Monitoring surface blackening and zinc reaction products near Munch’s *The Source* in the Aula at the University of Oslo (2013-2021)

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Introduction

The treatment history of Munch’s eleven monumental and unfinished canvas paintings in the Oslo University Aula (from 1916) spans almost a century. This history charts an extraordinary narrative of rapid and continuous dirt accumulations followed by numerous dirt removal campaigns.1 2 In 1925-26, restorers applied a reverse side coating – in all likelihood as an attempt to stop penetration of dirt from the brick wall behind the paintings. Recent cleaning tests and the findings of the EU-Access, Research and Technology for the Conservation of the European Culture Heritage (EU-ARTECH MOLAB) team also highlight the potential chemical changes that are likely to impact on the paintings.2 3 The surface contaminants comprise materials such as soot, sulphates, silicates, as well as invisible metal soaps and zinc oxalates.4 Measurements of relative humidity (RH) during a rainy summer have shown values up to 85%. High RH is a driving force for the growth of metal soaps, as oxalic acid can be for oxalate patinas. Moreover, the Aula is a listed building that is not sealed and outdoor pollutants will continue to enter.3

Aims

To gain knowledge about the threats and risks related to the ongoing contamination of the Aula paintings we are monitoring surface blackening on canvas samples with white grounds. The aim is to evaluate the development of reaction products from their zinc-white containing recto and verso applications (similar to Munch’s original grounds and the 1925-26 restorer’s reverse side coating). The oxalate-acid content in the air may also be measured.

Sample preparation

The 216 test samples have been made of 3 x 3 cm² pieces of washed and pre-stretched linen canvas.5 All samples received the following recto applications: first a glue priming, followed by one layer of a glue-bound chalk ground (Fig. 1). Finally, and only on the right-hand side of each sample a zinc-white containing chalk layer was applied. In addition, a mixture of zinc white and chalk white was applied to 50% of the samples, with chalk white on the verso (Fig. 2). (For the recipes see Table 1). The 3 x 3 cm² test squares were attached with rust-resistant staples on to nine A4-carboards made of unblended, acid-free cellulose. Each cardboard support has 12 test samples of both types (with and without the verso application). In all, 24 test squares are included on each cardboard (Fig. 3).

Localisation

Between March and May 2013 the test pieces (72 samples on 3 A4 carboards) were located in three places: in the Aula at three different heights near *The Source* (Fig. 4, 7, 8) nearby on an office wall at Conservation Studies covered by a transparent sheet of melinex (Fig. 5); and finally, sealed in a freezer with 18°C as constant temperature (Fig. 6).

Results

In April 2013, two unexposed pieces (c. 10 x 15 cm²) of each of the two top layers (also with and without the verso application) were sent to ISTM-CNR of Perugia for the measurement at T=0 by reflectance mid-infrared spectroscopy. The possible oxalate-acid content in the Aula air may be measured on site during the period that the test pieces are exposed.

Expected outcome

It is hoped that recording of future accumulation of visible surface pollution over a period of eight years will motivate the University of Oslo to continue to improve of the Aula’s indoor climate conditions. Increased emphasis on preventive conservation is integral to this. Furthermore, if a future growth of invisible metal soaps and zinc oxalate can be better understood, we might also be able to identify and restrain the formation of oxalates in the paintings and possible source(s) of oxalic acid in the Aula’s atmosphere.

Acknowledgements

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Notes

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Notes

6 The samples have never been touched without gloves and this routine will be followed throughout.
7 Konica Minolta CM-700d (software SpectraMagic NX pro)
8 See Table 2 for their minimum, maximum and average values.

Table 1 Recipes

<table>
<thead>
<tr>
<th>Glue Size</th>
<th>Recto Primer</th>
<th>Verso Preparation</th>
<th>Third Recto Layer</th>
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</thead>
<tbody>
<tr>
<td>260 ml dissolved glue (same as glue size)</td>
<td>200 ml dissolved glue (same as glue size)</td>
<td>135 ml chalk</td>
<td>525 g dissolved glue (same as glue size) and 497 g chalk</td>
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Table 2 Minimum, maximum and average values

<table>
<thead>
<tr>
<th>Sample</th>
<th>C*</th>
<th>M*</th>
<th>a*</th>
<th>L*</th>
<th>a*</th>
<th>b*</th>
<th>L*</th>
<th>a*</th>
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</tr>
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<tbody>
<tr>
<td>Average</td>
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<td>Max</td>
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</table>

Fig. 1 Washed and pre-stretched linen canvas with glue printing and one-layer of a glue bound chalk ground.

Fig. 2 Application of mixture of zinc white and chalk white on the verso.

Fig. 3 Cardboard with 24 test squares.

Fig. 4 In the University Aula.

Fig. 5 Measurements with colorimeter/spectrophotometer.7 This has been performed prior to placing the ambient test pieces on to nine A4-carboards made of unblended, acid-free cellulose. Each cardboard support has 12 test samples of both types (with and without the verso application). In all, 24 test squares are included on each cardboard (Fig. 3).

Fig. 6 From the mounting of the test samples.

Fig. 7 On an office wall at Conservation Studies covered by a transparent sheet of melinex.

Fig. 8 From the mounting of the test samples.

Fig. 9 Measurements with colorimeter/spectrophotometer.7 This has been performed prior to placing the ambient test pieces on to nine A4-carboards made of unblended, acid-free cellulose. Each cardboard support has 12 test samples of both types (with and without the verso application). In all, 24 test squares are included on each cardboard (Fig. 3).

Fig. 10 Green sheet of the colorimeter measurements.