

## Plaster made of aerial lime.

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### IS IT:

☒ *Product*

☐ *Technology*

☐ *Equipment*

### APPLICABLE FOR:

☒ *Restoration*

☒ *Rehabilitation*

☐ *New Construction*

### APPLICABLE ON:

☐ *1. Foundations and underground structures*

☒ *2. Vertical structures*

☐ *3. Horizontal structures and vertical connections*

☐ *4. Roof and terraces*

☒ *5. Façade and building envelope*

☐ *6. Finishes and completion elements*

☐ *7. Integrated services*

☐ *8. General strategies for building recovery*

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***Related companies:*** No companies; university research; structural study.

## DESCRIPTION

The *cocciopesto* (earthenware powder) is an inert material used since ancient times (Fig.1) for the preparation of mortars (so-called compound mortars), especially in areas far from natural pozzolanic deposits. Mortars with *cocciopesto* were used in Roman times as a waterproofing agent and throughout history have been commonly used as it gives the lime putty-based mixture the ability to set in contact with water (hydraulic properties). Before the diffusion of cements, composite hydraulic mortars were used to carry out works in humid environments (Fig.2), including underwater, tanks, water pipes and also hangings for retaining dams.

Other characteristics of the *cocciopesto*, such as high vapor permeability and thermal insulation, favor the hygrometric regulation of environments, making it useful for green building applications and particularly suitable for the healthiness of living spaces. The natural raw material and the absence of additives in the compound classify it among the compatible products for restoring the plasters of buildings of historical and artistic value, respecting traditional materials and techniques.

## WHY TO USE

The *cocciopesto* is obtained from pulverized bricks (Fig.3), and in particular those products with a thin thickness, in which the action of heat determined a more thorough breakdown of the aluminum silicate and the vitrification of part of the mass. The behavior of *cocciopesto* mixed with air lime is similar to that of natural pozzolan, reacting with the formation of hydrides (hydrated calcium silicate), with the ability to thicken and harden even in a humid environment. The possibility of setting even without air favors the use of hydraulic mortars also in very thick walls.

The mortars prepared with aerial lime and *cocciopesto* are also used for the realization of substrates for internal or external plasters, and also for the finishing layers. That thanks to the high resistance to bad weather and the yellow or pink tint, similar to that of brick, which is almost always kept visible to decorate the facades of buildings in place of the traditional paint layer. This mortar is also suitable for grouting and the creation of screeds and leveling layers.

## HOW TO USE AND APPLY

The *cocciopesto* is obtained from the pulverization of the terracotta brick (Fig.4) which generally derives from waste products (tiles, tiles, pottery, etc.).

The hydraulic effect derives from the fired material, as the action of heat causes a breakdown of the aluminum silicate present in the clay and its subsequent vitrification. The best vitrification is found in fragments of pottery and tiles as the thin thickness guarantees good firing at low temperatures even in the most internal parts. The low firing temperature induces a high porosity in the brick which is maintained, even after crushing.

Today, also poorly cooked bricks are used as, once crushed and granulated, are subjected to further firing. This treatment creates a stable product with better hydraulic performance and increases the speed of hardening.

The preparation of the mortar with aerial lime and *cocciopesto* is carried out on site in the following two ways:

- 1) slaked lime, sand, brick dust and sand (quarry or river) (Vitruvian recipe), in sizes: 1 part of slaked lime, 2 parts of sand, 1 part of *cocciopesto* with grain size 0.2/0.3 mm.
- 2) premixed product with air lime mortar, silica sand and *cocciopesto* to be mixed with water.

The mortar based on aerial lime and *cocciopesto* is compatible with new or old brick or stone ashlar of various typology, as long as they are dry and suitable for supporting the plaster. If there is a damaged plaster, it must be demolished until the masonry is brought to light and any dust, saline efflorescence, inconsistent residual parts, oils, molds or other organic material, etc., must be removed by sandblasting or brushing.

On the dry masonry a traditional plaster is applied as follows:

- preliminary layer (rough coat), of variable thickness (5-10 mm) in order to regularize the substrate before the application of the plaster, using the mortar with a slight excess of water in order to homogenize the absorption of water from the support;
- after drying, a leveling layer (curl) in several coats until the facing is flat and uniform, without undulations, up to a thickness of about 3 mm,

finishing the surface with a trowel with circular movements.

- finishing layer (plaster or veil), using a mixture with finer grain sizes of *cocciopesto* and spread with a trowel (Fig. 5) or a roller in a thickness of 1-2 mm, possibly on the curl, which is still quite fresh, in order to create a stable connection between the two layers. For a smooth finish, metal trowel is used.

It is necessary to apply the compound on dry, clean substrates, free from dust, inconsistent parts, oils, greases, salts and not subject to rising damp. The mixture should be laid with a consistency of damp earth, spread and finished with a straightedge and trowel.

One of the most ancient techniques for flooring realization consists of the spreading with a mixture based on fat pit lime and scraps of bricks or tiles, without sand, with any additives; or a mixture based on pit lime, sand (of various granulometry depending on the thickness of the layer), fragments of clay material, of adequate size, and/or pozzolana. A particular type of substrate is the so-called "beaten Venetian style", made with several layers of beaten mortar with *cocciopesto* and with the addition of small stone flakes in the last layer (Fig. 7).

If the mortar based on aerial lime and *cocciopesto* is applied in order to exploit the characteristics of transpiration in the restoration of damp walls, it is important, during the drafting, not to compress too much the slurry on the support to keep it macro-porous. If, on the other hand, it is used as a waterproof layer, it is better closing the pores as much as possible by smoothing the layer with a trowel until a polishing-like effect is obtained. On the funds it can also be applied only as a finish.

## TECHNICAL CHARACTERISTICS

The mortar based on aerial lime and *cocciopesto* is free of additives, shows a high mechanical resistance; it is porous and breathable; it has good adhesion to supports and suitable elasticity; it has excellent hydraulic properties. It is available in different granulomers: with an impalpable grain of 00-0 mm; powder 0-1.2 mm; fine 1.2-3 mm; average 3-8 mm; rough 8-20 mm.

## RECOMMENDATIONS AND OTHER INFORMATION

Do not apply on wet or water-impregnated substrates to avoid poor adhesion; but in the case of substrates with high water absorption it is necessary to moisten the substrates before application or proceed with the application of a thin coat as a rough one.

Do not apply at temperatures below 5°C; It is not recommended to use antifreeze additives that might affect the workability of the slurry. In the presence of high temperatures and ventilation, take all precautions to prevent the material from drying too quickly.

The mixture can be kneaded on site, preferably by hand so that the crushed bricks with a suitable grain size are not crumble anymore (Fig. 8). Any excess of water in the mixture can cause difficulties in laying the material as well as lengthening the drying times of the product on site. If the mixture is not well compacted, it can cause cracks or poor surface consistency. A *cocciopesto* made from lightly cooked (yellow) bricks contains a greater quantity of salts therefore it must be used in the doughs only in modest quantities.

## EXAMPLES

### INTERVENTION OF RECOVERY AND CONSERVATION OF THE ROMAN VILLA DEL CASALE, PIAZZA ARMERINA (EN)

In Sicily there is a large number of testimonies of the use of area lime mortar and *cocciopesto* in plasters and floor substrates with marble or mosaic tiles (so-called nucleus, consisting of three parts of *cocciopesto* and one of lime), deriving from Hellenistic and Roman times. One of the most emblematic examples is the Roman Villa del Casale, located in Piazza Armerina (EN), the subject of a recent restoration of the mosaics, wall paintings and plasters, aimed at ensuring a more effective and stable conservation, according to the need of opening the site to visits.

The villa covers an area of 4,000 square meters and consists of an articulated series of rooms, a Frigidarium, a Tepidarium with gym and a Triclinium; all spaces are decorated with mosaic coverings. The original *cocciopesto*-based mortar is well preserved and can still be found today: in all the remaining layers of external plaster; as a background for wall paintings; as a background for the mosaic floor; in coarser grain as a screed in the ventilated crawl space of the thermal environments; as a bedding layer of the marble slabs that



cover the pools in the octagonal room of the frigidarium. Furthermore, in correspondence with the ovoid peristyle of the triclinium, a floor with *cocciopesto*-based mortar was found beneath the mosaic, probably relating to an older rustic settlement.

From the diagnostic campaign, in the design phase, a heterogeneous deterioration of both the paintings and the floors was reported, mainly due to the capillary rising damp and unsuitable interventions that required the application of cement in some gaps in the floors. The most emerging issue was the presence of soluble salts from the groundwater, the soil and the concrete screed. Deposits of various kinds (organic, inorganic), saline efflorescence, biological attacks, encrustations, gaps, cracks, chromatic alterations, areas not cohesive with the substrate, as well as the oxidation of metals embedded in the cements were detected.

The poor state of conservation has thus led to the articulation of the work in different operational phases including the removal of the cement and reinforcing rods, the detachment of the mosaic portions that were not cohesive with the substrate, the reclamation of the screed and subsequent repositioning. The reconfiguration of the gaps in the internal and external plasters and floors was carried out by applying aerial lime mortar with *cocciopesto* where the size of the gap and the present figurative design did not allow the execution of an exact integration and lime mortar neutral area in the remaining areas. The mortar based on aerial lime and *cocciopesto* was also used as flooring for the walkways that guide the entire mosaic path. The choice fell on such mixture, as well as for an aesthetic affinity, for total compatibility with the constituent materials, for the total absence of salts, high breathability, high resistance to alkaline aggression and to the formation of mold and bacteria.



Fig.1: Mortar based on aerial lime and *cocciopesto* as filling a gap in the mosaic floor (previous recovery intervention). ©Private Archive



Fig.2: Mortar based on aerial lime and *cocciopesto* as a background for the mosaic paving. ©Private Archive



Fig.3: Mortar based on aerial lime and *cocciopesto* as external plaster. ©Private Archive





Fig.4: Mortar based on aerial lime and *cocciopesto* as internal plaster and support of the wall painting.

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Fig.7: Removal of parts of the non-cohesive mosaic paving. ©Private Archive



Fig.5: Mortar based on aerial lime and *cocciopesto* as internal plaster of the Frigidarium area. ©Private Archive



Fig.8: Laying of mortar based on aerial lime and fine-grained *cocciopesto* as a sediment of the mosaic floor to be relocated. ©Private Archive



Fig.6: Mortar based on aerial lime and *cocciopesto* as screed for the ventilated crawl space in the Frigidarium area. ©Private Archive



Fig.9: Fragments of *cocciopesto* as a transpiring filler (new intervention). ©Private Archive



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## WEBSITE OF THE COMPANY

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[www.hdsystem.it](http://www.hdsystem.it)

[www.marraccinilucca.com](http://www.marraccinilucca.com)



Fig.10: Mortar based on aerial lime and *cocciopesto* to integrate gaps in the mosaic paving (new intervention). ©Private Archive



Fig.11: Mortar based on aerial lime and *cocciopesto* as flooring for internal paths (new intervention). ©Private Archive



Fig.12: Mortar based on aerial lime and *cocciopesto* as external flooring (new intervention). ©Private Archive



## IMAGES AND CAPTIONS



Fig.13-14: Ancient plaster based on aerial lime and *cocciopesto* finished in “marmorino” (fig.13). Plaster based on aerial lime and *cocciopesto*, walls of the Arsenale in Venice (fig.14). © <https://www.quaderniquarneti.it/quaderno-4/il-cocciopesto-materia-amica.html> ; <https://www.quaderniquarneti.it/quaderno-4/il-cocciopesto-materia-amica.html>



Fig.15-16: Fragments of brick (fig.15). *Cocciopesto* powder (fig.16). © <https://dianti.it/boutiquedellacalce/index.php/calce-uso/il-cocciopesto> ; [https://www.edilportale.com/prodotti/sandtex/crushed-and-dishydrated-coccio-powder/cocciopesto-cc\\_362201.html](https://www.edilportale.com/prodotti/sandtex/crushed-and-dishydrated-coccio-powder/cocciopesto-cc_362201.html)





Fig.17-18: Spreading plaster based on aerial lime and *cocciopesto* using a trowel (fig.17). Background screed with less finely ground *cocciopesto* (fig.18).

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<https://www.bellisottofondi.it/cocciopesto/>



Fig.19-20: Paving realized using beaten *cocciopesto* with stone inserts (fig.19). Preparation on site of the mortar based on aerial lime and *cocciopesto* (fig.20).

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