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Aftercast

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Plaster—an Intermediate Material

After the plaster has been carefully ground, calcined, and graded, the white powder that remains has certain important properties. One of these is that the plaster is homogeneous, which means that, when properly mixed with water and allowed to crystallize, plaster will provide us with a solid that has no grain, no soft or hard spots, no lumps or knots; it is therefore a perfect material for receiving our cutting efforts. Whether we carve plaster by hand, turn it on a lathe, or scrape it with a template, we need not be concerned with irregularities of density that are common to other materials such as wood.

For the uninitiated, using plaster can be a maddening experience.

When the roasted powder is mixed with sufficient water to render the mass creamy in consistency, it recovers the 1½ parts of water it possessed prior to calcination, and the mass 'sets' to a uniform, inert, and solid mass of substantially the same composition as the original gypsum.

The basic material for mould-making is plaster of Paris. This is an incompletely hydrated calcium sulphate produced by heating or boiling gypsum stone, after it has been ground. When mixed with water usually in the proportions of about 2 pints (1.1 litres) water to 3lb (1.5kg) plaster, to a thick liquid, the plaster will set fairly quickly in about 20 minutes. After drying, it will be absorbent. The plaster needs to be contained round the object or model being moulded. This can be done with any strong non-porous material, such as plastic, wood or soaped plaster slabs, that will easily release from the plaster when it has gone off.

Working With Plaster

No matter how simple or how elaborate a sculptor's studio is, a supply of plaster is essential.

The crystals, which form after plaster is mixed with water and begins to set, are made up of approximately 20 per cent of water of crystallization. Subsequent to the setting or crystallization, all of the water in excess of that which was required for crystallization slowly evaporates from the set plaster mass.

When the free water has been evaporated from a set plaster mass, air spaces remain between the crystals. These spaces, formerly occupied by the free water, give to a plaster cast its porosity and absorptive power.

Plaster is manufactured from the mineral gypsum {from the Greek word *ge* for earth and *epsum* for concoct}, which is mined from quarries or underground deposits, the most famous of which is the deposit around the Montmartre area in Paris, first mined in 1770. Plaster consists chemically of calcium, sulphur, oxygen, and water {$CaSO_4 \cdot \frac{1}{2}H_2O$}.

WORKING WITH PLASTER

Commercially, gypsum is secured from underground deposits by mining or quarrying. It occurs as a solid, crystalline mass containing contaminating silicates and carbonates, and the purity of the substance is regulated largely by the selection of the rock in the quarry or mine.

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Plaster of paris
Plaster of paris is manufactured by heating gypsum (a mineral formed by the deposition of salts in inland lakes during the course of many geological periods) to a high temperature, which partially calcinates and dehydrates it. When the powder is mixed with sufficient water to form a mass of creamy consistency, the chemical reaction causes it to thicken and to set hard. Plaster has a wide range of uses. It can be modelled by building up the sculpture or it can be made into a block and carved. Plaster can be obtained from art and craft suppliers, builders' merchants and some of the larger chemists. There are a number of different grades of plaster. Dental plaster has a short setting time (about 7 minutes) which enables the sculptor to work at a reasonable pace. Casting plaster has a longer setting time (15–30 minutes), which can be rather tedious when modelling a sculpture, but in other respects it is similar to dental plaster. *Herculite* and *Crystacal* are very hard plasters for pouring into the mould to make the cast.

Water, Key to Understanding Plaster

Dry plaster is converted back to its original rock-like condition when combined with water. This setting or hardening of plaster—called hydration—is a process in which a certain amount of water recombines chemically with the plaster to replace the water previously removed in the manufacturing process. To bring about complete hydration, physical stirring or mixing is essential. The mixing itself, however, requires a considerable amount of water, more than can be chemically combined with the plaster. Therefore, in addition to the water that will combine chemically, we must also have sufficient water for mixing. This "mixing water" must reach every particle of plaster: to flush away the layer of air that envelops each dry particle, and to wet the particles sufficiently so they flow together in a fluid mixture, called a "slurry."

Gypsum plaster. Hydrated calcium sulfate, $CaSO_4 \cdot 2H_2O$, which sets after mixing with water to form a firm block. Used by the potter for molds.

Gypsum is converted into plaster through calcining or heating to 225°–350°F, followed by grinding into a fine powder. The powder has an affinity with water, and when 1 part plaster is mixed with 1 part water, it regains the original amount of water possessed before calcination and returns to gypsum's original crystalline form. The material is homogeneous and behaves predictably, setting to a hard, uniform mass with a low coefficient of expansion. This makes plaster ideal for molding and casting, as it will penetrate intricate areas and set into a dimensionally accurate cast of the original.

Hydrated calcium sulphate $CaSO_4 2H_2O$ (gypsum), when heated to 350°F (117°C), loses 75 per cent of its water to form $CaSO_4 \frac{1}{2}H_2O$, which is known as plaster of Paris. It is named after the Paris region in France, which has an abundance of gypsum. Commercially, the plaster is more often called dental or superfine casting plaster and this is the grade most often used by sculptors.

Bought plaster comes in the form of a white powder which, when mixed with water, recovers the water it had prior to being treated by heat, and sets to a uniform mass with the same composition as the original gypsum.

Using Plaster

As plaster is used in so many of our operations as sculptors, it is worthwhile mentioning methods of using it. I often found in my dealings with students that they would not mix their plaster correctly and such a simple error could sometimes lead to weak or broken moulds or casts.

Plaster

The best types of plaster for casting are dental, casting, or surgical plaster. These are most suitable because they harden fairly quickly (in about 10 minutes). When used for making moulds, these plasters take a good copy from the original model, and can be chipped away easily from the completed cast. Builder's plaster is unsuitable but as an economy measure it can be used to back up the first layer of the fine quality plaster. Plaster for casting can be obtained from the larger chemists, builders' merchants and art shops. It is generally sold in quantities of 7, 25 and 50 kg. Unless a small piece of work is being cast, it is more economical to buy the plaster in larger quantities (at least 25 kg). Plaster is usually packaged in a paper sack but it is much easier to use when it has been poured into a plastic or galvanized container, such as a dustbin. This reduces possible mess and helps to keep the plaster dry. It is essential that the plaster is not allowed to become damp. Plaster has a recommended shelf life of 3 months, but kept in an airtight container it can last up to 12 months before losing its setting properties. If there is any doubt that the plaster will set properly, it is inadvisable to use it for casting. A wise precaution is to test its setting properties beforehand by mixing up a small quantity.

Plaster is a kind of common denominator in sculpture, being a workhorse equal to clay. Used mainly as an intermediary material, for mouldmaking, and for making patterns by direct working suitable for casting from, it is not a durable material, although some artists today do choose to use it as a final material. Because of its fragility and vulnerability, it requires treating to make it tougher and longer lasting indoors. For extermal use it can be treated to stand out for a couple of years only. The Henry Moore gift to the Ontario Museum of Fine Art in Toronto includes a large number of original plasters known as master casts that have been treated with white shellac. This hardens the plaster and gives it an appearance similar to ivory or bone.

Plaster is not found in a ready-to-use state; it must be quarried, crushed, screened, pulverized, and then heated, before it is suitable for casting purposes. This the plaster manufacturer or processor does under closely controlled conditions. The heating process, called "calcining," drives off three-fourths of the plaster's chemically combined water. The residue is then placed in pits and cooled.

Physically, a mixture of water and plaster is a suspension of a solid in a liquid. The particles of plaster are heavier than water and tend, therefore, to settle out of the mixture. This can be prevented by either making the mixture sufficiently thick so that the plaster will not easily settle out prior to its setting or crystallization, or, if it is desired to work with a thinner and more plastic mix, the plaster should be sifted or stirred constantly until it is ready to be poured.