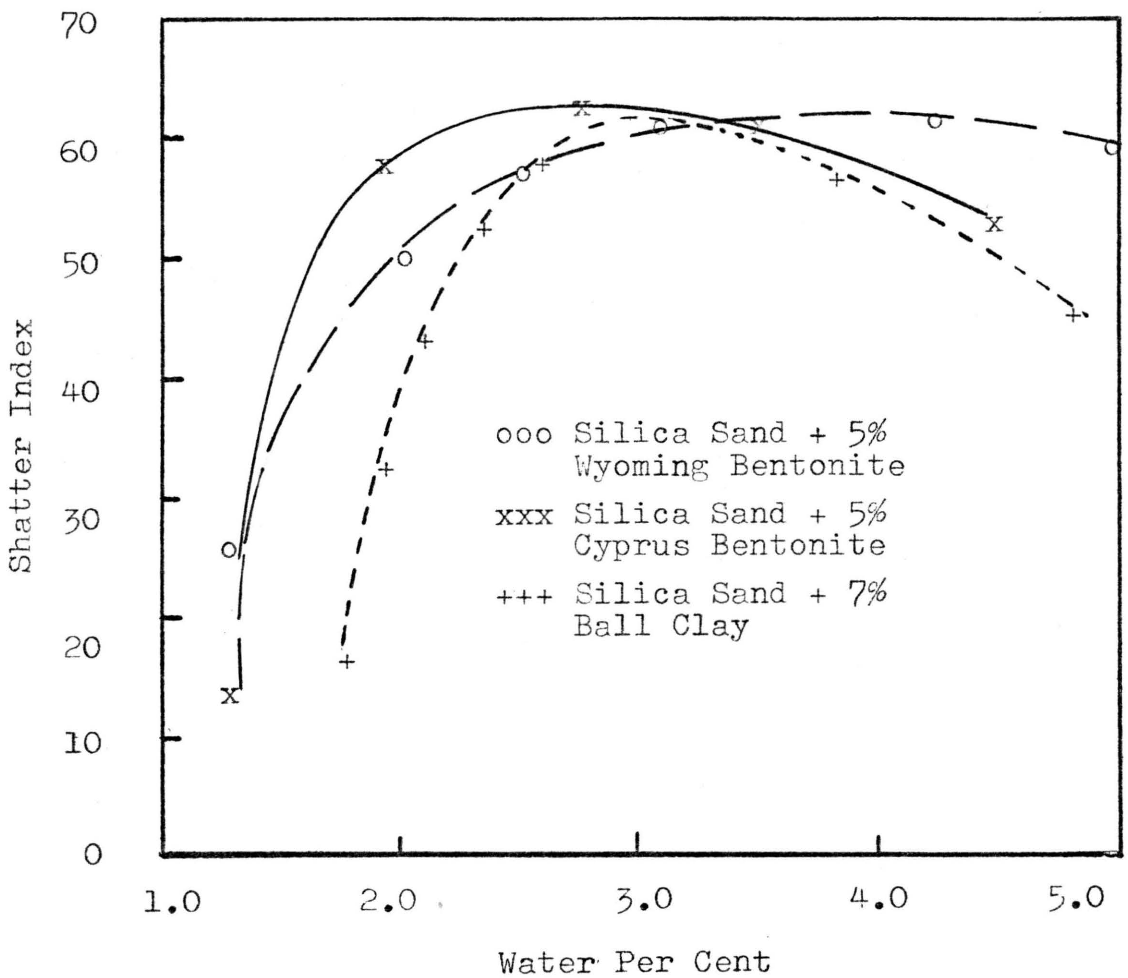

Figure 2-b Shatter index of synthetic sands.

production causing blows and misruns in thin sections or roughness and scabs in thick parts. High moisture also leads to high deformation and low strength which can result in swelling, unsoundness and breakout.

Some of the other properties that may be tested for are mold hardness, refractoriness, estimation of coal dust, estimation of pitch, estimation of wood flour and the pH value.

The reason for these tests is to be able to predict with some accuracy consistent quality castings. In the case of casting problems these tests can be a guide as to what corrective measures need to be taken. With the full mold process as used in these tests several of the tests become unnecessary. The test for dry strength and the test for green strength are not required. Moisture is tested for, however, because of its relationship to surface defects.

One of the unique properties of sand molding is that because of the sand's porosity it can absorb the gas given off during the casting and thus reduce, or eliminate, the need for vents on the piece being cast. This in turn reduces the amount of work required to clean up the piece. The ability to allow gas to be absorbed is one of the factors that needs to be controlled by the foundry. Parks gives the following relationship:

> "The volume of the pores in a granular material depends on size distribution of the grains and on the way in which they are packed."[11]

There are several formulae and tests to determine sand size ratios and permeability. It is not necessary to expound on those in this overview, but it should be noted that in handling and processing of the material, sand is broken down through various means producing very fine grains compared to the original. This powder eventually causes a reduction in permeability, so it must be removed occasionally. For the small foundry this process can simply be pouring the sand from one container to another so that it falls in a small stream. This action coupled with some sort of air movement (wind or an exhaust fan) will be sufficient to remove the particles that reduce permeability.

There are two stages affecting the properties of molding sand. The first is when it is used as a mold material to obtain a pattern and the second is when molten metal is poured into the mold and must retain its shape under the stresses of heat and pressure.

There are many tests to monitor both situations

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[11]Parks, p. 74.

in order to provide consistent quality in castings. One of the conditions tested for that has a cumulative effect on the sand as a mold material is the reaction of heat on the clay binder.

Clay when heated to 100°C has what is termed "free water" removed. This results in increased strength in the clay and the change is reversible. Between 100°C and 300°C water that is bound to the clay more firmly, or "bound water," is removed with little effect on the strength and the change is reversible. At 600°C to 650°C the water that is combined with the clay particles is released resulting in clay breakdown. This change is not reversible, and the resulting product is called dead clay.

> "In order to determine the effect of dead clay on the physical properties of molding sand, a series of sands was produced in which the active clay content was constant and and the amount of dead clay was raised in steps. The difficulty in estimating the amount of dead clay was avoided by heating a sand with known clay content until breakdown of the clay was complete."[12]

This relationship is shown in chart 2-c.[13]

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[12]Parks, p. 118.

[13]Parks, p. 119.

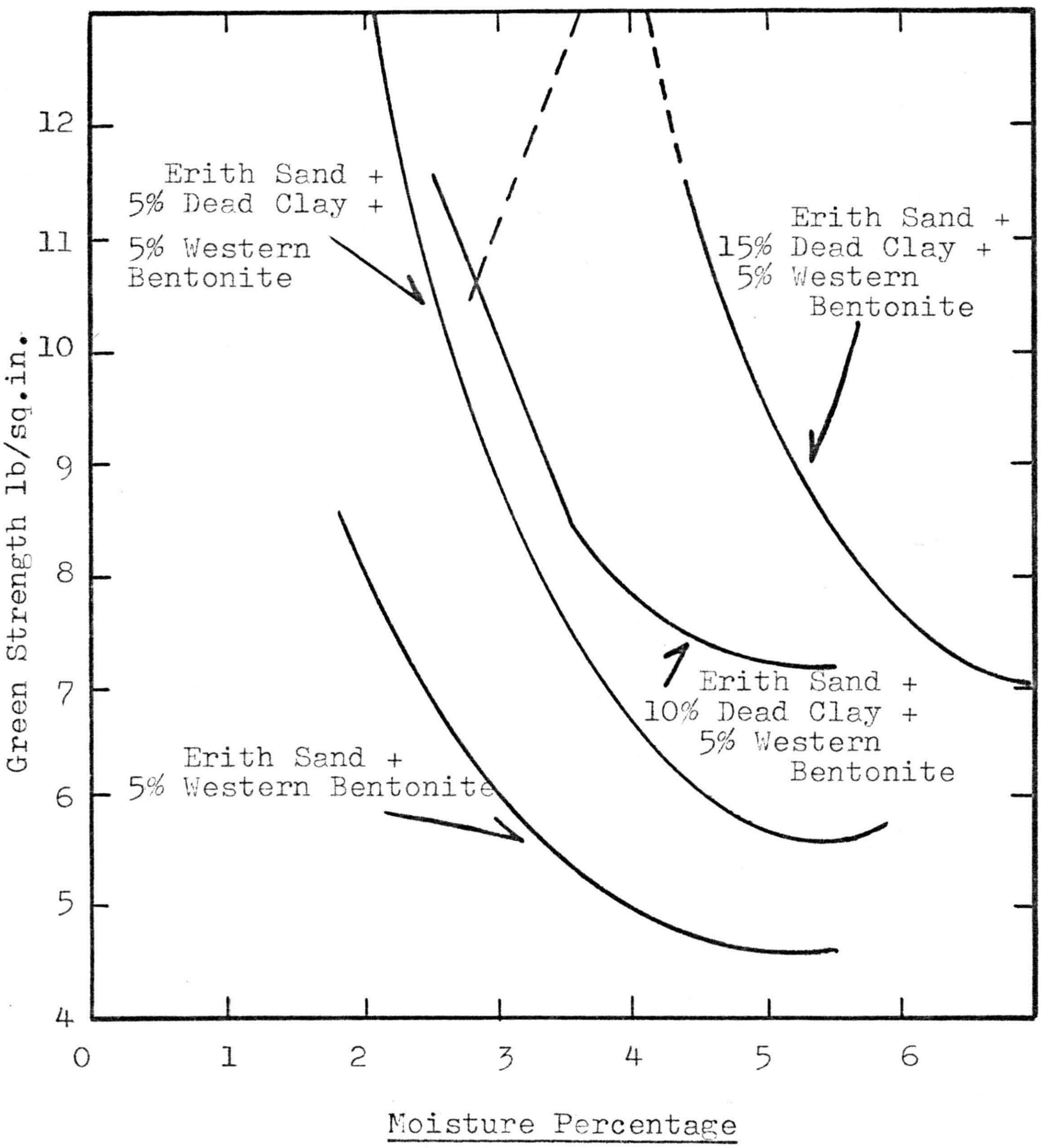

Figure 2-c Effect of Dead Clay On Green Strength

Dead clay affects foundry sand in two ways. The first is that as more dead clay is built up, the permeability of the sand is reduced. Second, as the dead clay builds up, the amount of water required to make the mixture mold properly increases, changing all the qualities of the sand. Since consistency is the most desirable quality of molding sand, buildup of dead clay needs to be controlled. This is less of a problem with naturally occurring sands than with synthetic sands because the ratios of clay to sand are less affected with the addition of new material to control the dead clay.

The control of dead clay in the art foundry is a small problem and may never arise if new sand is added to stock from time to time.

THE FULL MOLD PROCESS

> "A significant innovation in producing castings is the construction of patterns from a material known as expanded polystyrene board. When embedded in a sand mold, the polystyrene material vaporizes in the presence of molten metal, creating a metal duplicate of the pattern. Full mold, the common name given to this patented process, describes the unique cavityless feature of the mold."[14]

This process is starting to be used in pattern shops as an alternative to the expensive process of making patterns out of wood. When these patterns are for a research machine with the possibility of being changed many times, the savings with the foam is obvious. The artist is also a pattern maker. In the traditional method of cast sculpture a piece is modeled out of clay, a mold is taken from the clay, and then wax is painted into the mold. This wax pattern is then invested into a sand and plaster mixture and burnt out in a kiln. The piece of sculpture is now ready to cast.

With the above process many parts can cause problems; and if the piece should miscast, the process must be repeated from the mold on. It is obvious that the full mold process offers the artist the time and money savings it offers industry.

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[14]American Foundrymen's Society, Pattern Makers Manual (Illinois: American Foundrymen's Society Inc., 1970) p. 49.

FULL MOLD CASTING PROCEDURES

4.1 Assembly of the foam

There are many types of glues and adhesives which may be used to assemble rigid foam. The three types discussed by Ferrigno are those that dry, set or cool to form a bond.[15] With any kind of adhesive the major considerations are the nature of the solvent base and whether it will affect the foam. Another factor which may relate to the studio artist is setting time.

Also to be considered when a piece is being built is the structural quality while being assembled, that is the ability to maintain its shape during the construction and ramming processes. Rigid foam when milled to a thin profile can be very flexible and may require temporary bracing which is removed before ramming or cut of after the piece has been cast. Another alternative is to design the necessary structural parts as part of the piece.

When a piece is determined ready to cast, then decisions must be made as to its position in the mold so as to facilitate metal flow. One must also consider at this time whether any risers or vents need to be attached on the piece.

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[15] Ferrigno, pp. 246-247

4.2 Ramming

When all questions concerning the position of the piece and the attached parts, if any, have been dealt with, the ramming up can begin. The sand should be prepared ahead of time so that it is free from lumps or dry sand clusters, and has the correct moisture content. The piece is then set in the flask on a two inch bed of sand. Sand is then placed around the bottom of the piece and packed (rammed) tightly to the form. Care should be taken to make sure the sand is packed tightly into all areas, especially those that are on the bottom or underneath sides of the piece. If this is not done there will be gaps between the sand (the pattern the metal will conform to) and the piece itself, resulting in large clumps of extra metal on the surface of the piece. Once the piece is secured by the initial ramming, more sand is placed in the flask and packed to and around the surface of the piece until it reaches the lowest area that requires the attachment of vents, risers or whatever has been determined to be needed. Care should be taken during the entire process that the foam pattern is not distorted by too vigorous packing of the sand. As mentioned earlier, thin, or unsupported sections, are very suceptible to warpage. When dealing with flat plains such as reliefs, a backing board may be used to maintain the flatness of the pattern. With this method the piece is placed next to the backing board and rammed up as usual. Then the backing board is removed and the other side of the piece is rammed to the same level. The process is completed in normal fashion from this point.

As the process reaches the point where attachments are to be made, ramming is stopped and risers, vents and/or pouring cup are attached. The adhesive is allowed to set thoroughly, and then packing is continued to the rim of the pouring cup. Any sand that may have fallen into the cup causes no problem because the last step before pouring the molten metal is to remove the cup from the sand leaving only its impression with the sprue exposed on the bottom. A ridge of sand is then built around the cup hole to act as a dam.

4.3 Pouring

Some considerations for the pouring process are the fumes made by the vaporizing foam and the ability of the metal to flow. Fumes and smoke are given off during the pouring; so the area should be well ventilated. Respirators should also be used. Since the metal is being poured into a mold which is cold and contains moisture which will chill the metal, the piece should be arranged in the flask in such a way as to have most of its surfaces vertical. Metal flows much better in this direction. Also because of the cold and moisture the metal should be poured at a higher temperature than for investment casting.

TEST PROBLEMS AND PROCEDURES

5.1 Problem

The use of rigid foam as a pattern for casting metal is a recent application and has its use in industry where a limited number of castings are to be made and the cost of permanent molds or patterns is not justified. As a pattern for metal sculpture the problem of surface texture is more important than in industry because of the time and machinery required to machine the cast surface. Also the machined surface in many cases is too limited for the artist. The problem is then to be able to manipulate the surface of the piece easily and in a way that does not detract from the advantages of the process.

One method that fulfills these requirements is the application of materials to the surface of the pattern that will burn out with the foam and leave their texture on the surface. These textures would hopefully cover a wide range of possibilities. When applied to the surface of the foam, these materials would ideally have no adverse affect on the casting such as the creation of gas or the chilling of the metal. Finally the use of these materials should not alter the casting procedures or require special tools.

5.2 Test Procedures

To help answer the problem of what materials, if any, could match the requirements, the following tests were set up. Forty-eight test tiles approximately three and one half by four inches and three sixteenths of an inch thick were set up into two grids as can be seen in photographs 5-a and 5-b. The tiles were made from commercially available rigid expanded polystyrene with the gates, runners and risers made from the same material. The pouring cups were commercially available rigid polystyrene hot drink cups. These foam parts and all the materials attached to them were glued together with Scotch Spray Ment. Those materials that had self adhering properties were applied by themselves with no adhesive. The selected materials were applied to the test tiles in a random order; this order and any resulting effects from it are not considered in this paper. Each tile was divided roughly into thirds by applying the test material as smoothly as possible to the top of the tile and in a coarse or wrinkled fashion to the bottom leaving the middle blank. In the case of colorants or stiff materials, only the top third of the tile was covered, or the application was of a light to heavy nature rather than smooth to coarse. This was done so that a comparison could be made between the test material and the foam as to the resulting surface. The tiles were rammed up against a backing board with commercially available green sand having an approximate moisture content of five percent. The mold was then filled with molten aluminum poured at 1650^{o}F. The pour went smoothly and no gas release through the pouring cup was observed.

The tiles were examined as they were pulled from the sand; these results are shown in photographs 5-c and 5-d. The tests were then washed and the right half of each was sand blasted with E-70 silica sand at 40psi. These results are shown in photographs 5-e and 5-f.

The test went according to plan with one exception. During the ramming process one of the test sheets fell away slightly when the backing board was moved. This action caused a scabbing of the surface of some tiles. These tiles will be noted when they are discussed in the results. They were left in the test because the results may be of interest to some readers.

These materials were selected for one or more of the following: burnability, texture, colorant possibilities or a contrast to the other materials.

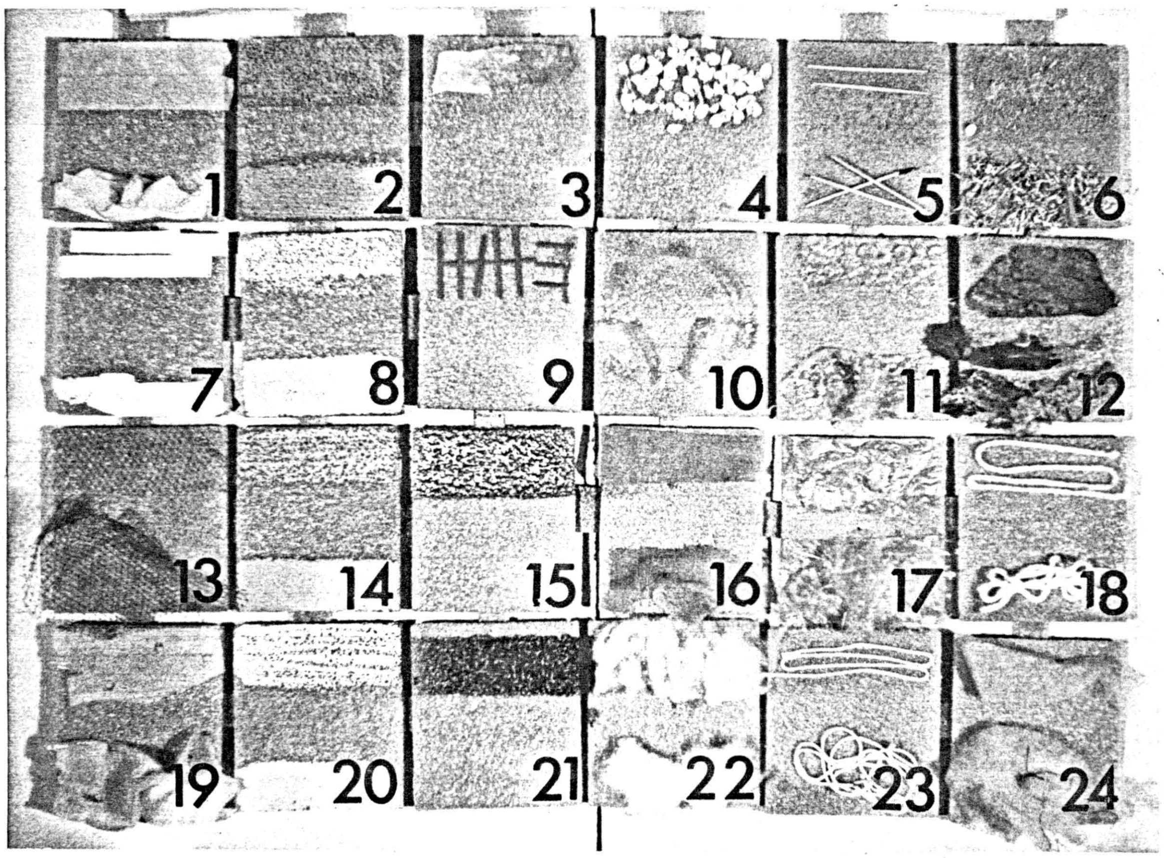

Plate 5-a Test Tiles 1 - 24

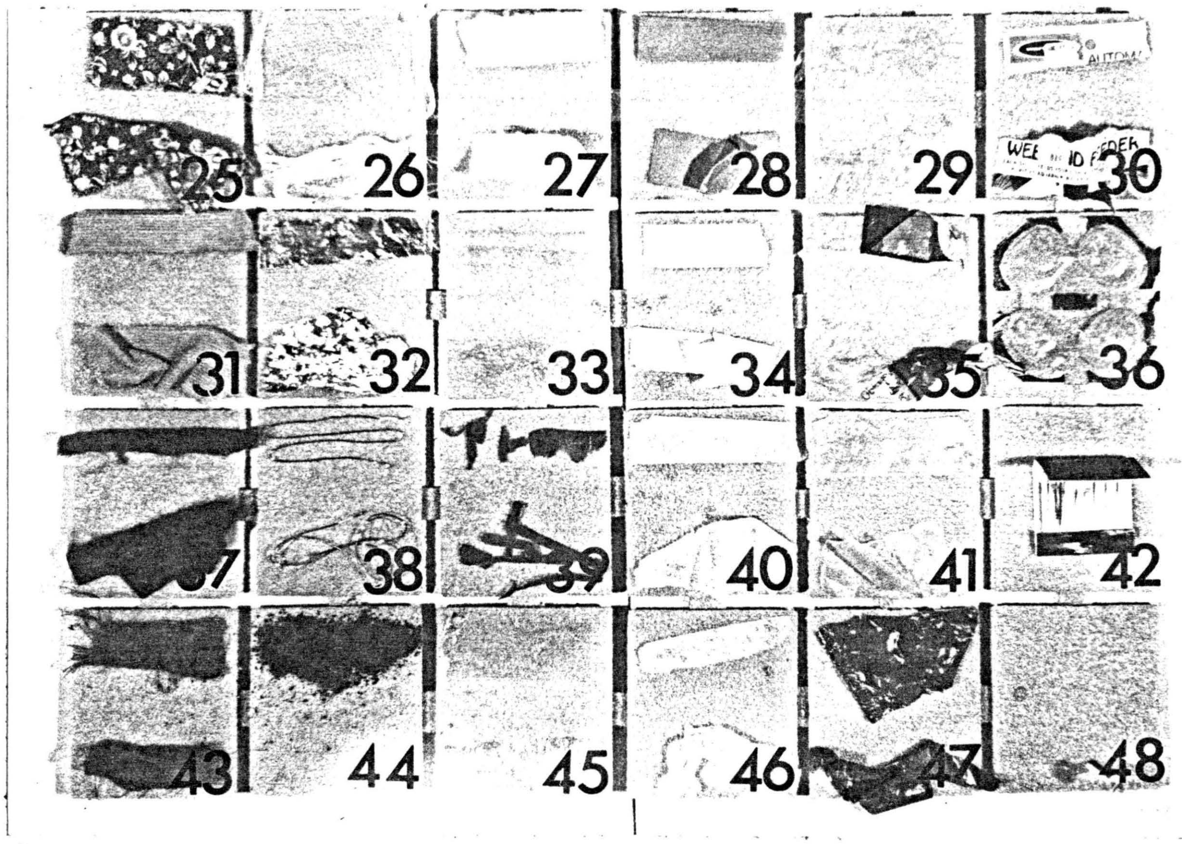

Plate 5-b Test Tiles 25 - 48

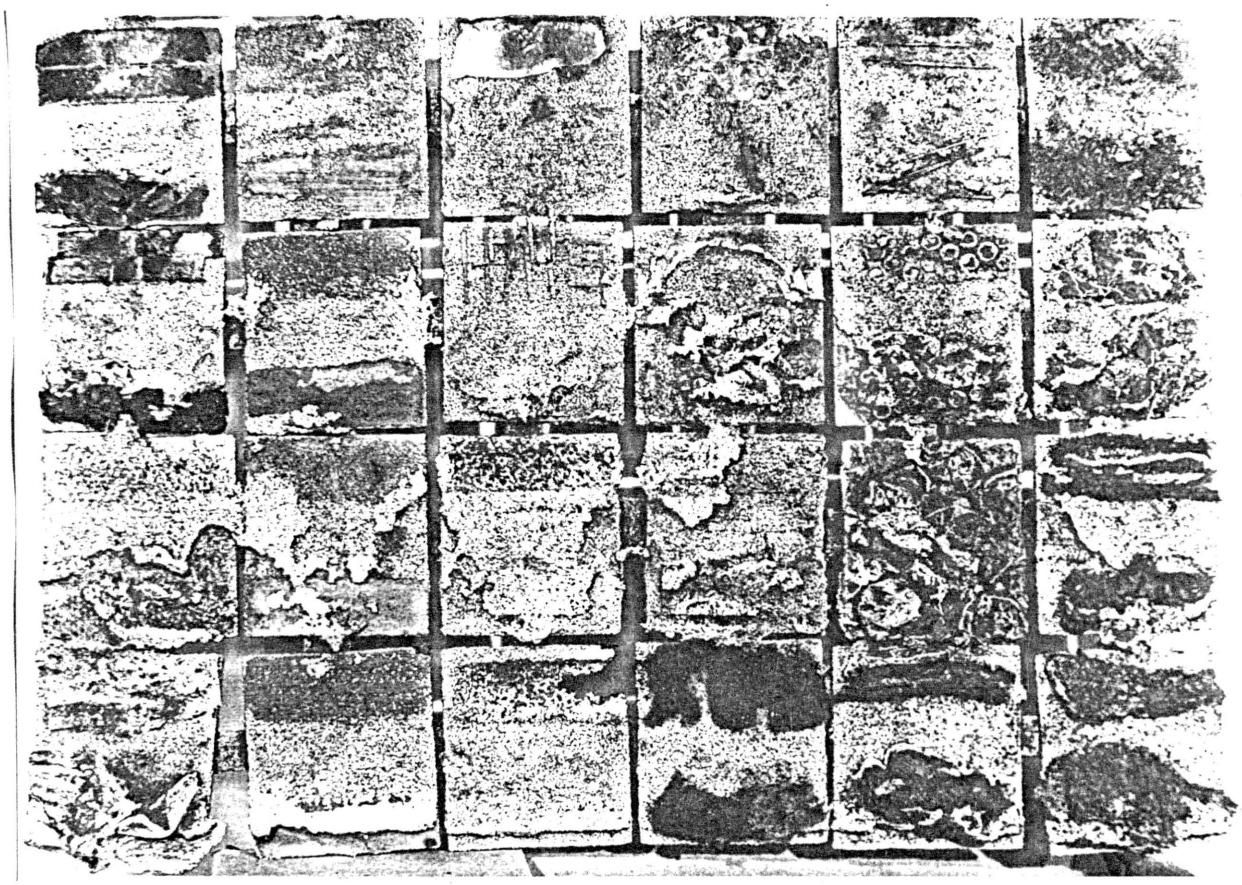

Plate 5-c Test tiles 1 - 24 Cast

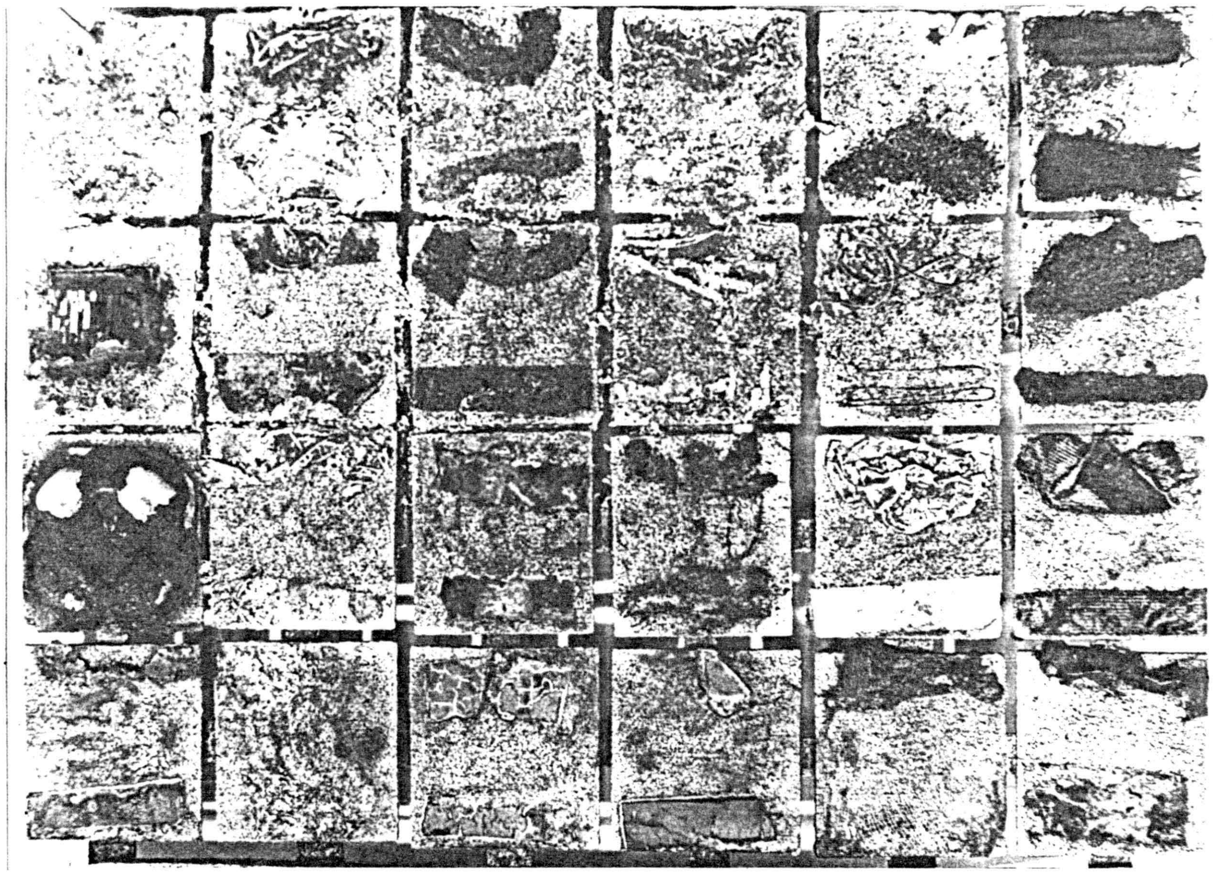

Plate 5-d Test Tiles 25 - 48 Cast

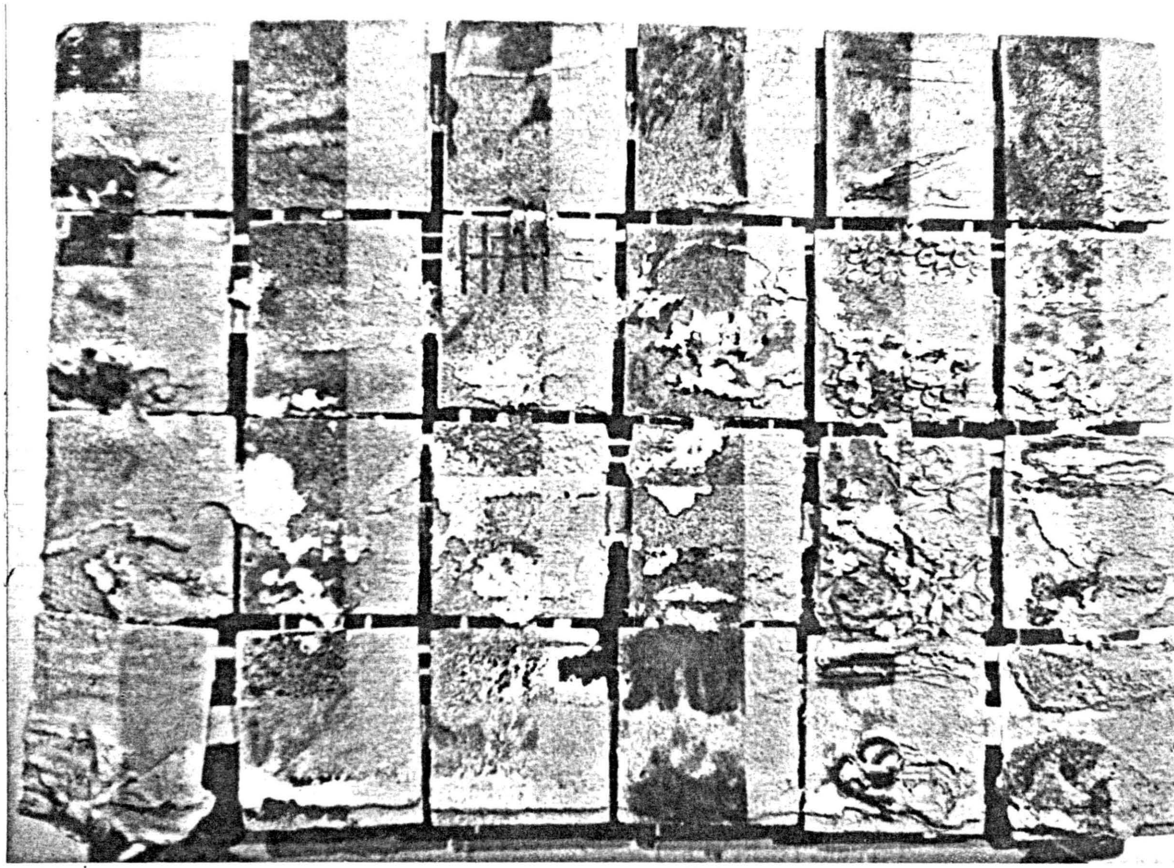

Plate 5-e Test Tiles 1 - 24 Cleaned up

Plate 5-f Test Tiles 25 - 48 Cleaned up

TEST RESULTS

The photographs of the test tiles before they were cast are numbered to corespond with the numbers in the following report. All other photographs have inclusive numbers (i.e. 1-24) printed underneath. Specific reference can be made with plates 5-a and 5-b as all photographs are arranged in the same order. This was done so that the results would not be obscured by numbers.

1. Masking tape. This was a good test showing a change in texture from the foam and a three deminsional change where the material was wrinkled.
2. Duncan Ceramic Glaze, Cardinal Red. All of the glazes were cone six low fire formulations. The glazes were applied in a light versus heavy relationship and in all cases the light area was reduced to a carbon deposit with no change in surface texture. The heavy area resulted in very fragile colored material only on the surface of the metal.
3. A Piece of Clorox Bottle. The material was very stiff and was only applied to the top third of the test tile. The result was a change in surface texture and a retention of the thickness of the material.
4. Quaker Oatmeal. This material was applied to the top third of the tile only. The resultant change in

surface texture and dimension is very subtle.

5. Round Wood Toothpicks. There is a good relationship between the three areas of the tile with the wood showing change in both texture and thickness.

6. Wood Dust and Shavings. The wood dust on the top of the test was reduced to a carbon deposit and no change of surface resulted. The shavings on the bottom, however, did result in surface change of texture and thickness but with little reference to the original.

7. Teflon Tape. The results were basically the same as the masking tape (no. 1) with change in both surface and thickness.

8. Duncan Glaze, Orange Fizz. This is also a low fire glaze with the same results as Cardinal Red (no. 2). The glaze was applied in a light heavy relationship with the light area being reduced to carbon and the color in the heavy area being fragile in both hue and adhesion,

9. Rigid Plastic Fruit Box. Again because of the stiffness of the material only the top third of the tile was covered. The results were the same as the Clorox bottle (no. 3). There was a change in surface texture and thickness.

10. Beverage Plastic Container Ring. The results were similar to the Clorox bottle (no. 3). There was a change in surface texture and thickness however there is a scab over much of the surface.

11. Small Bubble Pack. This was a good test showing surface texture and thickness changes and the relationship between the three areas of the tile.

12. Elm Leaves. The surface changes of texture and thickness are subtle with the coarser area being better than the top.

13. Expanded Plastic Mesh. This test is similar to the Clorox bottle (no. 3) however the dominant factor is a scab over much of the surface. The scab makes the texture and thickness of the test material hard to judge.

14. Duncan Ceramic Glaze, Tangerine. This is also a low fire glaze with the same results as Cardinal Red (no. 2) and Orange Fizz (no. 8). The glaze was applied in a light heavy relationship with the light area being reduced to carbon and the color in the heavy area being fragile in both hue and adhesion.

15. Metalic Spray Plating. This is a spray paint (in a can) with metalic particles in suspension. It was sprayed on top of the tile only, producing the

eroded effect because its solvent attacked the foam. The paint produced no color change and the texture was produced before the tile was cast. The rest of the texture on the surface is from pattern separation and the resulting scab.

16. Flexible Urethane Foam. This foam is of a different shape and color than the beverage container ring (no. 10). The results are less than readable because of the scabing.

17. Large Bubble Pack. This is the same material as the small bubble pack except for the size of the bubbles. It was a good test with obvious texture and thickness, however the middle of the tile is covered with a scab.

18. Yarn. The material was applied in an even manner on the top third of the tile and in a bunched array on the bottom third. The surface on the top, while resembling the original material, is indistinct and there is no change in surface texture. The bottom of the tile is covered by a scab.

19. Flexible Polyurethane. This is a good test showing the relationship between the smooth, rough and uncovered areas of the tile.

20. Duncan Ceramic Glaze, Agean Blue. This is also a

low fire glaze with the same results as Cardinal Red (no. 2), Orange Fizz (no. 8) and Tangerine (no. 14). The glaze was applied in a light heavy relationship with the light area being reduced to charcoal and the color in the heavy area being fragile in both hue and adhesion.

21. <u>Rustoleum Primer.</u> The results were the same as Metalic Spray Plating (no. 15). The texture was a result of the paint's solvent reacting with the foam and occured before casting.

22. <u>Cotton.</u> The material showed change in thickness but no change in texture due to the lack of form of the test material.

23. <u>Cotton String.</u> The results were similar to the yarn (no. 18) with the material being applied in a smooth coarse relationship. The results show change in texture and thickness with a better definition.

24. <u>Polyester-cotton Batting.</u> The results were the same as cotton (no. 22) with the surface showing change in thickness but not in texture due to the lack of form of the test material.

25. <u>Cotton Cloth.</u> This was a good test; there was a

change in texture and thickness with the weaving of the cloth being reproduced very well.

26. <u>Cheese Cloth.</u> The results were good with a definite change in surface texture and thickness and reference to the original material.

27. <u>A Wax Milk Carton.</u> The top of the tile with the smooth piece reproduced with definite texture and thickness; but the bottom piece, since it was mostly unattached, did not reproduce as well.

28. <u>Tag Board.</u> This was a good test showing surface texture and thickness with reference to the original material.

29. <u>Polyethelene Vegetable Wrap.</u> There is a change in surface texture and thickness but it is very subtle.

30. <u>Cardboard.</u> This was a good test showing surface texture and thickness with reference to the original material.

31. <u>Corduroy.</u> The results were the same as cotton cloth (no. 25) with texture and thickness reading well and reference to the original material being exceptional.

32. <u>Aluminum Foil.</u> This was a good test showing surface texture and thickness with reference to the original material.

<u>33. Five Minute Epoxy.</u> There was surface texture and thickness but it was subtle.

<u>34. Notebook Paper.</u> This was a good test showing surface texture and thickness with reference to the original material.

<u>35. Plastic Bread Wrapper.</u> This was a good test with surface texture and thickness and reference to the original material.

<u>36. Vacuum Formed Polyethelene.</u> This was a good test showing surface texture and thickness with reference to the original material.

<u>37. Cotton Felt.</u> This was a good test showing both surface texture and thickness with reference to the original material.

<u>38. Copper Wire.</u> The wire is still on the surface and not part of the cast metal.

<u>39. Victory Wax.</u> There is a change in thickness but the texture and reference to the original material is lacking.

<u>40. Napkin.</u> There are changes but they are subtle and ill defined.

<u>41. Waxed Paper.</u> This was a good test showing surface texture and thickness with reference to the original material.

<u>42. Match Book.</u> The material reproduced remakably well.

<u>43. Linen.</u> This test had results similar to cotton cloth (no. 25) with good texture, thickness and reference to the original material.

<u>44. Coffee Grounds.</u> The material was applied to the top of the test tile only and was reduced to carbon with no change in texture or thickness.

<u>45. Glad Wrap.</u> This was a good test showing surface texture and thickness with reference to the original material. There is also a small scab on the top of the test tile.

<u>46. Tissue Paper.</u> The results were subtle showing both surface texture and thickness.

<u>47. Potato Chip Inner Bag.</u> This was a good test showing surface texture and thickness with reference to the original material.

<u>48. A Steel Screw.</u> The screw did not cause the metal to chill or miscast.

CONCLUSIONS

The test tiles with the various materials show that there are many common easily obtainable substances that can be applied to rigid polystyrene foam to alter its surface. These materials in most cases were reproduced in the cast metal with good results. With the possibilities offered by these and any other substance that the artist may care to experiment with, the problem of surface texture has many solutions.

The full mold process, with all of its advantages when combined with these or other materials to create a surface texture that the artist feels enhances the form, is another step toward freeing the artist so he can be concerned, not with the process, but the idea.

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7. M.F.A. CANDIDATES CLEARANCE FOR ART HISTORY RESEARCH PAPER

This paper must be done and filed before the final examination of the candidate is made. This clearance sheet must be filled out and filed in the candidate's folder.

I have completed and filed the original term paper in Art History

AR 311	Spring	1978
Course No.	Semester	Year

in the Art Department Office and I have given a copy to the instructor for the course.

Dennis Stroh

Student's signature

3-14-79

Date

Advisor

Robert J. Smyth