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TECHNICIAN TRAINING FOR THE CONSERVATION OF MOSAICS

PART 1
THE CONSERVATION OF IN SITU MOSAICS

Conservation mortars for in situ mosaics: their formulations

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Factors influencing the properties of a mortar

- Non-hydraulic or hydraulic **properties**
- Binder-aggregate **ratio**
- Particle-size **distribution** of aggregates
- **Amount** of water
- **Color and texture** if the mortar will be visible

Non-hydraulic or hydraulic **properties**

A lime-based mortar with **non-hydraulic** properties is made with a non-hydraulic binder and inert aggregates. It needs to be in contact with air to set.

A lime-based mortar with **hydraulic** properties is obtained in several ways. It can be a mixture of non-hydraulic lime and aggregates giving hydraulic properties (fired clay and/or volcanic earth and rocks) or a mixture of hydraulic lime and inert aggregates, or one that gives hydraulic properties. Most of the setting is done in contact with water.

Binder/Aggregate **Ratio**

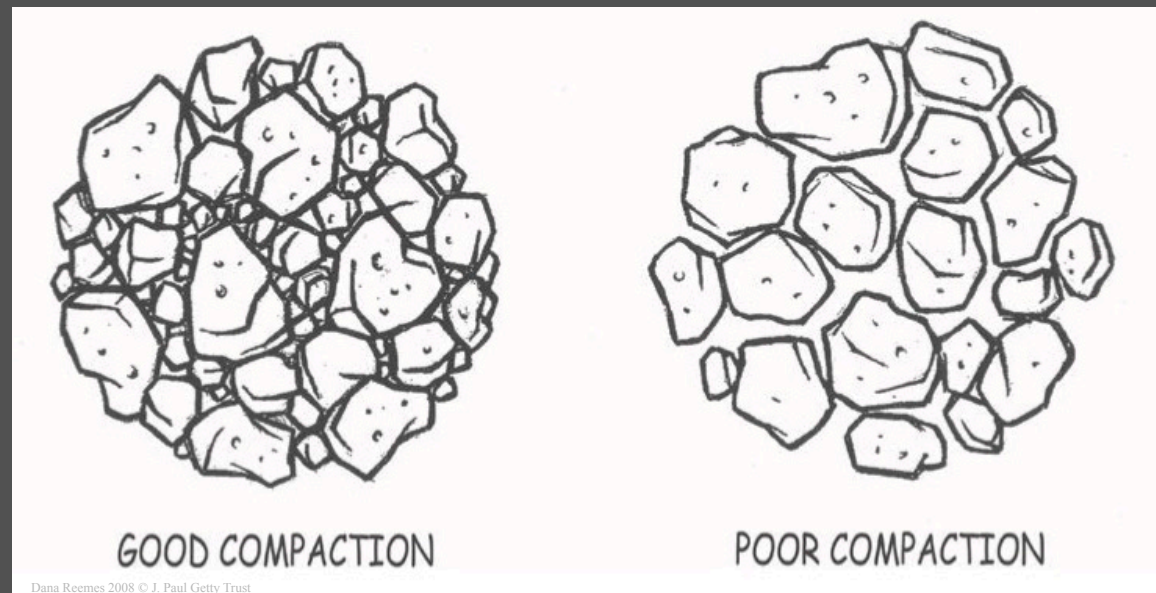
The binder/aggregate ratio is the ratio between the amount of binder and the amount of aggregates contained in the mortar. That ratio significantly influences the properties and the performance of a mortar.

A mortar that contains more lime is called '**lime-rich mortar**'. It is more malleable, easier to work, and more adherent, but it will have a stronger tendency to shrink and crack more easily during setting.

A mortar that contains less lime is called '**lime-poor mortar**'. It is more difficult to work and less adherent, but it will have a lesser tendency to shrink.

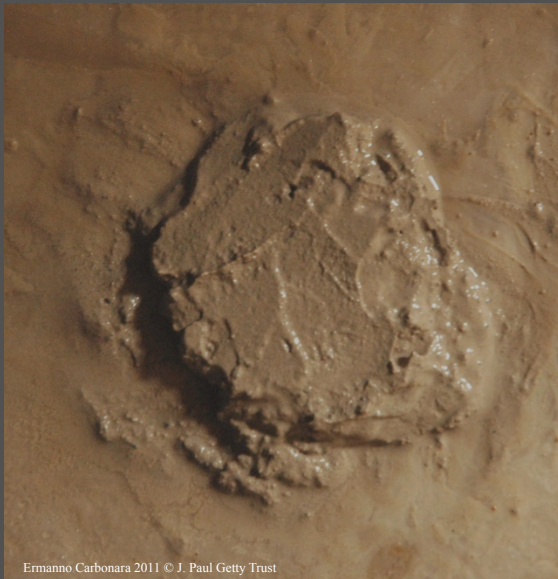
Particle-size **distribution** of aggregates

The particle-size distribution of aggregates influences the properties and performance of a mortar. To make a good mortar, aggregates should have a good particle size distribution between coarse and fine particles.



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Amount of water



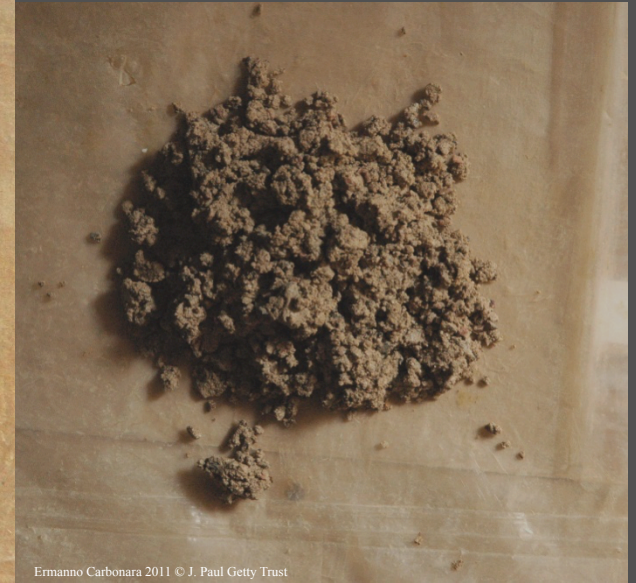
Ermanno Carbonara 2011 © J. Paul Getty Trust

Mortar with too much water



Ermanno Carbonara 2011 © J. Paul Getty Trust

Mortar with the right amount of water



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Mortar with too little water

Color and texture if the mortar will be visible

The visual appearance of a mortar depends on the color of the binder and aggregates.



Beige background mortar and colored particles



White background mortar and black particles

A mortar for mosaic stabilization should consider:

- *Quality* of materials
- *Affinity* with original materials
- *Reversibility*
- *Visual impact*

Quality of materials

To obtain a mortar that is stable and durable over time, binders and aggregates without soluble salts should be used.



Poor quality



Good quality



Poor quality

Affinity with the original materials

A mortar should have a good affinity with the ancient materials and, in particular, it should have a hardness and porosity similar to the materials of the mosaic.



Poor affinity



Good affinity



Poor affinity

Reversibility

A stabilization mortar should be **reversible**; that is, it should be removable without damaging the mosaic.



Not very reversible



Very reversible

Visual impact

The color and texture of a mortar should not stand out. The mosaic surface should always remain visually dominant.



Mortar with a pronounced visual impact



Low visual impact



Mortar with a pronounced visual impact

Formulation of different mortars for different stabilization interventions

Resetting detached tesserae

1 lime putty

½ white sand 0 – 0.5 mm

½ beige gravel..... 0 – 0.5 mm

BINDER : AGGREGATE RATIO = 1 : 1

Parameters for the formulation of a mortar

- Non-hydraulic or hydraulic **properties**
- Binder-aggregate **ratio**
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- **Amount** of water
- **Color and texture** if the mortar will be visible

Filling of voids between preparatory layers

liquid mortar – grout

1 lime putty
1 natural hydraulic lime NHL 3.5

1 brick powder.....0 – 0.25 mm
½ sand.....0 – 0.25 mm
½ stone powder.....0 – 0.25 mm

2 lime putty

1½ brick powder.....0 – 0.25 mm
½ stone powder.....0 – 0.25 mm

BINDER : AGGREGATE RATIO = 1 : 1

Parameters for the formulation of a mortar

- Non-hydraulic or hydraulic **properties**
- Binder-aggregate **ratio**
- Particle-size **distribution** of aggregates
- **Amount** of water
- **Color and texture** if the mortar will be visible

Interstices in-filling

Light color

1 lime putty

1 white sand.....0 – 0.5 mm

1 light beige gravel.....0 – 1 mm

Dark color

½ lime putty

½ natural hydraulic lime NHL 3.5

1 white sand.....0 – 0.5 mm

½ beige gravel0 – 1 mm

½ black gravel0.5 – 1 mm

BINDER : AGGREGATE RATIO = 1 : 2

Parameters for the formulation of a mortar

- Non-hydraulic or hydraulic **properties**
- Binder-aggregate **ratio**
- Particle-size **distribution** of aggregates
- **Amount** of water
- **Color and texture** if the mortar will be visible

In-filling of lacunae – preparatory layer

Thin preparatory layer

2 lime putty

1 sand.....	0 – 3 mm
1 gravel	0 – 1 mm
1 gravel	1 – 3 mm
2 crushed brick.....	0 – 4 mm

Thick preparatory layer

2 – lime putty

4 – natural hydraulic lime NHL 3.5

3 – sand.....	0 – 3 mm
3 – gravel	1 – 3 mm
3 – gravel	3 – 5 mm
2 – crushed brick.....	0.5 – 5 mm
4 – crushed brick.....	5 – 10 mm

BINDER : AGGREGATE RATIO = 1 : 2.5

Parameters for the formulation of a mortar

- Non-hydraulic or hydraulic **properties**
- Binder-aggregate **ratio**
- Particle-size **distribution** of aggregates
- **Amount** of water
- **Color and texture** if the mortar will be visible

In-filling of lacunae - surface layer

Small lacunae

2 lime putty

1 white sand.....	0 – 1 mm
1 beige gravel	0 – 1 mm
1 beige gravel	1 – 3 mm
1 washed black gravel.....	1 – 2 mm
1 light red gravel	2 – 3 mm

Large lacunae

1 lime putty

1 natural hydraulic lime NHL 3.5

1 white sand.....	0 – 1 mm
1 beige gravel	0 – 1 mm
1 beige gravel	1 – 5 mm
1 washed black gravel	1 – 3 mm
1 light red gravel	2 – 4 mm

BINDER : AGGREGATE RATIO = 1 : 2.5

Parameters for the formulation of a mortar

- Non-hydraulic or hydraulic **properties**
- Binder-aggregate **ratio**
- Particle-size **distribution** of aggregates
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Different tools for mixing mortar



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Spatula and small bowl



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Trowel and mortar bucket



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Shovel and wheelbarrow

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MOSAIKON is a partnership of four institutions: the Getty Conservation Institute, the Getty Foundation, ICCROM, and ICCM.

The aims of the project are to strengthen the network of professionals concerned with the conservation, restoration, maintenance, and management of mosaic heritage in the southern and eastern Mediterranean region; provide training to a variety of individuals involved in mosaics conservation and, more generally, with the management of archaeological sites and museums with mosaics; work with national and international bodies to provide a more favorable legislative, regulatory, and economic environment for the conservation of mosaics in the Mediterranean; and promote the dissemination and exchange of information.

