



Technical Corner

LIME AND ITS ROLE IN PLASTER

Article By:
Walter Pruter
Michael Logue

In the ancient beginnings of the plastering craft we are taught shelters were constructed of mud and reeds or ‘daub and wattle.’ The moisture sensitive earthen plasters were protected from rain erosion with coatings of **lime wash**.

Essentially, lime wash is a mixture of slaked lime (quicklime or calcium hydroxide) in water, which sets very slowly by absorbing carbon dioxide from the air. The chemical reaction that occurs produces crystals of calcite (calcium carbonate).

Over a period of time early builders thickened the consistency of the lime wash by adding volcanic ash, seashells or river sand to produce the first lime plasters and masonry mortars. Evidence of the use of lime plaster dates back to around 4000 B.C. in Turkey. Popular with the Romans who invaded the British Isles, lime plaster had been used extensively in the cold, wet climates of northern Scotland and Wales to protect stone buildings and mortar from inclement weather. While protecting the structure from rain and snow, lime wash and lime plaster assists in maintaining the ability of a building to breathe, as it is one of the most vapor permeable of all decorative and protective coatings.

Although it is considered a natural material, lime itself does not exist in nature. The term lime comes from the word limestone. Limestone is converted to lime when it is heated. It has been established that the production of lime is the oldest industrial process of mankind.

Lime is made by heating or burning crushed limestone (calcium carbonate) at more than 1650 degrees Fahrenheit to produce **quicklime**. The heat burns off the carbon dioxide, leaving calcium oxide (quicklime). Quick lime was made into putty by soaking it in water for weeks and sometimes months to slake or hydrate. Slaking lime to make lime putty produces a great deal of heat. It is very caustic at this stage and can cause serious irritation to skin, eyes and mucous membranes.

Prior to 1932 lime was delivered to a construction site in the quicklime form and had to be hydrated or slaked before using.

The availability of autoclaved or double hydrated lime after 1932 allowed lime to be added directly to the plaster mix without the required soaking time. There are three different types of lime – dolomitic, high calcium and magnesian – deriving from three different types of limestone. The differences among the limes are determined by the weight of the magnesium carbonate found in the limestone. Dolomitic limestone is preferred in making lime for plaster and mortar. The high levels of magnesium in dolomitic limestone give the lime very good water retention and plasticity that cannot be obtained in the high calcium or magnesian types.

LIME PLASTER

Prior to the patenting of portland cement in 1834, lime putty was the principal binder in plasters and mortars. Lime mortar may be applied either as three-coat work or as two-coat work. Three-coat work can be applied over metal and wood lathing. Two-coat work can be applied over brick, clay tile, gypsum block and other masonry surfaces. Lime plasters must not; however, be applied to gypsum or insulation laths because lime plaster does not supply the bonding action that is vital for good results on these bases.

Lime mortar must be well aged in order to work properly and it must not be too rich. A rich mortar will shrink while setting and in doing so will crack. Since it is so slow to set, lime plaster must be protected from dry outs caused by exposure to dry winds.

The scratch coat, whether used for the three-coat work or for two-coat work, is made of 3 parts aggregate to 1 part of stiff putty. If the scratch coat is to be put on wood or metal lath, the addition of fiber is necessary.

In three-coat work the scratch coat is allowed to set but is scratched before the coat dries. After the scratch coat has become dry the brown coat can be applied, using a mix of 3 to 1 (3 parts sand to 1 part lime). Aging the plaster mix for approximately one week will enable the plasterer to proceed with brown coat applications. Suction can be controlled by dampening the scratch coat before applying the second coat. The day after the brown coat has been applied it should be floated with a large cross-grained wood float. Floating is done by densifying the mortar, thus minimizing crack formation.

The addition of portland cement or Keene’s gypsum cement helps to prevent the development of shrinkage cracks and they produce a stronger mortar as well. Interestingly enough, the addition of portland cement to lime-sand mortars in the late 19th century was to speed up the construction process. Portland cement was initially considered an additive to enhance the setting characteristics of lime-sand plasters. With the thought that stronger mortar or plaster was better, portland cement was increasingly added in larger and larger volumes to the lime-sand mix, in some cases eliminating the lime altogether.

PORTLAND CEMENT-LIME PLASTER

All of the portland cement used in the United States prior to 1871 was imported from England and France, usually as ballast in ships and at very low freight rates. This does not mean that the United States was without cement until that time. On the contrary, a large and flourishing natural cement industry had emerged. **Natural cement** rock was limestone that contained the appropriate amounts of clay to give it hydraulic properties. Natural and portland cement competed for market share. As cement-testing equipment became more sophisticated, enabling cements to be tested at increasingly higher load limits,



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it was soon acknowledged that portland cement developed higher strengths much sooner than natural cement rock.

Portland cement, sand and water does not produce a workable mix and is more difficult to manipulate with the trowel than lime or gypsum mortar. For this reason lime, pozzolons or other plasticizing materials are added to improve workability. Lime being cementitious like the portland cement has proven to be the best plasticizer by far and has been shown to provide elasticity, reduce shrinkage and cracking, all while providing sufficient strength. Adding lime to portland cement plaster mixes improves resistance to water intrusion and enhances bonding of stucco finishes to basecoats.

The ability of a mortar to reknit itself if voids are present or if small cracks develop in the plaster is called **autogenous healing**. High lime containing plaster mixes have this characteristic.

Nature provides this cure by rainwater and atmospheric carbon dioxide. Hydrated lime, which is very slightly soluble, will dissolve and is recarbonated by the carbon dioxide. Gradually, this chemical reaction (similar to formation of stalactites) plugs the crack or interstice.

Building codes and published standards typically allow 20 lbs. of lime to a sack of cement for **portland cement** plaster scratch and brown coats.

For **portland cement-lime** scratch and brown coats the lime volume can be increased to 1:1 but the volume of sand must be increased accordingly; otherwise the mix will be too cement rich. When a cubic ft. of lime (50 lbs.) is mixed with a cubic foot of portland cement the sand should be 6 to 8 parts.

A survey of major contractors who prefer portland cement lime plaster discloses that the most popular mix design is 1 cubic foot cement (94 lbs.) to ¾ cubic foot hydrated lime (75 lbs.) to 5 to 7 cubic foot of sand (30 to 42) shovels. As with regular portland cement plaster the addition of fibers is recommended to inhibit shrinkage cracking. Two common

mistakes made by plasterers using portland cement-lime plaster for the first time are:

Not using enough aggregate. Remember, lime is also cementitious so the sand-to-cement ratios must be increased.

Portland cement-lime basecoat mixes must be mixed longer (ten minutes or more) to produce the optimum physical properties.

LIME PUTTY FINISH PLASTERS

There is presently a remarkable resurgence in the demand for premium "Venetian plaster finishes, which are for the most part prepared from aged lime putty. These vari-colored smooth troweled finishes were recently made popular by Dennis Hopper, President of the Ora B. Hopper Co. in Phoenix, Arizona. Architects attending his (and other lime plaster adherents) seminars found fascination in the unusual surface glow characteristic of lime plaster and lime washed surfaces.

This appearance is the result of the chemical reaction that occurs when slaked lime slowly absorbs carbon dioxide from the atmosphere. The chemical reaction produces crystals of calcite (calcium carbonate). These crystals are unusual because they have a double reflective index; light entering each crystal is reflected back in duplicate.

This results in the wonderful surface glow that is characteristic of lime plastered and lime-washed surfaces and is not found on look-alike paint products or imitation polymerized plaster coatings.

Each lime putty finish manufacturer seems to have their own mixing and application instructions, so it is advised that the manufacturer of the plaster intended for use be contacted for specification information. Some of the more prominent lime based Venetian plaster manufacturers include:

FIRENZ Enterprises, Inc. Miami, Florida	TEXTON INDUSTRIES Canoga Park, California
HOPPER Phoenix, Arizona	TRANSMINERAL, USA Petaluma, California
VERO Orange, California	

The ultimate result in a "Venetian" plaster finish is not due to the material used as much as it is the talent of the plasterer doing the application. The trowels and the troweling techniques are different from conventional finish coat plastering. Short strokes made in varying directions seem to produce the uniformly mottled appearance most successfully.

While lime finishes can be burnished to a beautiful glossy sheen, some prefer to wax or otherwise shine the finished lime plaster.

PHONE SCAM WARNING

Gary Kehrier (President of the Orange County Chapter, CSI), received a telephone call from an individual identifying himself as an AT&T service technician, who was conducting a test on telephones lines. He stated that to complete the test, Gary should touch nine (9), zero (0), the pound sign (#), and then hang up.

Luckily, Gary was suspicious and refused. Upon contacting the telephone company, Gary was informed that by pushing 90#, you give the requesting individual full access to your telephone line, which enables them to place long distance calls billed to your phone number.

Gary was further informed that this scam has been originating from many local jails/prisons. Gary also verified this information with UCB Telecom, Pacific Bell, MCI, Bell Atlantic and GTE. Please beware.