

THE SLIP CASTING PROCESS IN CERAMICS PRODUCTION

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INTRODUCTION

Slip casting in plaster molds is a basic process employed in quantity production of ceramic wares such as dinnerwares, art pottery and sanitary wares. The slip is clay in liquid formed after sieving; before sieving, it is called snurry. The process is better suited to hollow wares rather than the flat wares. Slip casting makes possible the manufacture of extremely thin sections as in fine porcelain. It is also, used for producing massive sculptures and heavy sanitary wares.

This paper describes the slip casting process as it is done at the Ceramics Research and Productivity Center of the University of Northern Philippines.

MATERIALS USED

The materials needed for slip casting are the following:

1. Ready mixed clay
2. Deflocculant
3. Water
4. Mold

Ready mix clay is a pre-formulated clay body composed of clay, silica, feldspar and ball clay. It can be purchased from ceramics companies or from other sources. Deflocculant, the most common of which is sodium silicate, is a solution of soda and silica. Potable water provides consistency besides using deflocculant. Mold (slip or drain mold) is employed in order to cast and article. Strips or rubber band is used to hold the mold in place. Worn-out interiors of tires can be a practical source of rubber strips, if commercial rubber strips are not available.

TECHNICAL DEFINITION OF TERMS

Slip Casting - is the basic process employed in quantity production of ceramics using slip and plaster mold.

Slip is a sieve liquid clay.

Plaster Mold - is a material **formed to** produce quantities of **desired** identical **clay** products. It is made of Plaster of Paris.

Deflocculant - is a base material, usually sodium silicate or sodium bicarbonate, used to thin a slip.

Spare - is the funnel-shape neck of a plaster mold or a cast article intentionally **made** to determine the thickness of the article.

Firing - is heat treatment given to a ceramic ware.

Glaze - a semi-vitreous material applied to the ceramic ware which forms a glossy bond when fired at maturing temperature.

Bisque Firing - is used to treat the greenwares with heat below the maturing temperature in order to make them hard and strong and semi-impervious to liquid without distorting the shape.

Greenares - are ready-to-fire articles which have 3-0% moisture content; unfired but thoroughly dried.

Glaze Firing - is the process **where** bisque-fired articles are applied with glaze and fired at a maturing temperature.

Kiln - is a refractory chamber where ceramics articles are fired.

TECHNICAL DESCRIPTION OF THE PROCESS

There were basically three steps followed in slip casting and these were: (1) preparing the slip casting clay materials; (2) the slip casting and (3) firing.

The materials and accessories needed were ready mixed clay, sodiwn silicate, soda ash, water, container with cover, series of screen wires, and weighing scale.

The process was done following the procedure below:

1. Prepare all materials needed.
2. Weigh the materials before mixing them altogether.
3. Soak overnight the weighed materials in a container. This will allow water to penetrate deeply into the clay granules in order to avoid lumps.
4. Screen the soaked materials with a series of screen wires. This will ensure uniformity of the particle size of the materials and at the same time eliminate any impurities.
5. Stir the slip continuously to come out with the right pouring consistency.
6. The slip is now ready for use.

The Slip Casting

This process was done observing the following steps:

1. Thoroughly sieve and blend the slip to the pouring consistency. Screening the slip will break coagulated clots and air bubbles. (See Figure 1.)

2. Prepare the mold. Make sure the mold is dry and the cavity clean. Hold the mold together with heavy rubber bands. (See Figure 2).

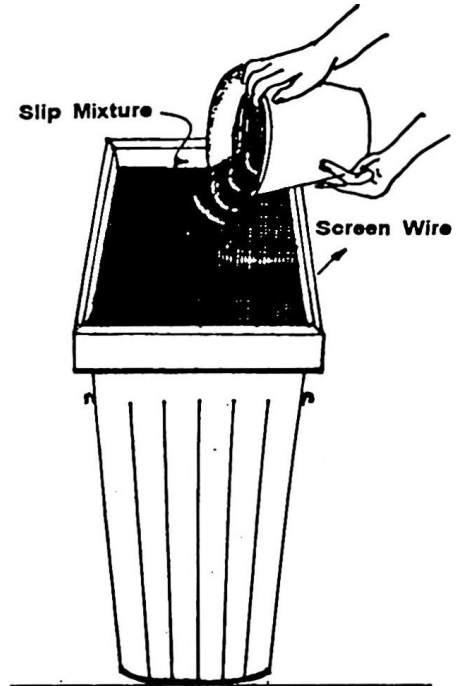


FIGURE 1.
Screening the Slip Mixture

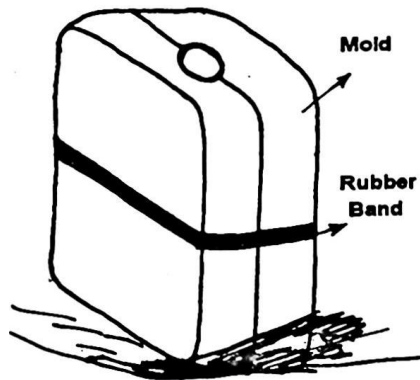


FIGURE 2.
Joining the Mold Pieces with Rubber Band

3. Pour the slip smoothly into the mold and without stopping until the mold is level full. Time the casting period to produce the desired wall thickness. (See Figure 3).

4. Drain the mold by tilting first one side of the mold and slowly turning it upside down. Leave the mold on such position for five minutes. Perfect casting should drain clean inside and without runs and lumps. (See Figure 4).

5. Open the mold when clay pulls away from the walls stiff enough to hold its shape. (See Figure 5).

6. Trim and scrape excess clay from the piece with a knife. Sponging is most effective when the piece is near dry. (See Figure 6a & 6b).

7. Dry the piece for several days. (See Figure 7).



FIGURE 3.
Pouring Slip into the Mold

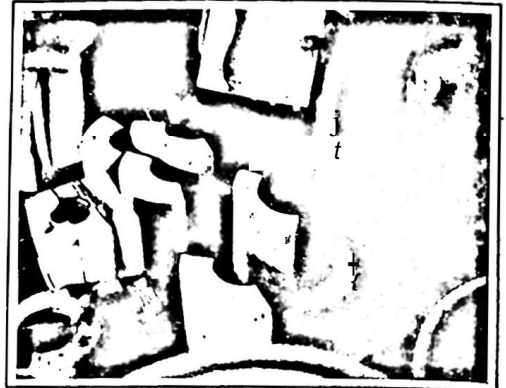


FIGURE 5.
Open the Mold When Clay Pulls Away from the Walls



FIGURE 4.
Draining the Mold



FIGURE 6a.
Trim and scrape excess clay



FIGURE 6b.
Sponge the Parting Lines and Rims of Article



FIGURE 7

Firing

Firing was done using the electric kiln. Traditional potters in the rural areas use the open-pit firing. Among industries and schools, kiln is preferred for special purposes. Firing has several stages: (1) bisque or firing, (2) glaze firing; and (3) decorative firing.

Bisque Firing. The purpose of *this* firing is to fuse the body so that it achieves the desired qualities of strength and density and at the same time retains its shape and structure. Bisque firing is done below the maturing temperature of the clay body and glaze in order to retain its porous characteristics and the ability to absorb glaze.

Glaze Firing. The bisque-fired articles is applied with glaze using dipping, pouring, brushing and spraying techniques then fired to maturity after which will form a glossy bond or effect.

Glazing ceramic articles have several advantages: (1) it can command a higher price; (2) it is easier to clean; (3) it is water proof; (4) it is acid-resistant; (5) it is resistant to thermal shock and electrical conductivity; (6) more pleasant to look at; and (7) it is more sanitary.

A minimum distance of 3/8" to 1/2" between articles during glaze firing must be observed. This will prevent one glaze from staining another and also from fusing together. During firing, glaze bubbles violently, staining adjacent articles.

Decorative Firing. This is usually done after glaze firing. Enamels, overglazes and decals are applied to the ware and fired at a temperature almost 50% lower than glaze firing. Again, distances between articles must be observed. Some glaze, especially low-firing mature at 600C and overglazes, have a firing range of 6000 - 700C. Over-firing will wipe out the decorations.

RESULTS

The following were observed during the slip casting of some ceramics products:

1. Articles of the same shape and design were not uniform in thickness.
2. After several castings, cast articles became soft and eventually deformed. This was due to the saturation of the mold.
3. Unwanted impurities as a result of the deteriorating refractory bricks from the cover of the kiln fused with the glazed articles.
4. Uneven coloring or covering of the glazed body was evident. Bare spots were also visible.

RECOMMENDATIONS

Based on the above results, the following recommendations are offered:

1. The time for casting articles must be the same in order to have uniform thickness.
2. There must be a strict interval between castings. The mold deteriorates rapidly

and saturates easily if intervals are not observed. Mold must have a maximum use of 6 castings per day.

3. The deteriorating cover of the kiln must be immediately repaired.
4. The technique of applying the glaze must be uniform. Constantly mix and stir the glaze. It must be remembered that glaze ingredients are heavier than water and that they settle quickly at the bottom.
5. Articles to be applied with glaze must be sponged to remove dust and unwanted marks, and to avoid bare spots.
6. Quality or product standard must be imposed rejecting immediately articles of inferior quality.

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