



United States Gypsum

Industrial Sales Division
300 West Adams Street • Chicago 6, Illinois

IGL Bulletin No. 311

CASTING WITH PLASTER AND HYDROCAL* GYPSUM CEMENTS

Among the many useful and ornamental articles that may be cast in plasters and super-strength HYDROCAL cements are: statuary, art objects, figurines, lamp bases, advertising displays, premium ware, molds, novelties, dioramas, and simulations. The casting process involves proper proportioning and mixing of the plaster with water, pouring (or otherwise placing) the mixture in molds, allowing it to set up hard, trimming and smoothing the casts, drying them, and, finally, painting, or otherwise decorating them.

There are four requirements that usually must be met in order to produce an attractive, saleable, and durable plaster casting. These are:

1. Good design - An aesthetically pleasing, but practical, design or model. Should have rounded edges and corners, adequate Thickness, proper surface, and be of a castable shape.
2. Good material - The proper plaster or gypsum cement should be selected for the intended use, and should then be correctly handled.
3. Good molds - Since casts will faithfully reproduce the model only if good molds are used, the mold must have accurate reproduction of detail, proper surface, and correct design. In addition, it should be easy to work with, and have sufficiently long life to produce the casts desired.
4. Good finish - A durable finish of desired color and texture must be properly applied to the adequately prepared casting.

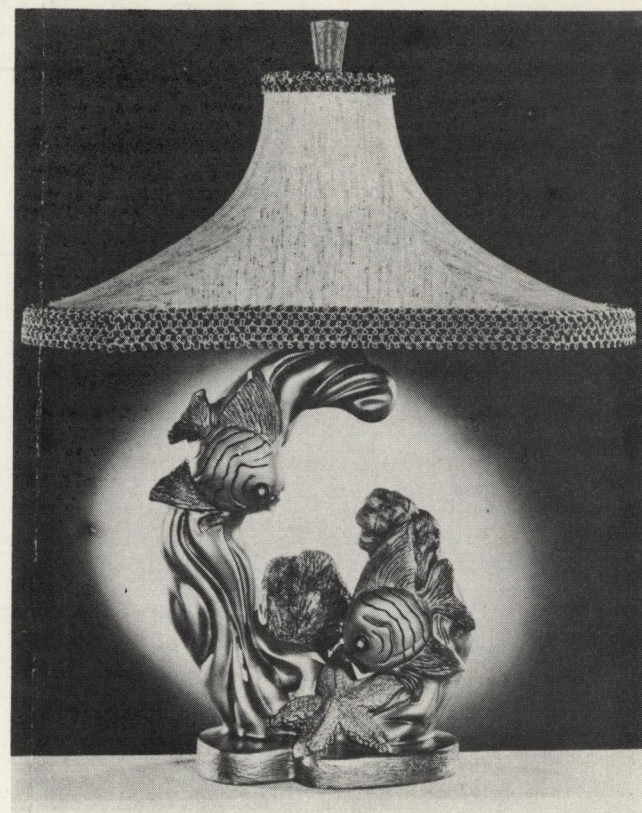
Each of these fundamentals is generally essential, and should be carefully provided for before actual production is undertaken.

This bulletin is mainly concerned with the characteristics of plasters and gypsum cements for this type of work, and the correct methods of handling them,

HYDROCAL AND HYDROSTONE ARE TRADE-MARKS REG. U.S. PAT. OFF. FOR SUPER-STRENGTH GYPSUM CEMENT
MANUFACTURED BY U.S. GYPSUM CO.



COURTESY FLORENCE ART CO.



COURTESY CONTINENTAL ART CO.



COURTESY FLORENCE ART CO.

BASIC FUNDAMENTALS OF PLASTERS

Gypsum cements and plasters are so formulated that each type displays certain properties that make it suitable for specific applications. All USG* plasters are characterized by high quality, purity, and uniformity. The degree of production control used in manufacturing them is such that behavior of any type is virtually identical from bag to bag. Uniform shop results will be obtained also, provided the user of the material maintains a uniform method and procedure for handling each batch.

Factors which distinguish one type of gypsum product from another are their physical properties in regard to setting time, consistency (water required for mixing), fineness, hardness, strength, workability, and surface characteristics.

Setting Time

The setting time of a plaster, practically speaking, is the period of time elapsing from the time at which the plaster is added to the water, until the mix becomes hard enough to remove its mold. During the first portion of this period, the plaster mix is very fluid, and is readily poured. Later in the setting process, the material is in a plastic state which allows it to be worked under a template or shaped in some other manner than pouring. Thus, the time at which the plaster is used should be selected to suit the manner by which the final form is obtained. Once the material has set, its form cannot be changed except by carving, or by adding fresh plaster mixes to it.

Water to Plaster Ratio

The water to plaster ratio (consistency) is the amount of water used to mix with a definite amount of plaster as, for example, a 70 consistency mix would mean 70 pounds of water per 100 pounds of plaster. It is always specified by weight, and volume measurements should not be used as uniform results will not then be obtained.

When less water is used (low consistency) the setting time and the periods of fluidity and plasticity, are comparatively short. Density, hardness and strength are higher in such a mix. In a high consistency mix (more water), the setting time is lengthened somewhat, and density, hardness and strength are decreased. The figures shown below illustrate this variation.

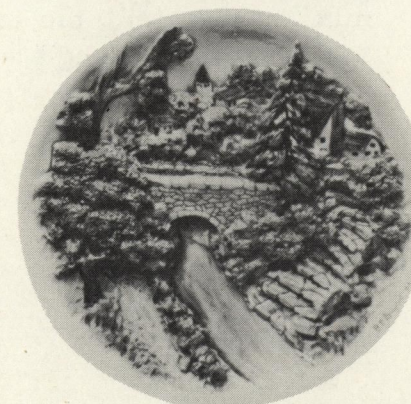
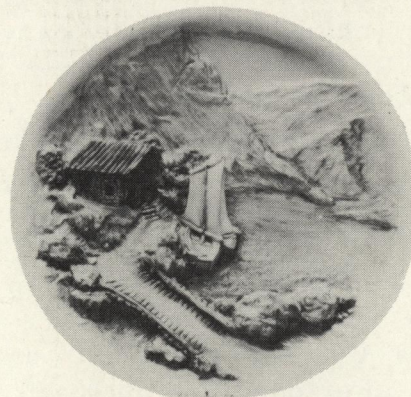
CONSISTENCY (LBS. WATER/100# PLASTER)	DRY DENSITY (LBS./CU.FT.)	PER CENT VOID VOLUME	APPROX. DRY COMP. STR. (LBS./SQ.IN.)
33 (HYDRO-STONE)*	105	27	9750
46 (HYDROCAL)	90	38	5000
50 (HYDROCAL)	85	42	3750
67 (PLASTER)	71	51	2100
80 (PLASTER)	63	57	1400

*T.M. REG U.S. PAT. OFF.

COURTESY OF PLASTO MFG. CO.



COURTESY OF
PLASTO MFG. CO.



COURTESY FLORENCE ART CO.

For HYDROCAL gypsum cements, best results are obtained by use of from 30 to 50 parts of water, by weight, to 100 pounds of material. For other plasters, use from 67 to 80 consistency. With these proportions, setting time in each case will be from 35 to 45 minutes.

The proper time at which to pour or shape the mix, and the best consistency to use can be best determined by experience - not only because these factors depend upon the type of object being made, but also because the user's technique (user shop factors) will affect the mixing method and time.

MATERIALS CHARACTERISTICS

HYDROCAL cements possess much greater strength and hardness than the usual types of casting plaster. They require less water for mixing, and produce casts that are heavier, less porous, easier to paint, and more durable. HYDROCAL generates considerable heat upon setting, and glue molds should not be used. Instead, molds of plaster, Koroseal, or rubber are recommended.

HYDRO-STONE

HYDRO-STONE is the hardest and strongest of the gypsum cements, and should be used at consistency 32 to 40. When mixed properly, it has a heavy, syrupy consistency and cannot be worked in the plastic state. It is not suitable for carving, and is recommended where extreme surface hardness is required.

HYDROCAL White or HYDROCAL Gray Gypsum Cement

These materials differ only in color, and are intended for general, all around, use. Both have a gradual set and long period of plasticity, with high early strength, and moderate carvability. Not as strong or hard as HYDRO-STONE, but more versatile. Should be used at 45-55 consistency.

For less critical work, where softer, weaker casts may be tolerated, it is satisfactory to use No. 1 Casting and Art Plasters. These plasters require more water in mixing, and are consequently lighter, more porous, and from one-fourth to one-half as strong as HYDROCAL cements.

No. 1 Casting Plaster

No. 1 Casting is especially formulated to develop a hard surface upon drying (not as hard as HYDROCAL), and is well suited for castings which are to be painted. The presence of surface-hardening materials

minimizes paint absorption, and gives chip resistant cast without sacrificing the smooth working qualities of untreated plasters. The best and most uniform surfaces are developed by drying castings rapidly in circulating warm air not over 125°F. (Note - Mildew may form on molds or castings in damp, warm weather unless good drying is practiced). Castings should be trimmed and sanded before drying.

Art Plaster

Art Plaster is quite similar to No. 1 Casting, except that it is not as hard, or as chip resistant. It is handled in exactly the same manner as No. 1 Casting, though greater care is necessary in decorating because of its more porous surface.

Molding Plaster

Molding Plaster has no surface hardening additives, and produces casts of minimum strength and hardness. It is highly plastic and easy to carve, and thus best fitted for original models. Casts are quite porous, and must be carefully sealed before decorating. This material is not recommended for high quality, durable work.

No. 1 Casting, Art Plaster, and Molding Plaster are best used at consistency 67 to 80. Like the HYDROCAL, each will faithfully reproduce the most intricate detail.

INSTRUCTIONS ON STORAGE AND USE

The following rules should always be observed by the user if best results are to be obtained with gypsum plasters.

1. Always store plaster bags in a warm, dry, clean place so that the oldest materials are used first. Do not use plaster that may have become lumpy as a result of improper storage.
2. Use water that is fit to drink. If a number of batches are being used, water of approximately the same temperature should be used in each batch to insure uniformity in all mixes.
3. Control soaking and mixing time by means of a clock.
4. Sift or strew plaster evenly into the water (never add water to plaster), allowing no lumps to form which will prevent complete wetting of all the particles. The unmixed plaster must then be allowed to remain undisturbed for from 2 to 4 minutes. Upon completion of soaking, mixing should be continuous until the slurry attains the consistency of thick cream.

This generally requires from 2 to 6 minutes, if machine mixing is used. If necessary to mix by hand, be sure all lumps are mixed out.

5. Keep all the mixing equipment scrupulously clean. Set plaster will greatly shorten setting time.
6. The plaster must be completely set before removal from the mold is attempted. Test the cast by pressing it with your finger, or wait till the cast heats up.
7. Dry freshly made plaster objects thoroughly before putting them into use. Paint will peel from a damp cast and ruin the finish. It is satisfactory to apply heat to the drying operation, but temperatures should not exceed 120°F. Higher temperatures (140 to 150°F.) have been used to hasten the drying operation. However, this is recommended only where the oven temperature can be controlled with very accurate thermostatic controls. The controls should be such that they will reduce the temperature in the oven automatically during the drying cycle to prevent over drying or calcination. The drying period is dependent upon the thickness of the cast object. When the higher temperatures are applied the average size piece can be dried over night while the lower temperatures require a longer drying time. Regardless of the temperature and cycle the oven should be cooled to room temperature to prevent thermal shock and possible cracking of the plaster upon removal from the oven.

MOLDS

Molds may be made of a variety of materials but there are two general categories into which all molds are grouped. These two types are rigid molds and flexible molds. All plasters and gypsum cements expand upon setting and this must be allowed for.

Rigid Molds

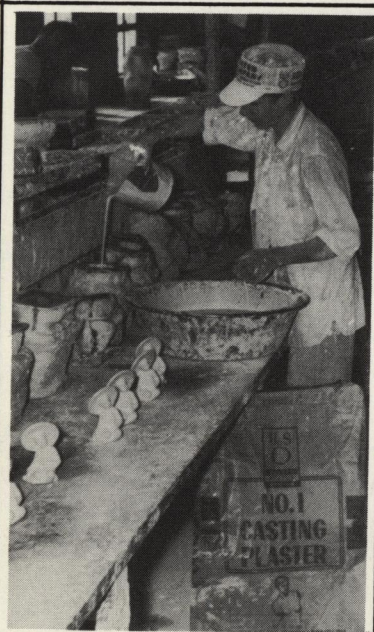
Rigid molds are made of plaster, metal, wood, clay and other materials which exhibit relatively little elasticity. These molds are fairly simple to make and are comparatively cheap, but they can be used generally for only the simplest castings. They must be well drafted (have no undercuts), and are generally made in several pieces.

Flexible Molds

Flexible molds may be made of glue or gelatin, latex, Koroseal, Perma-Flex CMC, and other materials which have good strength in



SCULPTOR carves or models the "original" from plaster or modeling clay.



CASTING PLASTER into rubber molds made from "original" hand carved model.

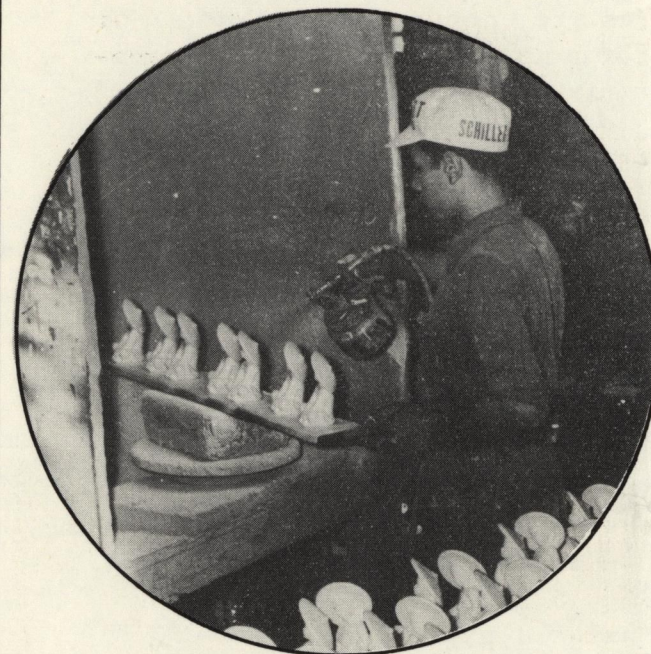


Completely set plaster cast being removed from rubber mold.



"SLUSH" CASTING technique to make hollow lightweight objects.

COURTESY OF UNIVERSAL STATUARY CO.



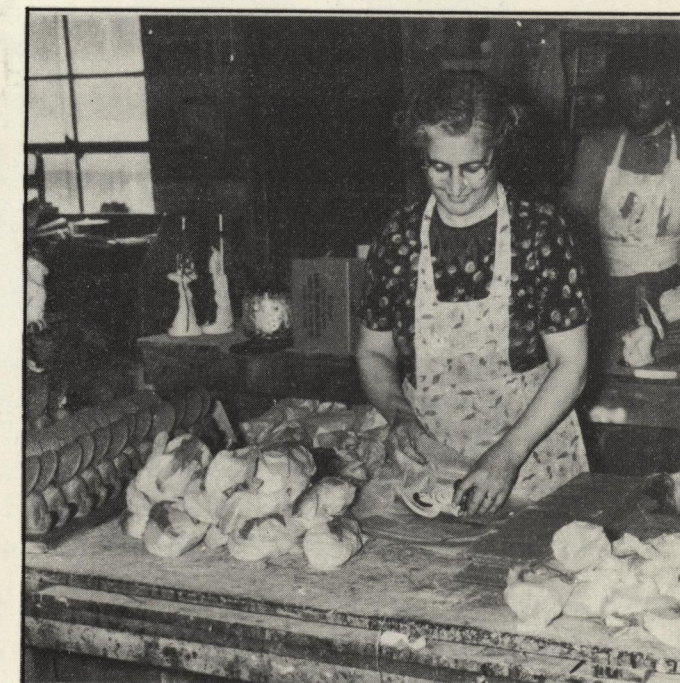
Base coat or sealant is sprayed over entire object to minimize point absorption.



Paint or lacquers are applied with an air brush to insure uniform coating.



Finishing facial expressions and other detail is applied by hand with camel hair brush.



Finished object should be carefully wrapped and packaged for shipment.

addition to elasticity. Flexible molds are almost a necessity for art work where complicated figures are encountered. (Note - For information on flexible molding compounds, write to The Perma-Flex Mold Company, 1919 East Livingston Avenue, Columbus 9, Ohio.)

PARTING COMPOUNDS

Parting compounds are necessary to prevent adhesion of the hardened gypsum plaster to a pattern, model or mold and to permit removal of the gypsum plaster from the surface upon which it sets up.

In the use of porous models, patterns or molds, it is necessary to seal their surfaces before the parting compound or separator is applied. This may be done with thinned brushing lacquer or shellac thinned with alcohol only. Several coats of thin shellac are better than one coat of thick shellac, because with the thick shellac the fine detail will be lost.

Some parting compounds that may be used for gypsum plaster are:

Stearic Acid and Kerosene, or Stearine

The stearine parting compound is made by dissolving 1/4 pound stearic acid shaved to flakes in one pint of kerosene. The stearic acid should be melted by careful warming (caution - fire hazard) removed from the heat source and the kerosene added with constant stirring until a uniform mixture is obtained. Apply to the pattern with a soft brush. If the brush marks show, the mixture should be thinned with more kerosene or warmed slightly. This separator is one of the most widely used of all parting compounds and is particularly recommended for glue molds.

Petroleum Jelly (Vaseline)

Petroleum Jelly may be used if it is diluted with approximately two parts kerosene to one part of jelly. The mixture should be blended by careful heating and thorough stirring. (Caution: FIRE HAZARD). This separator is satisfactory for taking casts from wood.

Light Lubrication Oil

This oil should be used very sparingly.

If a plaster mold is to be used for the casting of plastics, the manufacturer of the plastic should be consulted as to the proper sealer and separator to be used, and his recommendations followed.

When molds or patterns of Koroseal or most other flexible molding compounds are used to form the gypsum plaster or cement, no separator is necessary. An exception to this is the glue or gelatin mold on which a parting compound must be used.

FINISHING

The last important step in producing a good quality plaster casting is the finishing operation. The paint and lacquer industries have developed many special formulations for use in the finishing of plaster castings. An outstanding example is the glossy, ceramic type glaze which enhances the beauty of the plaster ware considerably. (Note - For information regarding the types and uses of these plaster finishes, write to Allied Finishing Specialties Company, 2639 West Grand Avenue, Chicago, Ill.)

In general, any good paint, lacquer, or enamel is satisfactory. Before a plaster object is painted or coated in any way, it must be thoroughly dry or the finish will flake off. If the surface is porous, it must be sealed before painting. Suitable materials for this purpose are shellac thinned with alcohol, clear lacquer or linseed oil.

Plaster castings may also be used for outdoor statues or displays provided that they are given the proper finishing and care. In this regard, the cast should be thoroughly dry, covered with several coats of paint, protected from excessive moisture and inspected regularly for surface injuries which should be repainted.

This bulletin has been presented to serve as your guide for quality casting with Plaster and HYDROCAL Gypsum Cements. Ask for the INDUSTRIAL DIVISION Representative at any one of the following UNITED STATES GYPSUM CO. offices for your nearest source of supply.

LOCATION	ADDRESS	TELEPHONE NO.
Albany, New York	45 Colvin Avenue	Ivanhoe 9-2504
Arlington 9, Virginia	1011 Arlington Boulevard	Jackson 5-3300
Atlanta, Georgia	3330 Peachtree St.	Cedar 3-3265
Baltimore 12, Maryland	6305 York Road	Idlewood 3-1600
Berkley, Norfolk, Va.	Appomattox and Buchanan Sts.	Kimball 5-2461
Birmingham, Alabama	1747 Reese Street	Tremont 1-0301
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Charlotte 4, N. C.	1535 Elizabeth Ave.	Edison 2-5023
Chicago 6, Ill.	300 West Adams St.	State 2-6100
Cincinnati 6, Ohio	Suite 206, 1423 E. McMillan	University 1-9115
Cleveland Heights, Ohio	2490 Lee Road	Fairmount 1-4141
Clifton, N. J.	1051 Bloomfield Ave.	Gregory 2-3900
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Davenport, Iowa	725 Union Arcade Bldg.	3-8850
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Grand Rapids 6, Mich.	4455 East Genesee St.	Gibson 6-1291
Hamden 14, Conn.	11 Fuller Avenue, S. E.	Glendale 6-8611
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2322 West Third St.
4050 Westport Road
Room 611, Sterick Bldg.
8340 N. E. Second Ave.
808 North Third St.
5050 France Avenue
3308 Tulane Avenue
415 Madison Avenue
1029 North Walker
120 N. 69th St.
Suite 204, Insurance
Center Bldg.
7616 City Line Ave.
221-A East Camelback Rd.
733 Washington Road
1888 S. W. Sixth Ave.
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7734 Bonhomme Ave.
175 West So. Temple St.
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Rm D-305
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75 Third Avenue

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