

NANORESTORE CLEANING®

Technical Sheet

OVERVIEW

Nanorestore Cleaning® systems are particularly effective in the removal of oily soils and organic coatings without redeposition into the pores of the substrate. They offer performances not achievable with traditional solvents or solvent gels and represent a new platform for conservation of work of arts. Nanostructured cleaning fluids (water-in-oil microemulsions, micellar solutions) are substantially based on water, with a drastically reduced solvent content while maintaining cleaning effectiveness.

AVAILABLE FORMULATIONS

Nanorestore Cleaning® Polar Coating S: Water-based nanostructured fluid containing an anionic surfactant and a mixture of 1-pentanol, ethyl acetate and propylene carbonate. This formulation is designed for the removal of polymeric coatings, such as acrylic and vinyl synthetic polymers and (aged) natural and synthetic varnishes.

Nanorestore Cleaning® Polar Coating B: Water-based nanostructured fluid containing a nonionic alcohol ethoxylate surfactant and a mixture of methyl ethyl ketone (MEK) and 2-butanol. This formulation is designed for the removal of polymeric coatings, such as acrylic and vinyl synthetic polymers and (aged) natural and synthetic varnishes. This formulation can be safely used when the presence of salts is significant.

Nanorestore Cleaning® Polar Coating G: Water-based nanostructured fluid containing a nonionic alcohol ethoxylate surfactant and a mixture of methyl ethyl ketone (MEK), 2-butanol, ethyl acetate, and propylene carbonate. This formulation is designed for the removal of a wide range of polymeric coatings and (aged) natural and synthetic varnishes. This formulation can be safely used when the presence of salts is significant.

Nanorestore Cleaning® Apolar Coating: Oil-in-water microemulsion containing an anionic surfactant and a mixture of 1-pentanol and xylene. This formulation is designed for the removal of apolar synthetic and natural polymeric coatings.

Nanorestore Cleaning® Test Kit: This kit includes 100 ml of each of the Nanorestore Cleaning® series formulations. It could be used for preliminary tests, in order to choose the best formulation for your specific need.

WHEN ARE THEY USED?

The formulations of Nanorestore Cleaning® can be used for the removal of oily soils, grime or (aged) organic coatings from the surface of (porous) works of art, in order to overcome the drawbacks of traditional cleaning methods (i.e. limited control on the cleaning action of neat organic solvents, spreading of the dissolved material, toxicity issues), or when neat organic solvents do not provide satisfactory results.

OK to be used for

- ✓ Removal of hydrosoluble dirt, grime or dust from mural paintings and stone artifacts
- ✓ Removal of (aged) coatings, such as acrylic and vinyl synthetic polymers and (aged) natural and synthetic varnishes from mural paintings and stone artifacts
- ✓ Removal of apolar material, such as wax, or oily soils from mural paintings

✘ For different applications, it is advised to contact us for assistance. We will be glad to help you in finding the best solution for your conservative need.

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HOW DO THEY WORK?

Nanorestore Cleaning® formulations possess excellent detergency properties thanks to their huge interface and to the combined action of solvents and surfactants. Essentially, nanostructured fluids, such as micelles and microemulsions, promote the swelling and detachment of detrimental coatings from the surface of the works of art, through different mechanisms with respect to those involved in the use of neat solvents, solvents blends or solvent gels. Overall, the spreading of dissolved/detached matter through the pores of the work of art is limited as compared to the direct use of solvents. Moreover, the environmental impact is minimized, and the safety for the operator increased. Finally, all of the Nanorestore Cleaning® formulations can be confined in Nanorestore Gels® allowing for a better control of the cleaning action, and expanding their applicability to water-sensitive works of art – for more details about this application, please refer to Nanorestore Gels® Technical Sheet.

HOW ARE THEY USED?

General features

Nanorestore Cleaning® formulations are designed for the removal of detrimental coatings from mural paintings, stone artifacts or other non-water-sensitive substrates, where they are applied confined in a compress (such as a cellulose pulp poultice). However, they can be also confined in Nanorestore Gels® and applied on water-sensitive surfaces for the cleaning of different classes of works of art. For the application of Nanorestore Cleaning® formulations confined in a gel network, please refer to Nanorestore Gels® Technical Sheet.

Storage

Nanorestore Cleaning® formulations are shipped in HDPE white bottles, in which it is advised to store them. In these containers, the formulations are stable, and can be conserved at room temperature for several months before the use. However, after long storage time, it is advisable to check Nanorestore Cleaning® formulations before the application. Nanorestore Cleaning® Polar Coating S and Polar Coating G formulations are composed of two bottles, one of them containing ethyl acetate, which should be added to the nanostructured fluid right before the application. Once the ethyl acetate is added, the formulations are stable for several weeks. Therefore, it is advisable to prepare only the amount needed for the application. In the following, the formulae to calculate the amount of ethyl acetate to be added as a function of the final volume of the two nanostructured fluids are reported.

Nanorestore Cleaning® Polar Coating S

1. Ethyl Acetate volume = (Total desired volume x 9)/100
2. Nanorestore Cleaning® Polar Coating S volume = Total desired volume – Ethyl Acetate volume

Nanorestore Cleaning® Polar Coating G

1. Ethyl Acetate volume = (Total desired volume x 7)/100
2. Nanorestore Cleaning® Polar Coating G volume = Total desired volume – Ethyl Acetate volume

Safety

Nanorestore Cleaning® formulations have a very low environmental and health impact. In fact, organic solvent, whose amount is usually less than 25% (w/w), are confined as droplets within the surfactant aggregates. Even though, the smell of these systems can be fastidious and some ventilation during the application is advisable. Nanorestore Cleaning® formulations should be handled wearing standard laboratory gloves according to common laboratory practice.

Preliminary tests

In order to check the compatibility between Nanorestore Cleaning® formulations and the original artworks that need to be treated, it is advisable to perform some preliminary tests using a cotton swab soaked into the nanostructured fluid. **In case you notice an undesired effect on the materials of the work of art, do not proceed with the application.** However, it is important to note that a poor result of this preliminary test does not necessarily indicate that the cleaning system will not work in a further application. In fact, Nanorestore Cleaning® formulations are designed to be applied for longer times confined in poultices or gels, therefore they could be poorly effective if applied for a few seconds with a cotton swab.

Application

For the application, Nanorestore Cleaning® formulation should be mixed with cellulose pulp (such as BC200 (average fiber length 0.3 mm) or BWW40 (average fiber length 0.2 mm) Arbocel® powder); usually, for each gram of cleaning fluid 0.3-0.4 g of cellulose pulp are used, to obtain a wet, **but not dripping**, poultice. The wet cellulose pulp should be evenly distributed over a Japanese paper sheet (grammage 8.6-11g/m²) placed in contact with the coating to be removed (**Fig. 1.1-1.2**). Poultice thickness may range from few millimeters to 10-20 mm. For the removal of thin polymer coatings from mural paintings, it can be estimated that 1.5-3 liters per m² are needed. The amount required for the cleaning of stones of other artifacts is strongly dependent on substrate's porosity, nature of the undesired substance and other parameters, thus it is hardy estimable *a priori*.

Reducing evaporation

If the relative humidity is low (RH <40%), a plastic film (e.g. Egapack®, Melinex®, or others) or an aluminum wrap can be placed over the poultice to reduce the evaporation rate of Nanorestore Cleaning® formulation. It is very important to check the solubility of the chosen film in the cleaning fluid before the application.

Application time

Application time strongly depends on the type of material to be removed and on the surface to be treated. In general, application time ranges from 60 to 180 minutes (**Fig. 1.3**). In case of long application, it is mandatory to avoid the drying of the poultice (see above). Note that repeated applications can be performed. In some cases, two or more short applications lead to better results

than a single long application.

Removal and mechanical action (optional)

Depending on the chemical nature of the undesired materials, Nanorestore Cleaning® formulations can directly remove the unwanted material or just swell and soften it. In the first case, the material to be removed migrates into the poultice, thus after its removal the surface appears clean. In the second case, after the removal of poultice, swollen and softened residues of the unwanted material may be present on the surface; in this case, a gentle mechanical action using dry or humid cotton swab is usually enough to maximize cleaning effectiveness (**Fig. 1.5**).

Final clearance

After the application of Nanorestore Cleaning® formulations, the removal of possible small residues of surfactant is recommended. If the surface to be treated is in good conditions, this operation can be performed with a humid sponge (**Fig. 1.7**). In the case of degraded works of art, the final clearance should be carried out using a humid cellulose pulp compress applied over the Japanese paper (**Fig. 1.8**). The compress should be removed only when dry (**Fig. 1.9**). **It is important that this operation is carried out only when the treated area is completely dry.** In fact, if some residues of swollen polymer are left on the surface they can favor the contamination by cellulose fibers coming from the poultice. However, as a general rule, when possible, clearing the surfactant with a water-soaked natural sponge is the best choice. To be sure that all the surfactant is removed from the surface, 2-3 rinsing cycles should be carried out (by using a sponge you will see no more lathering when surfactant residues are completely removed).

APPLICATION GUIDELINES AT A GLANCE

Goggles Yes

Gloves Yes

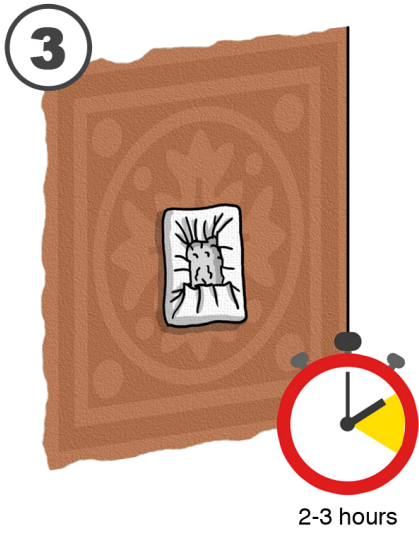
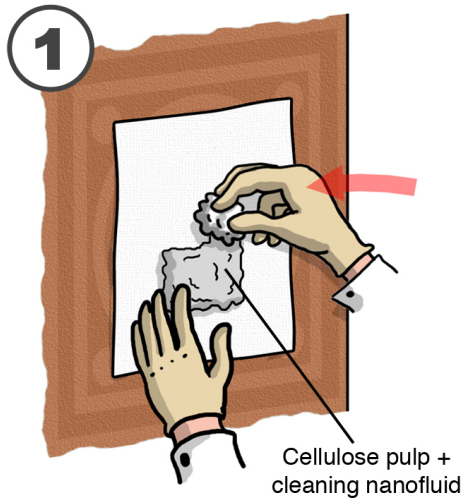
Ventilated hood or environment Recommended whenever possible

Application time 60-180 minutes, depending on the specific case

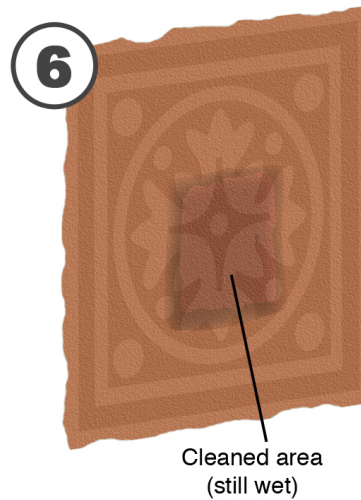
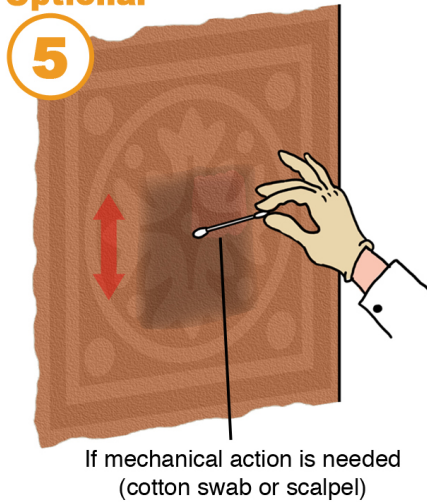
Residues after cleaning Possibly surfactants, removable after final clearance

Final clearance Rinse with water using a natural sponge (for surfaces in good conditions) or a cellulose pulp poultice applied over Japanese paper (for degraded surfaces)

FIGURES



Optional



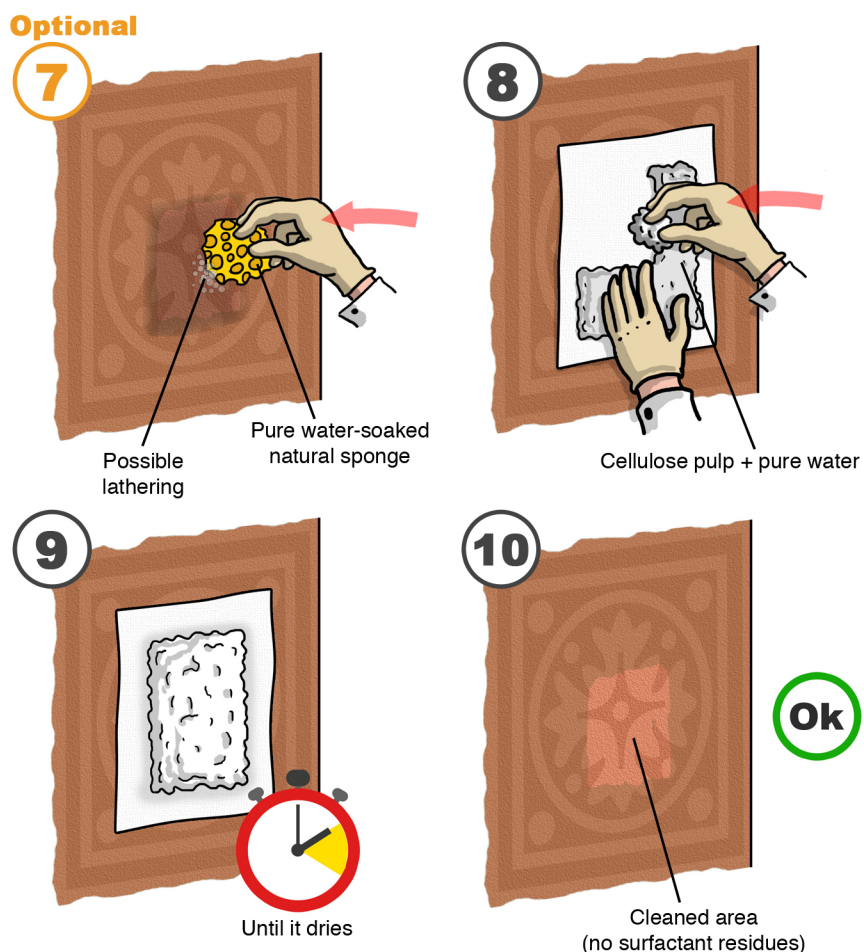


Figure 1. Application of Nanorestore Cleaning®.

- (1) A cellulose pulp poultice soaked with one of the Nanorestore Cleaning® formulations is applied over a Japanese paper sheet.
- (2) The Japanese paper is folded, in order to create a compress, which is easily removable at the end of the cleaning.
- (3) Application time ranges from 60 to 180 minutes.
- (4) The compress is gently removed from the substrate.
- (5) If swollen and softened residues of the unwanted material are present on the surface, a gentle mechanical action using dry or humid cotton swab is usually enough to maximize cleaning effectiveness.
- (6) Now the surface is clean.
- (7) After the application of Nanorestore Cleaning® formulations, the removal of possible small residues of surfactant is recommended. If the surface to be treated is in good conditions, this operation can be performed with a humid sponge.
- (8) In the case of degraded works of art, the final clearance should be carried out using a humid cellulose pulp compress applied over the Japanese paper
- (9) The poultice should be removed only when dry
- (10) The surface is now clean and no surfactant residues should be present.

FREQUENTLY ASKED QUESTIONS

Q Can I reuse Nanorestore Cleaning® formulations after the application?

A Nanorestore Cleaning® formulations cannot be reused; as a matter of fact, after the application, system composition might change, potentially altering the cleaning effectiveness.

REFERENCES

Further information can be found in the following textbooks:

1. Piero Baglioni and David Chelazzi. *Nanoscience for the Conservation of Works of Art*. Royal Society of Chemistry, 2013.

2. Piero Baglioni, David Chelazzi and Rodorico Giorgi. *Nanotechnologies in the Conservation of Cultural Heritage: A Compendium of Materials and Techniques*. Springer, 2014.

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