

Gillmore on Hydraulic Lime Production in France from:

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P57 MANUFACTURE OF HYDRAULIC LIME. 98. **In France, the practice of using lime that has been slaked in large bulk to a state of paste, by a copious use of water, has been entirely discontinued within the last few years, for the reason that only the fat or feebly hydraulic limes can be so treated.**

The presence of a sufficient amount of clay to confer eminently hydraulic properties upon the lime, engenders the presence of lumps and portions not susceptible of thorough extinction by the ordinary means, which would not only render the mortar heterogeneous, but might endanger the stability and safety of the masonry, by subsequent slaking within the work. Hence, whenever the advantage of employing hydraulic lime, either alone or mixed with cement, in order to confer energy and strength upon mortar, has been recognized, the lime is invariably used **in a state of freshly slaked, impalpable powder**. The use of fat lime has been very generally discontinued upon important works.

99. The following method is the one commonly practiced for obtaining hydraulic lime from argillaceous limestones containing from 12 to 24 per cent. of clay, the latter being composed of about 2 of silica to 1 of alumina.

There is no advantage in a high heat, like that necessary for burning Portland cement. **While still warm from the kiln, the stone is sprinkled with from 15 to 20 per cent. of its own weight of water, care being taken not to use enough to convert any portion of it into paste.** The slaking soon begins, and the stone falls to pieces, a portion of it in the condition of fine powder, while the rest remains in unslaked, or partially slaked, lumps of various sizes. The whole mass is then thrown together in large heaps, where it remains undisturbed for **six or eight days**, in order to complete the extinction as far as possible, and is then screened with a sieve of twenty-five to thirty fine wires to the lineal inch. **The portion which passes the screen is hydraulic lime of first quality**, if the stone be capable of yielding such, and, when used, requires only sufficient water to convert it into a stiff paste, in order to furnish an excellent matrix for mortar, beton, or concrete. **The lumpy portions which do not pass the sieve either contain too much clay**, or have been burnt at too high or too low a heat to be susceptible of thorough extinction by exposure to the air, or aspersion with water. **The quantity of this lumpy residue will be great in proportion to the amount of clay in the stone, or the extent to which the heat in burning has been improperly regulated.** In some localities this residue is thrown away, as dangerous or worthless, **while in others it is the custom to grind it up separately, and mix it with the powder previously obtained by aspersion.**

When the burning has taken place at a heat suitable for making common lime, the residue owes its origin to the presence of clay, and may be a light, quick-setting cement, like the Roman. If so, its incorporation with the lime powder will augment the hydraulic activity of the latter, though perhaps not its ultimate strength and hardness. When the residue is too much under-burnt to slake readily, it may cause damage by a tardy extinction in the mortar, and should be rejected. **When burnt at a high heat, the residue may be Portland cement, if the stone contain from 20 to 22 per cent. of clay; or it may be inert clinker, partially or wholly vitrified, depending**

not only upon the amount, but also upon the form in which the silica and alumina exist in the clay. The character of the residue, when ascertained, will determine whether it would be advantageous or otherwise to add it to the lime powder produced by slaking. (p59) and watchful care, in order that the introduction of ingredients that are worthless, or perhaps both dangerous and worthless, may be avoided....

...light, quick-setting cements are also produced by a moderate burning, from stone containing as high as 27 per cent., or even 30 per cent., of clay. Indeed, the amount of clay may reach, exceptionally, as high as 35 per cent. The cement made at Vassy, in France, the English and French Roman cements, and all of the American cements, (the Rossendale, Shepherdstown, Cumberland, Ooplay, and others,) belong to this class. In Austria the name of hydraulic lime is given to cements of this description. The Roman cement, made from the nodules of septaria derived from the Kimmeridge and London clay, is the best of the cements here referred to, though greatly inferior in strength and hardness to the Portland.

P61 Experience has fully proved that the heavy, slow-setting cements (the class upon which the name of Portland has been conferred, from the resemblance of the English variety to natural Portland limestone) **can only be obtained by burning, at a high heat, either limestones containing at least 20 and not more than 22 per cent. of clay, or an artificial mixture of the ingredients in similar proportions.**

Natural stone, suitable for this purpose, is found in Europe in the first range of the Jura formation, and on the lower slopes of the Alps in France and Austria, it generally occurs in numerous layers, which are very variable in the amount of clay which they severally contain, not exceeding from 10 to 15 per cent. in some, and reaching as high as 20, 25, and even 30 per cent. in others. The layers are generally thin, and there are but very few of them in which the desired proportion of 20 to 22 per cent. of clay exists, homogeneously distributed. By far the greater number contain either less or more than this amount. In whatever manner apparently homogeneous limestones may be exposed to burning, at a high temperature, it is impossible to avoid the complete vitrification of some layers containing too much clay, while others, not containing enough, or less than 20 to 22 per cent, produce cements having lime in excess.