CI/SfB | | Yq4 |
Issue 2 May 2012
(SUPERSEDES Issue 1 May 2004)

The use of lime in mortar

General Information

The benefit of using lime in mortar has been recognised by builders throughout the ages. The ancient Greeks and Romans produced mortar by burning limestone and slaking (mixing with water) the resultant product, then mixing this lime with sand. Many ancient buildings stand today as monuments to the efficiency and durability of these traditional lime mortars, and much of the lime used therein was hydraulic, that is, it gained strength by hydrating and setting.

Photograph courtesy of the British Lime Association

Introduction

With the rapid increase in building output, natural hydraulic lime mortars suffered because of their variable performance and cement based mortars were preferred for their more rapid strength development.

In the early part of the last century, the process of adding hydrated lime to a cement mix was developed to produce composite mortars, which retain many of the beneficial properties of traditional lime mortars. More recently the practice has developed of using admixtures to improve the properties of mortars.

This data sheet concentrates on the use of hydrated lime in mortar. Fresh and hardened properties of mortar containing hydrated lime are excellent and, when manufactured under factory controlled conditions, consistent quality is achieved to meet the exacting standards required today.

It should be noted that modern natural hydraulic limes are now available that are produced under rigorous quality control procedures and natural hydraulic lime mortars are becoming more widely available, especially for restoration and heritage projects.

Production

The production of lime commences with the quarrying of limestone or chalk (chemically these materials are classified as calcium carbonate); the extracted rock is then crushed and fed to a kiln. The calcination process was traditionally undertaken in small mixed feed kilns and examples of the remains of these can still be seen around the country today. Modern methods of lime production involve feeding the limestone or chalk to either shaft or rotary kilns where the raw material is calcined at a temperature in the range 850°C - 1100°C. The calcium carbonate is changed into calcium oxide (quicklime) and carbon dioxide. The calcium oxide is then reacted with water (slaked) in a closely monitored, computer controlled hydrating plant to produce a fine powder of calcium hydroxide.

Technically the terms hydration and slaking are synonymous, however hydration is generally taken to mean a process, which yields a dry hydrate powder, whereas slaking involves more water, producing wet hydrates. Traditionally, an excess of water was added to quicklime and the material allowed to soak for several days or weeks in pits (the process called slaking) to produce a material called lime putty. A more dilute mixture of quicklime with water is milk of lime where the solids content ranges from 1 to 20%.

Quality

Lime is classified according to its chemical composition. All the hydrated lime used in the construction industry in the United Kingdom conforms to BS EN 459-1 and is designated CL90. This designation indicates that the calcium oxide content plus any magnesium oxide present is in excess of 90%.

Materials

Lime mortars can be supplied to the building site from modern, computer controlled batching plants, guaranteeing the correct mix proportions for each delivery. Alternatively, lime sand mortar can be obtained from MPA Mortar member companies ready blended with the correct quantity of lime, sand and an air entraining admixture to give the optimum workability and freeze thaw protection.

This material merely requires accurate addition of the correct quantities of cement and water on site to produce mortar.

The use of lime in mortars is recommended by the Building Research Establishment in their publication BRE Digest 362 'Building Mortar' and by the Brick Development Association. The use of the material is approved in the Building Regulations and by the National House Builders Council.

Lime mortar properties

Workability

Lime is well known for its ability to improve the plasticity and workability of mortar. While providing a high degree of cohesiveness it spreads easily under the trowel. Cohesiveness reduces the wastage produced by material sliding off the trowel. The improved setting properties of mortar containing lime allow adequate time for tooling up the joints as work proceeds.

Water retentivity

This characteristic becomes important where mortar is to be used with bricks, or masonry units that have a moderate or high suction rate. The inclusion of lime in mortar generally leads to improved water retentivity. This provides an improved bond, as there is more intimate contact between the unit and the mortar. The retention of water in the mortar results in the best conditions for the early hydration of the cement, thus reducing cracking and water penetration into the hardened mortar joints.

Air content

Entrained air provides improved workability of fresh mortar and improved freeze thaw resistance of hardened mortar. The inclusion of lime into mortar can assist in stabilising the entrained air content.

Mortar strength

It has long been recognised that excessively strong mortars can lead to reduced bond and cracking, which may result in cracking being induced in the bricks and blocks instead of the mortar joints. The use of lime in a cement based mortar however, tends to reduce the compressive and flexural strength of the hardened mortar. In a situation where structural movement takes place, lime mortars can better accommodate this movement, whereas excessively strong mortars will tend to resist movement perhaps until some cracking occurs. For example, lime based mortars have always been used for tall factory chimneys as they can accommodate a considerable movement in high winds.

Autogenous healing

When lime based mortars crack they tend to do so in the form of a much reduced number of micro cracks. Subsequent movement of rainwater through the surface of the mortar joints dissolves the free lime, which is deposited in the micro cracks as the water evaporates. The lime subsequently reacts with the carbon dioxide in the air and is converted to calcium carbonate, a cementitious reaction. In a short period of time the cracks are healed, a process known as autogenous healing.

Weather tightness

The inclusion of lime in a mortar promotes more intimate contact between the mortar and the masonry units. For example, the increase in plasticity and cohesion results in a more effective filling of the vertical joints and results in a bond which subsequently resists penetration by wind driven rain better than some non-lime mortars. Furthermore, reduced moisture contents in walls resulting from their greater impermeability increases the thermal insulation of the structure as well as reducing internal damp penetration problems.

Durability

The reduced water penetration achieved with lime-based mortars can minimise the risk of freeze thaw damage. The inclusion of lime will also help to resist some forms of sulfate attack. Together, combined sulfate/freeze thaw attack can be very damaging to masonry structures.

Efflorescence

Some building materials contain soluble salts, which can be transported to the external surface by the migration of water through the structure. Once these salts are deposited on the surface, the water evaporates leaving unsightly staining. Lime based mortars minimise this effect by reducing the amounts of water that can penetrate the masonry units. Furthermore, they can also precipitate the soluble salts in the insoluble calcium form before they reach the surface.

Site practices

Lime has a higher sand carrying capacity than any other bonding agents. The excellent working properties of the mortars produced from it lead to higher productivity from the bricklayers and the quality of the finished work is better than with other materials. Due to the weather tightness and durability of the finished work subsequent maintenance is low.

References	
BS EN 459-1	Building lime. Definitions, specifications and conformity criteriaBS 8221 Code of practice for cleaning and surface repair of buildings
BRE Digest 362	Building mortar
Brick Development Association	The BDA Guide to Successful Brickwork
National House Building Council	NHBC Regulations

For a full list of British and European Standards see the MPA Mortar data sheet of technical references.

essential materials
sustainable solutions

MPA Mortar is part of the Mineral Products Association, the trade association for the aggregates, asphalt, cement, concrete, dimension stone, lime, mortar and silica sand industries.

Mineral Products Association Ltd
Gillingham House
38 - 44 Gillingham Street
London SW1V 1HU
Tel +44 (0)20 7963 8000
Fax +44 (0)20 7963 8001
mick.russell@mineralproducts.org
www.mortar.org.uk

There is a real danger of contact dermatitis or serious burns if skin comes into contact with wet mortar. Wear suitable protective clothing and eye protection. Where skin contact occurs either directly or through saturated clothing wash immediately with soap and water. For eye contact immediately wash out eyes thoroughly with clean water. If swallowed wash out mouth and drink plenty of water.

The relevant codes of practice, standards and statutory regulations must always be observed.