Nan Smith, Professor
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Technical Handout

U.S. GYPSUM INDUSTRIAL PLASTERS & GYPSUM CEMENTS

Plaster has been used as an art material for over 5000 years. The Egyptians used it in the burial vaults and Michelangelo used it to make full sized models for sculptures. Plaster architectural ornamentations like decorative reliefs on cornices, mouldings, and interior trims were very popular in Europe and in colonial America. Artisans handed down working methods to other artisans as secret information.

"United States Gypsum Company has played a major role in the growth of this industry with the development of the finest industrial plasters and gypsum cements".* For additional product information and literature the United States Gypsum Company can be contacted.

Address - United States Gypsum Company
Industrial Gypsum Division
Chicago, Illinois 60606-4385

Phone - 1-312-606-4000

Website - www.gypsumsolutions.com

Types of Plasters; Industrial Plasters and Gypsum Cements:

Industrial Plasters:

1 Moulding Plaster- nominal strength and hardness, reproduces intricate detail, porous, must be sealed before decorating.

USG White Art Plaster- gives excellent detail, provides harder surface, lower absorption than moulding plaster. This material contains a surface hardening agent.

USG #1 Casting Plaster- special additives maintain a smooth working quality. Dried surface is very hard and chip resistant. It has a very reduced absorption.

USG Industrial Plaster PC- blended with a polymer and synthetic fibers it provides better chip resistance and impact resistance. Superior strength permits thinner castings (25-35% less weight). Used for producing solid or slush cast products.

USG Industrial Plaster PC-1- contains a color dispersant which provides deeper, richer, more uniformly colored casts. Used industrially to create decorative brick, stone, and other deeply colored objects.

Gypsum Cements: All gypsum cements possess greater strength and hardness than standard industrial plasters.

Hydrocal- has a high green strength, gradual setting time, and long period of plasticity.

Statuary Hydrocal- excellent plasticity, harder and stronger than Hydrocal White Gypsum Cement. Applications are solid and hollow art casting.

Hydrostone- one of the hardest and strongest of available gypsum cements. Recommended for statuary castings requiring extremely hard surfaces. Best results are obtained when mixed mechanically.

"Factors which distinguish one type of industrial plaster from another include physical properties such as setting time, consistency (water required for mixing), fineness, hardness, strength, workability, and surface characteristics".*

Mixing Procedures:

"An ideal plaster mix is one in which the plaster particles are completely dispersed in the water to produce a uniform, homogeneous slurry."*

1. Use pure water. Drinking water is considered pure.
2. Water temperatures affect the setting time; the warmer the temperature, the faster the set. Temperature ranges for maximum solubility are between 70 and 100 degrees F.
3. The water to plaster ratio (consistency) is the definite amount of water used to a definite amount of plaster. This ratio affects the set time as well as the final density, hardness, strength and durability of the plaster form. It is recommended by the U.S. Gypsum Company water and plaster volumes be measured according to directions outlined on each product. A calculator window is available at the gypsum solutions website to aid in measuring the proper ratio of water to plaster.
4. Allow the plaster powder to soak in the water so that the particle can be fully saturated. Allow it to soak for 3-4 minutes to gain a completely wetted mixture. "Short-cuts in soaking adversely influence effectiveness of the mixing period and subsequently affect the quality of the plaster casts.
5. For quantities of under 5 lb. hand-mixing is generally acceptable. Mechanical mixing is recommended for larger quantities.

Additives (note - these materials can reduce final strength of casting produced):

Accelerators used are potassium sulfate and terra alba (ground gypsum) which are available commercially.

Recommended retarders are: USG Retarder or USG Sodate Retarder.

Pigments are used both dry and wet. Recommended dry pigments are metallic oxides like chrome and iron. Dry color and wet color can be added to the water in which the plaster will be mixed to gain more even dispersion.

General Water to Plaster Ratios (1 to 1 3/8 by weight):

WATER	PLASTER
½ PINT	11 OUNCES
1 PINT	1 POUND AND 6 OUNCES
1 ½ PINTS	2 POUNDS AND 4 OUNCES
1 QUART	2 POUNDS AND 12 OUNCES
1 ½ QUARTS	4 POUNDS AND 2 OUNCES
2 QUARTS	5 POUNDS AND 8 OUNCES
2 ½ QUARTS	6 POUNDS AND 14 OUNCES
3 QUARTS	8 POUNDS AND 4 OUNCES
3 ½ QUARTS	9 POUNDS AND 10 OUNCES
4 QUARTS	11 POUNDS
4 ½ QUARTS	12 POUNDS AND 6 OUNCES
5 QUARTS	13 POUNDS AND 12 OUNCES

6 QUARTS	16 POUNDS AND 8 OUNCES
7 QUARTS	19 POUNDS AND 4 OUNCES
8 QUARTS	22 POUNDS
9 QUARTS	24 POUNDS AND 12 OUNCES
10 QUARTS	27 POUNDS AND 8 OUNCES
11 QUARTS	30 POUNDS AND 4 OUNCES
12 QUARTS	33 POUNDS
13 QUARTS	35 POUNDS AND 12 OUNCES
14 QUARTS	38 POUNDS AND 8 OUNCES
15 QUARTS	41 POUNDS AND 4 OUNCES

To calculate the volume for rectilinear shapes, multiply the measured length, width, and height which will give you the cubic inches.

To calculate the volume for cylindrical shapes, multiply, 3.14 (PI) by the radius squared by the height.

To convert cubic inches into quarts divide the cubic inches by 80 : cubic inches divided by 80 = no. of quarts of water.

Drying Plaster Casts:

"For uniform results and optimum physical properties, plaster casts must be properly dried, done by transferring excess water in the cast to the surrounding air. For complete hydration in the setting process, plasters require about 18.6 parts of water per 100 parts of plaster. To obtain a mixable slurry, larger amounts of water must be used in the mixing. After the plaster has set, any water above 18.6 parts is considered excess or "free" and must be removed from the cast by drying. Drying equipment can be designed to remove the excess water in a specific time and at a predetermined cost. Advantages to controlled drying include:

Proper strength development
Uniform absorption
Increased production
Mildew prevention
Better, paint ability"*

If you design a dryer be sure that temperatures do not exceed 130 degrees F and that there is air circulation in the drying unit.
Storing Plaster: The material should be stored in a warm dry place, away from any damp surroundings.

* All quotes are from United States Gypsum Company product literature.