In situ consolidation of mosaics with techniques based on the use of lime

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The concept of the mosaic as an isolated object is, we hope, now obsolete, given the value duly attributed to the inextricable relationship between the artifact and its context. This value is given material expression in maintaining the mosaic in situ, with all the technical consequences this choice brings with it.

Documentation, protection, maintenance, consolidation, display, are all topics which definitely have to be covered and codified in some way, but consolidation perhaps more than any other, and in particular in situ consolidation techniques, exemplifies the idea of in situ maintenance of the artifact.

It is precisely the choice of techniques for consolidation and the selection of materials to be used which imposes a further need for respect of the ancient monument, that is, the compatibility of the techniques and of the materials used today with ancient working techniques and the original constituent materials. In the centuries- long life of the monument the work of conservation must not be seen as an exceptional event leaving an irreversible mark on its history, but as a work of maintenance aimed simply at prolonging the likelihood of the artifact's survival and of its entire context.

We would therefore like to take advantage of the shortspace available in this newsletter, which is written by "experts" for "experts", to present an outline of in situ consolidation using lime-based techniques.

The first question regards when the mosaic in situ can, or must, be consolidated using a lime-based method.

A brief answer is that the method can be applied in all cases in which we have before us an artifact which has not already been conserved (or, rather, where an attempt at conservation has previously been made) with materials which hinder the adhesion of lime to the original material (hydro-repellent resins, cement, etc.).

One necessary premise: the use of lime is not a simple technical operation but the result of centuries of practice, of knowledge handed down, of tradition. It is a culture. It should not be forgotten that two thousand years' of our architectural heritage has been built and maintained with construction techniques based on the use of lime. The quality of the method is thus indisputable. It has to be admitted, however, that the first time it is used can be a dissatisfying experience due to limited skill in applyingthe material, methods and conditions of application, and lack of knowledge of those "tricks of the trade" which have been lost.

At present, debate centres around the cohesive properties of modern lime, compared to that used in the past. The industrial nature of production of the material has led to marked changes. Yet it is cultural change which has caused the most damage: a material which is slightly weaker than the original one is used in interventions on ancient artifacts and the mistake of 'more resistant and harder' material must not be made.

It is thus a choice requiring confidence and courage from whoever is prepared to follow this method. The result is guaranteed by those who have already used it.

In order to help those who wish to use this technique, we have drawn a graph showing the various conditions which can effect working choices and thus review possible technical solutions.

To facilitate reading of the table a brief glossary of lime and its products has been compiled.

GLOSSARY

Non-hydraulic lime: common lime in powder or paste (slaked lime), which reacts with the carbon dioxide in the air. This can be more or less oily according to the Ca content. It is best when its slaking time is not less than one year. Cohesive and adhesive properties, considerable shrinkage when setting.

Hydraulic lime: lime with clay content exceeding 5%, with capacity to harden with water.[1] Cohesive and adhesive properties, less shrinkage than non-hydraulic limes when setting.

Non-hydraulic mortars: obtained using non-hydraulic limes as a binder and so-called 'inert' materials as aggregates, such as sand, marble dust, travertine dust, chalky stone, and sandstone.

Hydraulic mortars: can be obtained in two different ways, either using hydraulic lime as a binder, or using non-hydraulic lime with volcanic aggregates with capacity to react and determine the hydraulic propertis of the mortar (pozzolana, crushed brick and ceramic, fossil flour, volcanic tufas, pumices, volcanic lavas with a high content of amorphous vitreous phases, tripoli, or rocks made up of diatoms and radiolaria skeletons).

Consolidating and/or protective mixtures: mixtures obtained by adding a higher percentage of water to the lime selected. These can be made up solely of lime and water or also added to fillers of very fine-sized grain or to pigments. Liquid mixtures can be obtained from either hydraulic or non-hydraulic lime. As regards storage, hydraulic lime, once it comes into contact with water, begins setting and must be used within 3-4 hours.

Limewater: saturated solution of hydrated lime in water. This is prepared by simply letting the slaked lime deposit in plenty of water: the clear solution obtained within a few minutes is limewater. It has cohesive but not adhesive power. The percentage of hydrated lime in water is 0.165%. There is no chromatic change so it is always advisable to damp those areas to be plastered or treated with consolidating mixtures with limewater rather than with ordinary water.

Milk of lime: cloudy solution of hydrated lime in water (circa 60/100gr. slaked lime in 1000 cc. water).

The graph should be read vertically from top to bottom. Various conditions are placed along the graph line: type of damage; physical state of the consolidant; climatic conditions;the characteristics of the lime; the composition of the mortar and, finally, application techniques.

Types of damage referring to the mosaic in situ are subdivided at the first point.

Three possibilities have been identified for the physical state of the consolidant:

liquid: limewater and milk of lime

semi-liquid: liquid mixture of milk of lime and filler, where the latter is always hydraulic.

plastic: mixture of lime, filler, water and organic aggregates.

The **climatic conditions in which the mosaic may be found** have been identified at the third point.

The choice **of lime to be used** to prepare the mortar is fundamental to defining the characteristics of the intervention. The lime can be of two types: **hydraulic and non-hydraulic.**

The fifth point reports **the composition of the mixture**, characterized by the type of lime selected. This may vary according to the percentage of lime or binder in the complete mixture:

- with binder alone:

limewater, milk of lime, and the intermediate composition which reduces the defects of limewater (little consolidating power) and of milk of lime (covering power).

- with binder, filler, water, in equal parts:

whitewashes and infiltrations. These are milk of lime with fillers added. All mixtures in which the aggregate tends to deposit in a short time and which thus require stirring before application. These mixtures are:

slaked lime with pozzolanic materials with capacity to react with the air-hardening lime and to form a hydraulic mixture. Storage impossible;

hydraulic lime and pozzolanic materials. Mixture with hydraulic properties. Storage impossible.

slaked lime with inert filler. Mixture for whitewashes, not to be used in depth because it only sets in contact with carbon dioxide in the air. Storage possible.

with binder and filler: plastering and bedding layers.

1 layer - of rough coat - depth 10-20mm.
1 part binder, 3 parts large-grain filler

2 layer - bedding - depth up to 5mm.
1 part binder, 2.5 parts medium-grain filler

2 layer - finishing - depth < of 5 mm.
1 part binder, 2 parts fine-grain filler

Finally, application techniques. For all types of mixtures chosen it is important to carry out careful damping of the area of intervention, before application. Water is fundamental both in the reaction of carbonation of the air-hardening lime and in the setting of hydraulic lime.

The subsequent hardening stage must be controlled so as to avoid direct exposure to the heat of the sun. If necessary, it can be useful to dampen the area again or even to organize a system for keeping it damp until it has hardened.

The choice of filler may be affected by two factors: climatic needs which require a hydraulic mixture and aesthetic requirements regarding colour.

The surface of the plastering is carefully smoothed so that the material is nicely compact, taking into account, however, that this results in a slight deepening of tone.

Bibliography

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Notes

1. Lafarge, 157 Avenue Charles de Gaulle, 92521 Neuilly/ Seine Cedex, tel. 47475100