Hydarulic lime or lime putty

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There are essentially two sorts of lime available, below is a quick guide to choosing the correct grade and sort for you project.

Non hydraulic lime (CL or DL 70-90) is sold as either hydrated or putty lime; they set and harden through drying out and absorbing carbon dioxide from the air. This means they have a very slow set: CO2 is only absorbed when certain conditions are met. High calcium CL90 limes (normally 95%+ CaCO3) most limes contain some impurities, occur rarely and produced mainly for industrial applications. CL/DL70-80 are not commercial available in the UK.

Hydraulic limes, (so called because they set under water) are made in the same way as non hydraulic lime but using different limestone. They are sold as hydrated powder and have an initial set when water is added, followed by hardening while they absorb carbon dioxide. The more hydraulic a lime is, the greater the hydraulic set and lower Co2 absorbed giving a higher final strength, and consequently slightly less breathablility and flexibility. NHL5 is the most hydraulic, then NHL3.5, and NHL2 the weakest. They do not perform quite the same as modern cements or contain the same damaging components. It should be noted however that limes marked with NHL-Z or just HL on the bag can contain some additions that could be potentially damaging and at worst be not much better than cement.

Hydrated lime simply means that a controlled amount of water is added to quicklime to make a powder that is more stable and safe to handle. This can be done to hydraulic or non-hydraulic limes.

Lime putties can be made from either type of lime. They are made by adding an excess of water to quicklime. Hydraulic putties will set underwater within days of making, where as non hydraulic limes will remain plastic and improve with age.

Pozzolans are additions may be added to achieve harder, faster sets to any sort of lime or cement. Pozzolans when added produce similar chemicals to those found in hydraulic limes, so they reduce breathability and flexibility in exactly the same way. The disadvantage can be that through, site bulking errors and inconsistent in reactivity for some pozzolans you will never know how strong, breathable or flexible a pozzolan/lime is until set. Some pozzolans or adding even the smallest amounts of cement can be very damaging or produce poor performing mortars.

Which to choose?

There is often no definitive “right” answer: more often, the specifier or builder is faced with a series of conflicting needs. The secret is in achieving the best compromise. Below are some of the points to consider.

How exposed is the place you are using it?

The more exposed to the elements, aggressive conditions and wind driven rain a mortar or render is, the greater the need for durability. A faster setting (more hydraulic) lime mortar requires less carbonation to achieve a full set and therefore resists these conditions better and earlier. Detailing of a new or existing buildings to resist wind driven rain and the elements will play a vital role in the durability of any mortar - a dry mortar cannot freeze. Ruined, unused or unheated buildings will also require careful consideration, a very soft or permeable mortar may have been used for its construction, but once in an altered state the new mortar may have to resist or cope with very different conditions.

How hard is the material you are using?

Any mortar must always be softer and as or more vapour permeable than the main building material. Non hydraulic limes and NHL2 limes are more vapour permeable.

Product Data

How much movement will the mortar have to cope with?

The less hydraulic a lime is, the more it will flex and move with a building. Timber structures or mixed building elements therefore need a more flexible and breathable limes such as NHL2 or non hydraulic lime putty

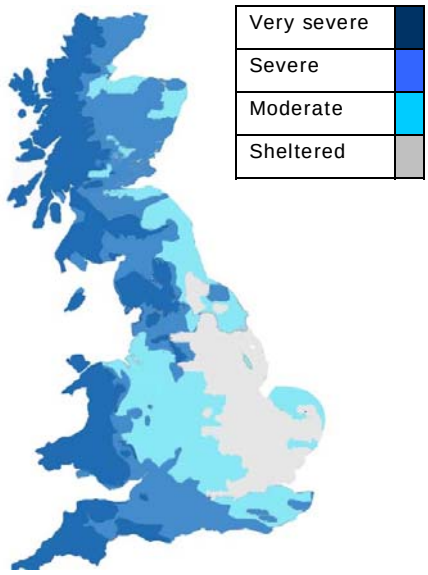
How much damp will the mortar have to cope with?

The stronger a mortar, the less breathable it is. NHL5 and NHL3.5 should be used with caution in houses where damp is a problem. (N.B. if a wall is permanently very damp, though, a putty mix will never set.) Low suction backgrounds (hard stone or blue bricks etc.) and damp cool weather make the use of lime putty very slow. NHL should be considered for both internal and external mortars. Retaining walls and those subject to sulphate laden water which could be subject to frost action also require mortars with greater durability.

New build or repair work

In new build structures with thin cavity walls greater consideration should be given to the structural requirements; speed of set etc. and resistance to water absorption. Repair work means compatibility and reversible measures are of greater importance.

Wind driven rain weather map



Please use the map as an aid to determining the exposure of your site to wind driven rain and aggressive weather conditions.
Wind driven rain map, exposure zones are approx.
Note: Derived from BS 8104:

Mortar application	Lime Mortar type	
	Old Masonry	New Build
Friable, soft bricks, earth supports	HLM 0.5	
Internal use, sheltered external walls, soft bricks	HLM 1.0	
General solid masonry	>HLM 1.0	HLM 2.5
Dense masonry, parapets, lintels and cornices	>HLM 2.5	HLM 3.5
Above roofline, below DPC incl. Copings and cappings	>HLM 3.5	HL5
Earth retaining walls	> HLM 3.5	HL5
Masonry below water level, marine uses	HLM 5.0	HLM 5.0
Lightweight blocks		
Cavity walls (single brick)		HLM 3.5 HL5

The correct specification for any mortar should consider the structural requirements, nature and condition of the background, site exposure, time of the year (weather maps / rainfall and wind driven rain indices are available from the BRE) and type of finish required.
Less porous masonry units and harsh climates require greater mortar designations. Information and recommended mortar uses are taken from the lime manufacturer and BRE/Foresight research 2003.

Indicated are possible uses for mortars alongside which a mortar durability class is given, with 1 the least durable through to 10 giving the greatest durability.

Misconceptions and further advice

As long as its lime, it doesn't matter which type

Using a lime that is too strong can be very damaging for some historic structures. People should be cautious with NHL5: it is best kept for aggressive situations and high strength applications and avoided on friable, soft masonry or timber structures.

All old houses were built with lime putty.

Many old stone or brick walls were built using hot-mixes. This is where the quicklime is mixed with damp sand and left for a couple of days. The end result is a dry powder and sand mix – nothing like putty, which was a much more expensive product for plastering. Great structures and engineering projects of the past used a hydraulic lime made in this way, as it enabled lime to be stored for a longer period

Hydraulic lime is a modern invention

Scientific testing for the hydraulacity of old lime mortars we have been sent from around the midlands and marches region has consistently shown the mortars to be a least weakly hydraulic if not the same strength as a modern NHL2 or NHL3.5

Lime|green is one of the few building specialist lime suppliers to have experience of firing lime. Using the restored National Trust kilns on Wenlock Edge and limestone from the original quarry, the resulting lime was undoubtedly weakly to feebly hydraulic.

Hydraulic limes contain the same damaging chemicals as cement.

We sell only St. Astier Natural Hydraulic Lime (NHL), which we know not to contain any sort of potentially damaging components. Lime from the St. Astier quarries has been used on historic buildings since Roman times without problems, the chemical composition of St. Astier lime make the problems associated with cement impossible.

Specialist builders and heritage groups only use lime putties.

Nearly all the major conservation contractors and institutions, including CADW, English Heritage and SPAB are happy to use either hydraulic or non-hydraulic limes, depending on what is the best solution.

Hydrated Limes are inferior to lime putty

Historically lime putty was made as it was the simplest method to ensure all the quicklime had thoroughly slaked and it enabled the material to be kept from carbonating while stored under water (some hydraulic limes were). It is often said that hydrated limes, hydraulic or non hydraulic are inferior because they have carbonated in the bag. In fact hydrated lime direct from the factory, as stipulated under the BS EN standards, will be of extremely high quality, however hydrates do need to be stored in dry conditions and purchased in moisture resistant sacks. Old products or limes stored in damp conditions and not in moisture resistant bags will deteriorate relatively quickly. In reality hydrated limes will not have the same workability or plasticity initially as lime putty, (necessary for plastering; NB some modern hydraulic limes can be stored for up to 24 hrs. wet to improve plasticity).

Gauging with cement

It has been shown that even small amounts of cement in traditional mortars leads to inferior less durable mortars that can cause damage. Building with cement and pointing with lime is also a waste of time technically and has no real advantages over a hydraulic lime mortar which will allow building and pointing to done in one operation.

Will lime mortars bloom/leach

Lime mortars high in free lime (lime reactive with CO2) will be more susceptible to this. All or most free lime will need to carbonate for the problem to be avoided, N.B unslaked quicklime in any mortar is to avoided at all costs. Typically cement/lime/sand mortars react the slowest with CO2 typically non hydraulic and NHL limes will absorb CO2 quicker providing fine loamy sands are avoided with NHL mortars rarely leach. Were carbonation is expected to be slow - thick mass walls damp structures etc., free lime will carbonate very slowly if at all and if subject to water penetration leaching will be potential problem.

Pozzolans

Should be added just before use, trials may be necessary to determine the correct addition rate, Metakalolins, typically Metastar are highly reactive consistent products designed for the concrete industry. Additions are typically made between 5-15% by weight of lime; addition rates of up to 25% are common for brick dust.

PFA, pulverised fuel ash from coal fired power

stations, less effective and varied in colour (grey to dark grey) low SO3 PFA should be sought
Brick dust, current advice is that the material should be derived from clay fired at temperatures below 950°C, and ground to a range of particle sizes between 38 and 600 microns. Also brick composition has a significant influence on the sulphate and sea water resistance of such mortars. Although most brick dust types provide enhanced durability, bricks which have a high calcium content (CaO>5%), particularly if they also have a low glass content (<20%) and a low sulphate content (SO3<1%) should not be used as pozzolans because they impair resistance.

Site mixing

Consistent performance, colour and workability between batches of any mortar are vital to its effective use and long term durability. The most accurate method of gauging materials together is by weight however this is not normally possible on site and the most common method is by volume. Powders and sands are susceptible to bulking errors and can lead to up to 40% errors. Lime putties vary in bulk density as lime putty is a suspension of lime particles in water. The average density should be sought and if materials fall outside the range then they should be used for other purposes. Wenlock lime only uses special lime slaking equipment to make lime putty with consistent properties. When mixing hydraulic limes a full bag mixer should be sought so that lime can be added by weight (full bag) and sand by volume - bags of St. Astier NHL have such mixing instructions on the back of each bag.
Lime putty and sand is best mixed in a forced action mixer, hydraulic lime and sand can be effectively mixed in conventional mixer. To avoid site mixing errors and all the problems associated Wenlock per-mixed mortars offer the best solution

Are mortar additives needed or necessary?

Historically many different components have been added to lime mortars to adjust everything from strength to colour, beer, urine, blood and plant extracts. Lime mortars high in free lime (lime requiring Co2 to set it) are generally have excellent plasticity and water retentivity equating to excellent workability on the other end of the scale however stronger NHLs and natural cements will be leaner to work with and often benefit from workability aids.
In many circumstances air entrainment is of benefit giving good pore structure and associated frost resistance and therefore durability. Proprietary air entraining products are normally suitable; please note all lime mortars increase in workability with longer mixing (at least 20mins) shorter mixing times and more plasticiser are not recommended. Too much air in any mix will lead to a weak bond Products such as waterproofers, SBR are not generally needed. frostproofers and accelerators should be avoided.
Porous particulates and limestone additions can be beneficial to any mortar they act as air entrainment helping during frosty periods, the selection of limestone is critical as some dense “mountain” limestone are of no benefit.

Which type of sand

Sands for lime mortars should conform to BS EN 13139 ideally sand with low category fines (well washed) and coarser particles should be used were possible to aid carbonation. A useful rule of thumb is that the maximum particle size of the sand should be no more than 1/3 the size of the joint. For plastering and rendering sand containing containments such as lignite should also be excluded.

Further Reading

Foresight hydraulic lime mortars
www.buildingconservation.com
www.spab.org.uk/
www.stastier.co.uk