



# Hardwall plastering – materials and mix ratios

**Feedback from industry participants regarding *Industry Bulletin 71 Paint adhesion to white set plaster* has prompted further advice be issued to building practitioners to assist in obtaining a durable and serviceable plaster finish.**

**This industry bulletin recommends building practitioners enhance or adopt a practice to ensure plasterers engaged by them are preparing and applying plaster to a specified standard at all times and that only materials which conform to the relevant Australian Standards and manufacturers specifications are used for both internal and external plastering.**

## Background

From information received by Building and Energy along with evidence collected from our complaint and audit programs, it is evident that some white set plastered walls do not achieve their expected bond strength or surface hardness. The cause of defective plaster can relate to material misuse and workmanship issues and some of these are discussed in Industry Bulletin 71. There are however, two recognised poor or incorrect plastering practices that require highlighting to building practitioners as identified through scientific testing conducted of internal plaster finishes.

They are;

- incorrect use of air entraining agents (includes plasticisers); and
- incorrect gypsum/lime mix ratio.

## Effect of air entrainment agent used in cement float coat under an overlaying white set (gypsum and lime) plaster coat

When the white set plaster coat is installed over the cement float coat, the air entraining agent in the float coat migrates through into the set coat producing bubbles in the plaster, which reduces the plasterer's capacity to produce a compact and durable finish. The surface of the white set plaster may appear hard, however the material under the surface is filled with bubbles which weaken the gypsum layer. When gypsum lime plaster is mixed with water it sets with a great number of small crystals interlocking to form a rigid structure. The use of an air entraining agent in the float coat can prevent the interlocking of the gypsum crystals.

The inclusion of air entraining agents will negate the role of any lime, and create a retarding effect on the set coat. In so doing, it slows the set of the material, which in turn diminishes the trowelling and compaction of the set coat.

Building and Energy has received numerous complaints in regards to bond failure of plaster in both internal and external locations. Air entrainment agents will always reduce bond strength as they increase the air content of the mortar and/or decrease the amount of water required for a workable mix. These two factors prevent the cement fines and paste from adhering to the full surface of the substrate and therefore bond strength is reduced.

Air entraining agents should only be used if specified and then strictly in accordance with the manufacturer's instructions. The use of air entraining agents is not recommended in HB 161-2005 Guide to plastering (HB 161-2005).

## What is air entrainment?

Air entrainment is the intentional creation of tiny air bubbles in plaster (float or base coat). A plasterer introduces the bubbles by adding to the mix an air entraining agent, a surfactant (surface-active substance, a type of chemical that includes detergents). The air bubbles are created during mixing of the plastic plaster, and most of them survive to be part of the hardened plaster. The primary purpose of air entrainment is to increase workability of the plaster while in a plastic state.

It is well known that when an air entraining agent is used it is common to overdose it because of the extreme workability enhancement that can be produced. However, this overdosing produces severe reductions in bond strength.

## Why is lime so important in the float coat?

Lime has certain useful properties in the plaster float coat and should not be under used or replaced by air entrainment agents to achieve workability. Importantly lime in the float coat assists to provide the necessary suction aspects for the compaction process of the set coat to achieve the required strength. Each lime grain can be described as a miniature sponge, expanding as it soaks up moisture and shrinking back as it dries. The lime grains encourage the drawing of moisture from the set coat, which in turn allows the pressure of the trowel to compact the set material.

If there is no lime present in the float coat, suction does not occur. The plaster then needs to obtain its own set potential which is controlled only by the weather conditions. In summer drying is likely to occur, but in cool conditions the plaster set can be delayed – resulting in soft weak plaster set.

Manufacturers of cement and lime products provide recommended mix ratios regarding the amount of cement, lime and sand. Additionally, HB 161-2005 provides recommended mix ratios for internal float coats in Table 6 and for external render in Table 7. Some manufacturers provide pre-blended General Purpose Cement & Hydrated Lime products to assist in simplifying the mixing process.

## Gypsum/lime plaster (set coat) mix ratio

Whilst mix proportions will vary depending on the background they are applied to, the recommended gypsum/lime finish coat ratio applied over a sand cement float coat should be as recommended in HB 161-2005, or in accordance with the manufacturer's specifications which are generally printed on the bags. The gypsum to lime ratio recommended in HB 161-2005 is 2 parts gypsum to 3 parts lime putty measured in kg.

Table – Gypsum/lime coat ratios (set coat) as recommended in Table 8 of HB 161-2005.

Gypsum plaster (kg)	Lime putty (kg)
17	25
34	50
51	75

These mix ratios based on the lime putty having an average solids content of approximately 40% should produce a 60% gypsum to 40% lime content when the set plaster has dried. Generally the gypsum plaster content should not fall below 50% or the finished surface will not attain sufficient strength or hardness.

The ratio of lime to gypsum plaster is very important and any overuse of lime putty will produce a weaker finish. The more gypsum plaster added, the surface should attain a harder finish.

There should be no reason for an air entraining agent to be used in the set coat. Some manufacturers may include an air entrainment agent in their products, however no further additive is required for plastering.

### **Curing and drying**

The circumstances prevailing on site will determine the method of curing plaster coats. More specific information is provided in Chapter 6 Conditions, Protection, Curing and Drying of HB 161-2005. Sand cement plaster finishes where exposed to direct sunlight may require continual wetting for several days after application to ensure satisfactory strength and bond to the background is achieved.

Retardants such as tartaric acid may be used to delay setting and improve working time of a gypsum lime set coat, however the inclusion may be detrimental to the final bond strength and hardness.

### **Material shelf life**

Materials will generally have a shelf life or use by date and cement and lime products should not be used after these dates. Poor storage conditions can affect the shelf life of products and any bagged cement that has hardened or is lumpy as a result of exposure to moisture should not be used.

### **Hardness of white set plaster**

Building and Energy has sought expert scientific opinion in regards to whether or not there is a suitable on-site assessment technique that can determine the hardness or strength of the white set plaster finish. No truly suitable field test was established. The recommended test method for assessing the quality of white set plaster is scanning electron microscopy (SEM) where gypsum concentration and white set layer thickness can be assessed quickly and accurately.

The SEM testing comprises the taking of a 20mm diameter core sample to a depth which includes at least 3mm of the cement float layer. The number of samples would depend upon the extent of the suspected areas and direction should be sought from the testing laboratory.

Testing of white set plaster using a Shore D Durometer by a scientific laboratory for Building and Energy could not produce reliable hardness values. Practitioners should not depend on this type of test as a reliable assessment to confirm the soundness of plaster.

### **Plastering standards and finish**

When assessing whether or not plaster has been installed in a proper and proficient manner or is faulty or unsatisfactory, Building and Energy will refer to HB 161-2005 and any manufacturer's recommendations.

As there is no specified site test for plaster hardness, Building and Energy when assessing weak or soft plaster (determined via the method recommended in Appendix D clause 2.2 of HB 161-2005 and/or section 3.10.6.3 of AS/NZS2311:2017 Guide to the painting of buildings) may seek further evidence to verify what mix ratios have been achieved and if air entraining agents have been used in the float or set plaster mixes. Where testing verifies that the set plaster mix ratios have excessive lime, the remedy will likely require the removal of the entire set coat, not just affected areas. Where air entraining agents have been over used in the float coat, it is likely that the entire float coat will also require removal.

Building practitioners should not rely on phosphoric acid as a solution to treat a soft set coat. A phosphoric acid treatment is only recommended as a treatment for a powdery set coat surface. Refer D.2.1 Powdery surfaces HB161-2005.

Building practitioners should be aware that whilst Australian Standard HB 161-2005 and manufacturers recommendations are not in themselves coercive, non-compliance may be prima facie evidence of a failure to provide a regulated building service, which includes plastering, in a proper and proficient manner, or that the service is faulty or unsatisfactory.

**Disclaimer**

The information contained in this bulletin is provided as general information only and should not be relied upon as legal advice or as an accurate statement of the relevant legislation provisions. If you are uncertain as to your legal obligations you should obtain independent legal advice.

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