



Facade of the factory La Ceramo.
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Characterization of historical coating mortars of La Ceramo factory in Valencia

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ABSTRACT

The objective of this paper was to characterize historical coating mortars taken from the La Ceramo factory, in Valencia, by means of historical, in situ and sample collection at various points in the building, for subsequent laboratory tests. The physical-mechanical characteristics studied were: compressive strength, water content, granulometry by sieving method, identification of calcium carbonate with hydrochloric acid, surface hardness, water absorption, apparent porosity and bulk density. The results showed that the mortars composed of cement and lime collected did not present very positive characteristics in the aspects analyzed in this study, resulting in material with low quality, both in its initial composition and in function of the external influences suffered over time. Regarding the other areas of lime mortar, these presented better results, although less resistant than those of cement, were shown to have good quality. It can also be observed that lime mortars, even having a similar composition in their origin, when applied at different points of the factory acquired uneven characteristics over time, directly related to the local conditions of the coated walls. Finally, the need for preventive conservation in buildings of historical interest makes this paper of investigative and scientific nature, since the knowledge of the original materials is the initial step to a good intervention and not to accelerate the process of degradation of historical constructions.

KEYWORDS

characterization, coating mortars, degradation, historical building

1. INTRODUCTION

The characterization of old mortars, at the level of execution techniques, of the constitution and evaluation of its conservation status, are an indispensable tool in the approach of a conservation intervention in these elements, allowing to define the compatibility characteristics required of replacement mortars. Besides, they can provide important information about the history of buildings, namely about the time and the context of its construction, and also regarding possible repairs already made (Santos, 2003).

The complexity of ancient materials, in the case of mortars, requires more than one type of technique for the characterization of the samples, which many must be used together, contributing to more realistic results, although there are characteristics left in the years of its existence that will not be reproduced, mainly in organic mortars (Rodrigues, 2013).

The most important aspect in the characterization of old mortars is the knowledge about the nature of the binder used. Old lime and sand mortars were usually performed in an approximate proportion, in volume, from three parts of sand to one part of lime. Used to join masonry stones or bricks or as a coating of exterior and interior walls, the old mortars functioned as both a structuring element and a protection of existing masonry. In other cases they had a decorative function, imitating materials such as marble or tiles (Falcão, 2010).

According to Velosa (2006), the behavior of the mortar can be altered due to the climatic changes that occur over the years. Therefore, it becomes even more relevant to study mortars at the level of their physical, chemical and mechanical properties. Through the survey of several research works, can be observed the existence of several techniques for the characterization of old mortars (chemical, mineralogical, thermal or microstructural nature) such as wet chemical analysis, thermogravimetry, granulometric analysis, among others.

These methods of analysis help to know the constitution of old mortars, to distinguish its function, by differences in its composition and, if necessary,

to determine the nature of chemical interactions between its constituents.

In view of the foregoing, this study had as objective to characterize historic coating mortars removed from the La Ceramo factory, of Valencia, Spain, by means of historical study, in situ and sample collection at various points in the building, for further laboratory tests.

2. HISTORICAL CONTEXT AND DESCRIPTION OF THE LA CERAMO FACTORY

The La Ceramo factory is located in the city of Valencia, Spain. It was founded in 1889 by Josep Ros Furió and his wife Salvadora Ferrer Carbonell, together with partner Julian Urgell, in the Benicalap neighborhood and has been closed since 1992. The factory continued to function as a family property of the founding couple until the late nineteenth century, its penultimate owner was the architect Pilar Ros Blanco. At the beginning of 1900 it represented an important point of reference for the production of ceramics in the city and in the whole country. In particular, it became famous for having spread in Spain the 'golden porcelain' or 'metallic reflections', a kind of enamel decoration with brilliant effects produced by metallic oxides, originally arab. One of the singularities of La Ceramo, is that inside it were produced all the necessary products from the raw material, the pigments were made (all formulas), only the basis for the manufacturing was bought and this craft process was passed from parents to children (Calia, 2017).

La Ceramo was a great contribution for modernist and post-modernist architecture of Valence, so the production focused on the execution of elements for architectural application, not only in Valencia, but in Barcelona and other cities. it began a great source of resources in architectural ceramics, with specific designs for buildings.

According to Calia (2017) the factory plan had an industrial type, with single corridor building aggregates around a courtyard. The self-sufficiency

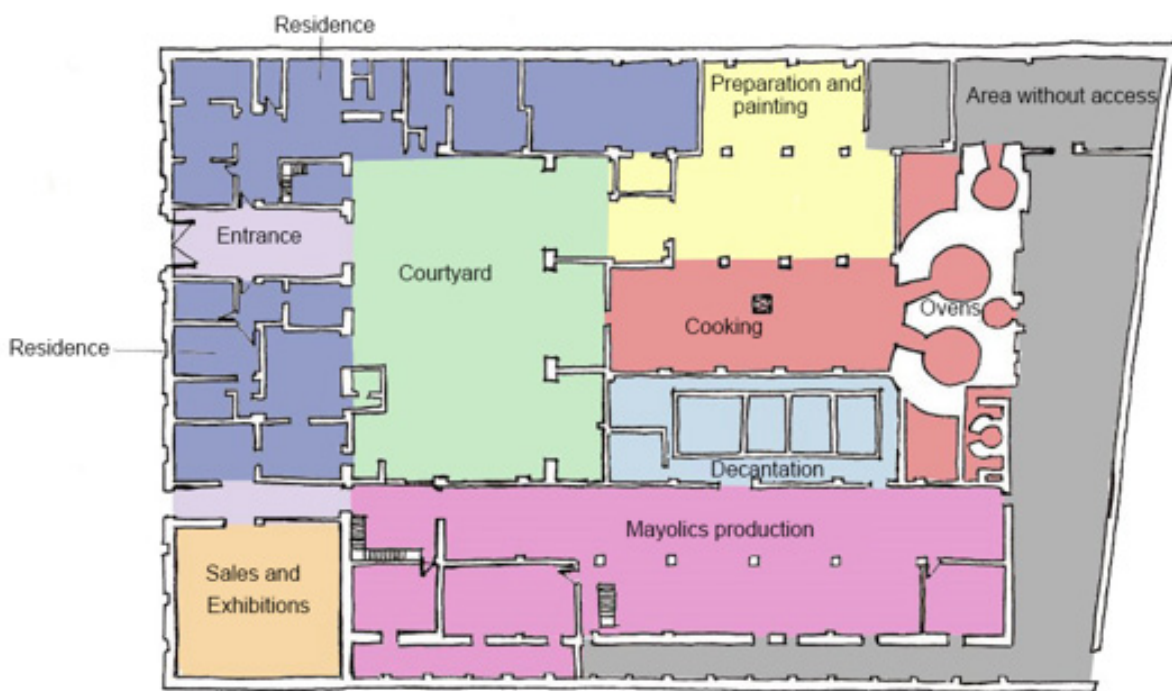


Figure 1.
Sketch of the Location for the built blocks and the open courtyards of La Ceramo

and rigor of the terracotta bricks present in the structure are interrupted by frequent decorative elements of oriental origin, such as inscriptions, arches, columns, low reliefs and Muslim iconography. Until 1992, La Ceramo had its entire structure still conserved as it was in the production phase and the factory operation, but today, more than 20 years later, this is no longer your reality.

The La Ceramo factory is basically formed by four built blocks and open courtyards. The building main entrance gives direct access to the activity courtyard and the owning family residence block. From this central patio it is possible to access the first factory

built block, the ovens and the cooking place; the second open patio, the decantation one; the block of ceramic production workshops; and the block connected to the ovens; preparation and painting processes, all presented in the sketch of figure 1.

The first block main facade consists of an entrance with an arc of evident arab influence, supported by two columns which the right-hand column was lost over time and the column on the left is all smooth containing capital, while the upper part consists of an abacus with interlaced decorations. The arc is also included within a large rectangular decorated frame, consisting an iconic rhombic pattern, also with



Figure 2.
Images of the La Ceramo factory

obvious arab origin. Finally an effigy above the arch, which also shows the city of Valencia's shield and the name of the factory, as shown in figure 2 [a]. The main access door is run down, made of wood and painted in green color, leads to the main patio of the factory. To the right of the entrance door there is another side entrance leading directly to the building where the ceramic production processes were present. Other openings, containing Arabic-style frames, are also present on the facade, now protected by safety nets (Pagliuca, 2017).

The facade observed in figure 2 [b] does not contain many of the original coatings, existing vestiges of an older mortar in the walls, but what prevails is a coating of ordinary mortar, regularizing what was before collapsing.

The central body, which only the head of the original building still remains, has been affected in recent times by the collapse of the roof, probably due to pathological factors (rot) of the wood elements. These factors, therefore, compromised in the static of the trellis (polonceau type), which is composed by wood and metal pieces that constituted the roof closing.

From the constructive point of view, the factory's body has similar morphological characteristics for both foundation systems and basic closing and supporting structures (masonry and brick pillars). The roof closing consists in a double slope with a simple plywood, (warped wood) structure characterized by the

presence of sharp arcs arranged in gaps (capable of ensuring a solid support of the ridge). The substantial difference between the two blocks (residential and production) consists of the intermediate wood lining, made with the traditional in cannuccia to technique and finished with painted plaster in blue color, in other words, wanting to evoke the bright colors of the ceramics and beautify the environments used for the exhibition of ceramic products made with the metallic reflection technique in the first block. The second block also has a buried environment that was used as a clay deposit, the attic made of an iron-trachea support structure and a double row of bricks (Pagliuca, 2017). A total of four circular ovens are found in the factory (figure 2 [c]), two larger and two smaller ones, which depended on the use and amount of clay that was produced during cooking. The closing system consists of an overlap of masonry, seated in constipated floor, in which the structural system is composed of sacco-type masonry (rough stone wall and clay band made with the regular use of bricks arranged in line). The roof closing, on the other hand, consists of a system with a built-in dome (also made of bricks) in which the symmetrically orifices ensure that the air is pulled upwards. In order to improve the mass behavior of the oven, very visible containers were made. The access to the roof was guaranteed by a circular tower, where inside a helicoidal staircase allowed the ascent.

3. REMOVAL OF THE SAMPLES

The removal of mortar coatings samples for study in this work was carried out inside the La Ceramo factory. All the pieces were taken from inside the factory masonry, because, as the building description shows, the outside part was not able to remove the cover layer, while inside the building, the chosen areas presented better conditions for this practice. Sample removal areas are marked in figure 3 and numbered from 1 to 4, as they will be displayed from this point of work.

For the selection of the study areas, a critical analysis of the entire La Ceramo factory space was carried out, in order to make a conscious sampling, which would not affect the good condition of the installations, however, these were only the most recent coatings, used for repairs. The coatings studied already had large detachments of the surfaces of the walls, being in

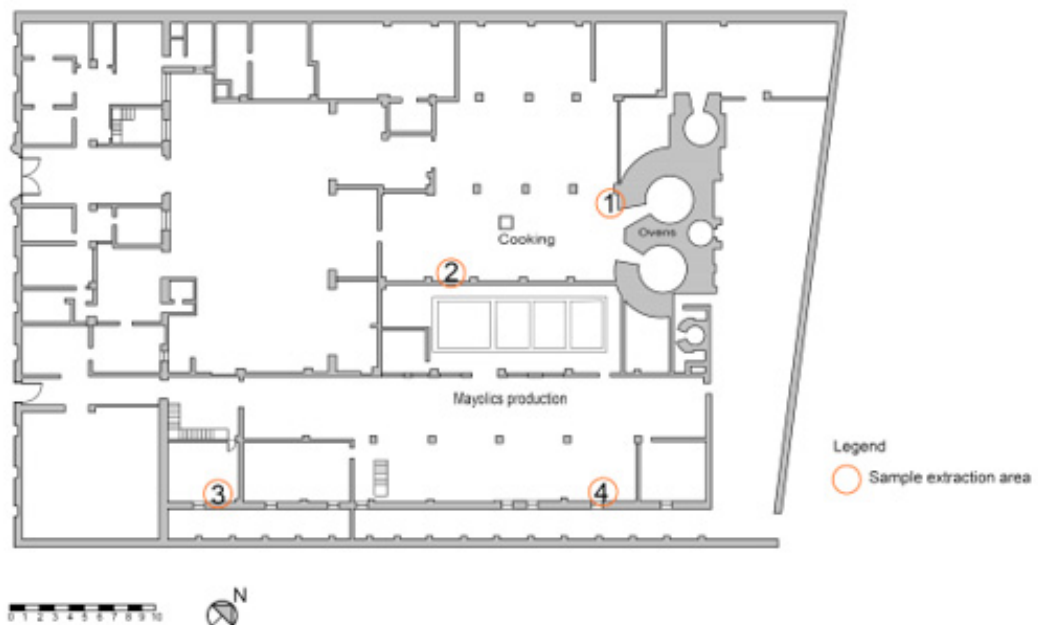
precarious conditions. It is not known exactly whether they are the original jackets of the construction, but all samples are from old mortars.

The block connected to the ovens, of the ceramics preparation and painting, was the last one to be built and was executed of exposed bricks, so there were no coatings to analyze, and the residence block was covered with painted plaster, thus, the kitchen blocks and ovens and the production of ceramics were chosen for the study of the coatings.

There are two study areas in each of the blocks chosen, the samples of areas 1 and 2 were in the oven block, and 3 and 4 in the production block.

Samples from area 1 were removed from a wall of the oven itself (figure 4 [a]), which has a sacco-type masonry structure. The coating was already very aggravated and compromised, with a large area with erosion, detachment and disintegration of the mortar, and there were practically no significant cracks amid lack of coating in the area. Dirt has also been

Figure 3.
Sample extraction areas



observed, but there are no manifestations of moisture spots, efflorescences or biological colonization.

Samples from area 2 were removed from what in their original state was an entire wall (unlike figure 4 [b], which shows the state in which it was found in situ surveys), the region was also originally covered. The area shows loss of mortar at the lower part of the wall, being possible the visualization of different layers of mortar, the external one already totally unobstructed, and the second with some remaining parts. There are few cracks, some dirt and a large region where there was loss of coating adhesion.

Samples from area 3 were removed from a fully covered room with few openings, only the window can be seen in figure 4 [c] and a door that leads to a room also covered, meaning that the wall did not receive direct sunlight. The wall, one of the exteriors of the building, is built of stone. The coating of the area is in serious condition, with the lower part fully compromised as the coating does not exist in this room anymore. It is possible to differentiate three different layers of coating in this area: the upper, still preserved, one in the middle, approximately 1.20 m from the ground, which presented some desolate areas on the surface, observed to the hollow sound resulting from a inspection with rubber hammer in the coating, and a third layer almost nonexistent, further down the wall. The removal sample has only two of the three layers observed. Samples from area 4 (figure 4 [d]) were removed from a wall which, even in a covered environment, had large openings. The remaining coating of this area showed some cracks, dirt and moisture spots, there were large areas with loss of adhesion and erosion of the coating.

4. SAMPLE PREPARATION

To perform the characterization techniques that will be presented in the next item of this work, two samples were collected from each areas, and these samples were grouped in two groups to perform different tests. Group A was used in the tests to determine the absorption of water by immersion, determination of the apparent porosity and soil density, water content

a- area 1



b- area 2



c- area 3



d- area 4



Figure 4.
Areas where samples were taken from the La Ceramo factory

| Sample | Shape | Substrat | Mass (g) | Layers | Porosity | Color | Presence of fibers |
|--------|---|--------------|----------|--------|---|-------------|--------------------|
| 1A |  | solid bricks | 95,2 | 1 | low porosity, easily dissolves in the hands | earthy tone | animal |
| 2A |  | solid bricks | 71,4 | 2 | slightly porous | gray | no |
| 3A |  | stones | 163,5 | 2 | low porosity | gray | no |
| 4A |  | stones | 96,6 | 2 | too much porosity | gray | no |
| 1B |  | solid bricks | 177,7 | 1 | low porosity, easily dissolves in the hands | earthy tone | animal |
| 2B |  | solid bricks | 122,8 | 2 | slightly porous | gray | no |
| 3B |  | stones | 182,3 | 2 | low porosity | gray | no |
| 4B |  | stones | 147,8 | 2 | too much porosity | gray | no |

Table 1.
Characteristics of the coating samples used

by gravimetric method and grain size. Group B was used for the calcium carbonate identification tests with hydrochloric acid, determination of the compressive strength and surface hardness.

Table 1 was created to provide a clear view to the characteristics of the samples used in the tests carried out, containing its nomenclature (number of samples / belonging groups), sample forms images, the type of substrate where it was, its mass, the number of sample layers, porosity, color, and whether or not animal or vegetable fibers have been found.

5 CHARACTERIZATION TECHNIQUES AND SPECIAL ANALYSIS

This part of the paper contains the presentation of the applied methodology by means of characterization techniques, which can be visualized in table 2, together with the references which the tests were based upon. It is also presented an analysis of the data obtained from the tests. It should be mentioned that the experimental program tests were carried out in the laboratory, belonging to Universidad Politécnica de Valencia, in Spain, with support from the Escuela Técnica Superior - Ingeniería de Edificación.

| Tests | References |
|--|-------------------------------------|
| Identification of calcium carbonate with hydrochloric acid | - |
| Surface hardness determination | UNE EN 13279-2 (2014) |
| Compressive strength determination | Válek e Veiga (2005) |
| Water content (gravimetric method) | Lanzinha (1998) |
| Determination of water absorption by immersion | Santos (1989); ABNT NBR 9778 (2009) |
| Apparent porosity determination | Santos (1989); ABNT NBR 9778 (2009) |
| Apparent density determination | Santos (1989); ABNT NBR 9778 (2009) |
| Granulometry | UNE EN 933-1 (2012) |

Table 2.
Testing techniques for characterization of old samples

These techniques were selected based on the paper done by different researchers. Although in this paper the objective is not to reconstitute a new mortar, however, there is a basis for this, and it is important to organize more complex records about the old mortars composition so that traces of traditional technologies are not lost.

5.1 IDENTIFICATION OF CALCIUM CARBONATE WITH HYDROCHLORIC ACID

By adding hydrochloric acid (HCl) to any surface containing calcium carbonate (CaCO₃), the reaction is marked by the formation of a gas, carbon dioxide (CO₂) instantaneously according to the formula: $\text{CaCO}_3 (\text{s}) + 2 \text{HCl} (\text{aq}) = \text{H}_2\text{O} (\text{l}) + \text{CO}_2 (\text{g}) + \text{CaCl}_2 (\text{aq})$.

Therefore, when hydrochloric acid was applied to samples from group B (figure 5), it was possible to identify whether or not there is cement in its



Figure 5.
Test with application of hydrochloric acid in some of the samples

| Effervescence reaction to hydrochloric acid | |
|---|-----|
| Sample 1B | YES |
| Sample 2B | NO |
| Sample 3B | NO |
| Sample 4B | NO |

Table 3.
Results of the hydrochloric acid test

composition. The data found are shown in table 3. It can be observed from the results obtained in figure 5 that only the sample from area 1 presents cement in its composition, the other mortars were constituted without this component, probably containing only limestone, mineral aggregates and water.

5.2 SURFACE HARDNESS DETERMINATION

The objective was to determine the hardness depending on the application of a certain force on the surface of the sample. First, the thicknesses of the four samples of group B were measured using a pachymeter, as shown in table 4.

| Identification | Measures (mm) | | | | | Average (mm) |
|----------------|---------------|----|----|----|----|--------------|
| Sample 1B | 28 | 14 | 17 | 10 | 17 | 17,2 |
| Sample 2B | 18 | 11 | 24 | 11 | 10 | 14,8 |
| Sample 3B | 12 | 26 | 20 | 18 | 18 | 18,8 |
| Sample 4B | 16 | 27 | 24 | 18 | 22 | 21,4 |

Table 4.
Measurements of sample thickness

| Area 1 (Shore D) | | | | Average 1 |
|------------------|------|------|------|-----------|
| 17,5 | 39,5 | 42 | 57,5 | 51,94 |
| 61 | 30 | 54,5 | 59,5 | |
| Area 2 (Shore D) | | | | Average 2 |
| 52,5 | 52 | 47 | 50 | 55,5 |
| 59,5 | 49 | 74 | 60 | |
| Area 3 (Shore D) | | | | Average 3 |
| 32 | 31 | 44,5 | 44,5 | 36,87 |
| 31,5 | 42,5 | 32 | 37 | |
| Area 4 (Shore D) | | | | Average 4 |
| 60 | 53 | 52,5 | 48,5 | 56,06 |
| 62 | 37 | 71 | 64,5 | |

Table 5.
Surface hardness data measured in situ with Shore D durometer

| Surface hardness (Shore C) | |
|----------------------------|----|
| Sample 1B | 75 |
| Sample 2B | 70 |
| Sample 3B | 85 |
| Sample 4B | 75 |

Table 6.
Surface hardness data measured in the laboratory with Shore C durometer

The values obtained in situ in the areas of sample removal using the Shore D durometer are shown in table 5. An eight-point mesh was made in each area and a measure of hardness was collected for each point, as well as its mean surface hardness value.

In the laboratory a new measurement was made using the Shore C durometer, this time in the own samples of group B, the mean values obtained for each sample are presented in table 6.

Then, the samples whose composition did not contain cement, that is, lime mortars, passed the UNE EN 13279-2 (2014) hardness test. In them, a steel sphere of diameter equal to 10 mm was placed at a fixed point on the surface, and a force of 200 N was applied, as shown in figure 6.

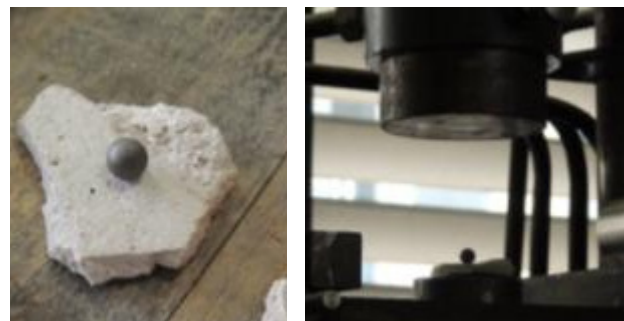


Figure 6.
Hardness test in laboratory

The hardness formula: $H = F / (\pi \cdot D \cdot t)$ was applied, where t refers to the depth of the mark that the sphere leaves on the surface after the test. Therefore, the hardness found in lime mortars is shown in table 7.

| Hardness H in MPa | |
|---------------------|-------|
| Sample 2B | 20,69 |
| Sample 3B | 20,02 |
| Sample 4B | 20,07 |

Table 7.
Hardness according to the test with the steel ball

According to the graph of figure 7, the results point to hardness values between 70 and 85 Shore C, so its water to gypsum ratio is approximately 0,7.

According to the measurement conversions data of the used durometers, the measurements made with Shore C between 70 and 77 correspond to measurements performed with Shore D between 46 and 58, so measurements taken in situ and in the laboratory coincide.

In situ hardness measurements showed much lower values for the area 3 sample, while in laboratory tests this value was contradicted, with the sample having a higher surface hardness. Due to the conditions found in situ, it is possible to consider that the detachment of the coating on the wall, and the hollow part that was cited as found in the sample removal area, influenced the in situ results of this sample. The tests performed on lime mortars presented very similar results in all samples, with values around 20 MPa.

5.3 GRANULOMETRY

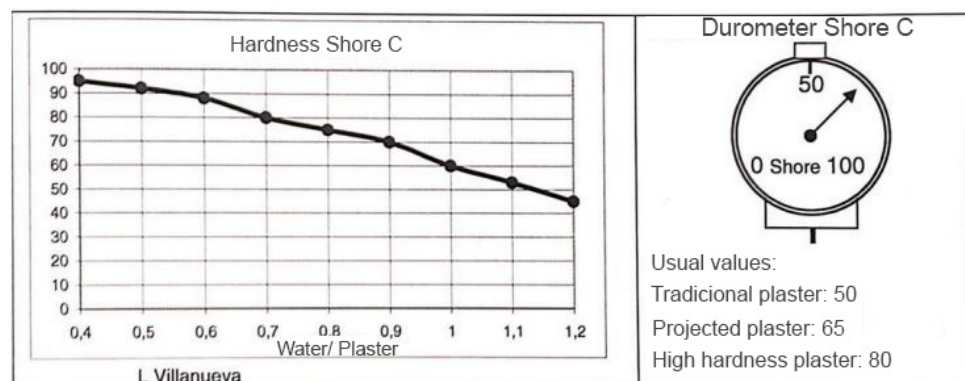
The aggregates granulometry directly influences the composition of the new mortar, in the texture, color, compactness and in the main properties of the mechanical resistances, besides the workability and water retention. The granulometry test was performed only on a sample of area 1 (cement and lime mortar), that mass was 45.2 g. The sample went through the disaggregation process with the rubber stopper (figure 8 [a]), to be able to pass the grains through the sieves, as shown in figure 8 [b].

The sieves used have their retention in mm of 12.5; 10; 8; 6.3; 4; 2; 1; 0.5; 0.125; 0.063. In each sieve, the retained material was weighed. The result of the process can be seen in the graph of figure 8 [c] which the different types of dimensions obtained in the sieving can be observed.

The granulometry presented boulders larger than 8 mm, which could already be considered too large for the composition of the mortar, and are not currently used. The aggregate used is considered well graded, with varying dimensions.

When analyzing the Coefficient of Uniformity $C_u = d_{60}/d_{10}$, it was obtained the value 31.7, greater than 15, referring to a non-uniform material. The Coefficient of Curvature obtained by the formula $C_c = (d_{30})^2/d_{60} \times d_{10}$ was 0.12; being fewer than 1, and refers to an open degree.

Figure 7.
Shore C hardness graph.
Source: Pastor e Agórriz (2009)



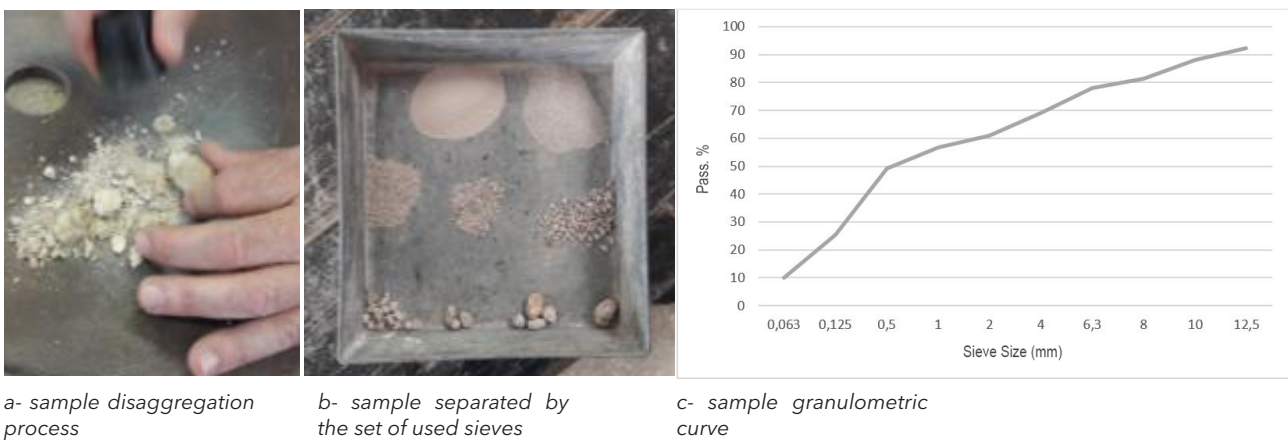


Figure 8.
Realization process of
granulometry test.

5.4 COMPRESSIVE STRENGTH

The method consisted of performing the compression test on irregular samples collected in situ with confined mortars of superior resistance to those to be tested and using the conventional press for compression tests of prismatic gypsum samples.

It was made wood molds of 4x4 cm to the confection of the confining mortar (composition of cement and sand in the 1:3 dash by mass) more resistant than the mortars studied, in order to regularize the surfaces of the samples and make it possible to carry out the compression test on a homogeneous basis, there are no specific accusations that will disqualify the judgment. To obtain a smooth surface, after 15 days drying of the confinement mortar, plates of sulfur were molded on them, as shown in figure 9.

Then the compression tests were performed on the four samples (1B, 2B, 3B and 4B), which had their lateral dimensions decreased, as shown in the figures in figure 9 [a]. The results are shown in the graphs in figure 10.

The speed of application charging with sample 1B (0.2 kN/s) was higher than the others (0.1 kN/s), because it is a mortar constituted with cement. The curvature of the graphs showed that the first two samples (1B

and 2B) are composed with more aggregates than the others (3B and 4B), because they presented a more curved graph, while the last ones, especially sample 3B, have the line formed by the graph more straight than the others, meaning a reduced amount of aggregates in their composition.

It was observed, through the values obtained in the tests, that sample 1B (cement mortar) did not present resistance to high compression, losing in mechanical resistance even for the other samples (composed only with lime), since the composite samples of lime (2B, 3B and 4B) presented slightly higher values of compressive strength.

It should be mentioned that sample 2B could lead to a positive result in terms of compressive strength, due to the very reduced thickness of the samples in this area of study when compared to the others, but this fact cannot be considered conclusive, since the amount of regularization mortar that needed to be used was higher than the other samples, which may have influenced its final result. The high compression result of the sample 3B, however, can be taken into account, since the sample had enough thickness for a more conclusive test.

Figure 11 shows the final appearance of the samples after the compressive strength tests, and as an example, one of the samples was used to show the

Figure 9.
*Test bodies and positioning
 in the compression test
 press*



a- final appearance of the tests bodies



b- test body positioned in the press

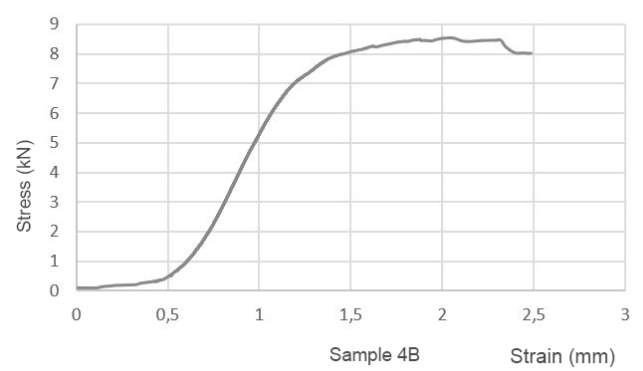
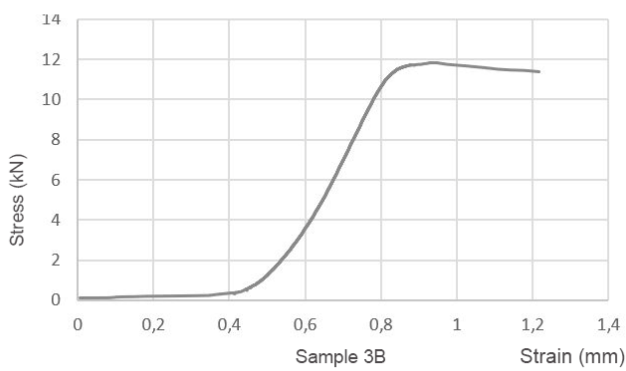
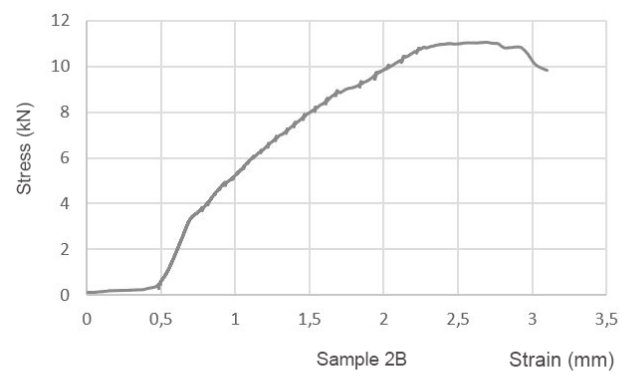
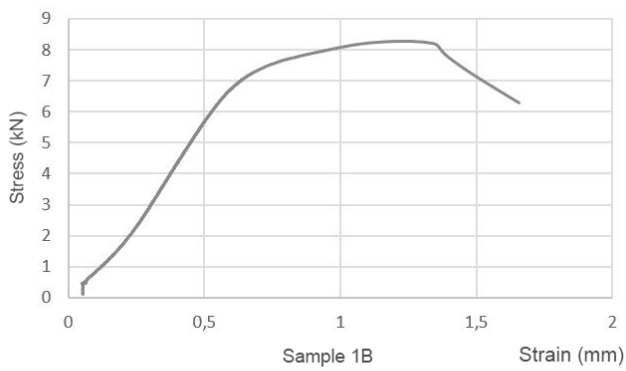


Figure 10.
*Individual results of the compressive
 strength tests of the samples*

vectors of forces acting on the test body during the test. The red vectors represent the compression suffered and the black ones the reaction of the part. In this way, as the upper ends were connected to another containment surface, tend to have vectors smaller than the center of the sample.

5.5 DETERMINATION OF WATER ABSORPTION, POROSITY AND DENSITY

Table 8 presents the results of water absorption, porosity and density of the samples.

Sample 1A, composed of cement, had the lowest water absorption when compared to lime mortars, which presented slightly higher values.

The sample with the highest porosity was 2A, followed by 4A, which were also the most porous for the in situ visual analysis. The porosity is also related to the water absorption of the samples, the most porous being the one that absorbed the most amount of water, except for sample 1A, which in this test had higher porosity than sample 3B, and in the immersion absorption test it was the one with the lowest value.

In relation to the apparent density, the highest value

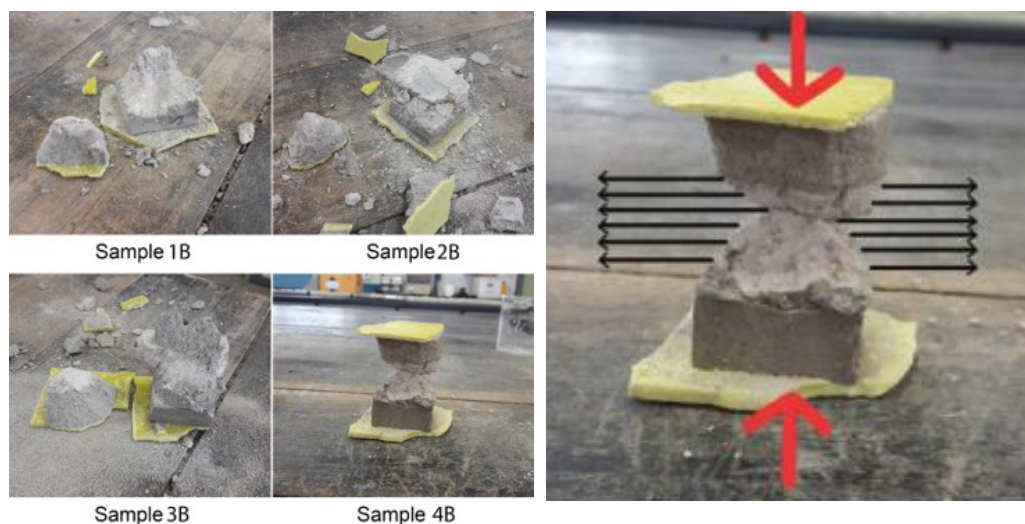
was the one presented by sample 1A, probably due to the composition with the presence of larger area, which already present high density by themselves, and also by the low porosity of this sample. The sample of lower density (2A) is the same one of greater apparent porosity and greater absorption.

5.6 WATER CONTENT (GRAVIMETRIC METHOD)

The material water content was calculated by means of the mass difference according to the sample in the initial state and after drying. The results were expressed, therefore, in percentage of mass, referring to the mass in the dry state. From this technique it is possible to indicate if the origin of the humidity is related to the capillary elevation, when it is detected, for example, the existence of coating areas with high levels of water, both in dry (summer) and wet (winter) weather conditions, and there are no other causes of permanent water supply (e.g. broken or leaking pipes).

The extraction of the samples was carried out preserving the humidity present in the mortar found in situ, for this they were stored in sealed and identified plastic bags, until the moment of the first

Figure 11.
Mortar samples after the compressive strength test



| Identification | Drymass, Ms (g) | Saturated mass, Msat (g) | Saturated, submerged mass, Mi (g) | Absorption (%) | Porosity (%) | Dry apparent density (g/cm ³) | Saturated apparent density (g/cm ³) |
|----------------|-----------------|--------------------------|-----------------------------------|----------------|--------------|---|---|
| Sample 1A | 94,72 | 104,86 | 55,83 | 10,70 | 20,68 | 1,93 | 2,14 |
| Sample 2A | 71,29 | 83,23 | 32,26 | 16,75 | 23,42 | 1,40 | 1,63 |
| Sample 3A | 154,71 | 174,27 | 68,60 | 12,64 | 18,51 | 1,46 | 1,65 |
| Sample 4A | 95,64 | 109,50 | 44,52 | 14,50 | 21,33 | 1,47 | 1,68 |

Table 8.
Results of water absorption by immersion, apparent porosity and apparent density

| Identification | Wet mass in the natural state, Mu (g) | Dry pasta in greenhouse, Ms (g) | Water content (%) |
|----------------|---------------------------------------|---------------------------------|-------------------|
| Sample 1A | 95,2 | 94,72 | 0,507 |
| Sample 2A | 71,4 | 71,29 | 0,154 |
| Sample 3A | 163,5 | 154,71 | 5,681 |
| Sample 4A | 96,6 | 95,64 | 1,004 |

Table 9.
Results of the water content in the samples

weighing, called wet in the natural state. The data of wet weighing, sample weighing after oven drying and water content are shown in table 9.

Sample 3A presented a percentage of water much higher than the other samples, which was collected in an environment without sunlight, different from the others, probably with a high concentration of humidity, which may have contributed to the water content found in the test. Sample 4A also belonged to a covered environment, but with a little more ventilation and sunlight, which contributes to the result of the water content also being higher than the others.

The lower value of water content was obtained with sample 2A, which had the highest absorption, higher porosity and lower apparent density. It should be mentioned that this sample did not present high humidity in its natural state in situ at the time of

collection, probably due to its position in relation to the Sun, but is disposed to great absorption, which can generate pathological manifestations in the coating.

6. FINAL CONSIDERATIONS

With the withdrawal and the study of samples of four distinct points of the buildings that constitute the factory La Ceramo, of Valencia, similarities and differences were observed between mortars of great importance for their characterization as elements of old coating.

Most of the factory's mortar coating are composed of water, lime and varying amounts of aggregates, but in the factory's main and oldest points, in this case the ovens where the ceramics are burned, the coatings found are cement and lime mortars, differing from the other samples collected in composition and characteristics.

With the results obtained through the characterization techniques performed in the laboratory and from the in situ observations, it was found that the mortars made of cement and lime found did not present very positive characteristics in the aspects analyzed in this work, resulting in material with low quality, both in its initial composition and in function of external influences suffered over time. This way, in the other areas of coating with mortars, in the case with lime, it was presented better results when compared to ovens mortars, as well as for samples of lime mortars produced in the laboratory for the purpose

of comparative analysis. The samples of lime mortar, generally less resistant than those of cement, showed good quality.

It can also be verified that lime mortars, even having a similar composition in their origin, when applied at different points of the factory acquired uneven characteristics over time, directly related to the local conditions of the coated walls. That is, each place within the walls of La Ceramo, due to its different characteristics, also have old mortars that have been distinguished over time.

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