Attempts to characterise modern oil paintings through simple surface measurements: a case study of works by Karel Appel

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Introduction
Several recent studies have shown the use of surface conductivity and pH measurements of acrylic paints in predicting the extent of swelling during aqueous cleaning and minimizing risks during aqueous cleaning (Ormsby et al. 2013). Conductivity and pH has been less explored in the case of modern oil paints. Although attempts to adjust the conductivity of cleaning solutions to oil surfaces were not successful (Soldano 2014), it was concluded that the ionic activity measured on the surface could still be valuable information about the paint film and help when making conservation considerations.

A case study of works by Karel Appel
Three oil paintings by Karel Appel were selected for this investigation: Grande Fleur de la Nuit and L’Homme, Stedelijk Museum, Amsterdam and Femme et Oiseau, Musee National d’Art Moderne, Centre Pompidou, Paris. The paintings date from 1953 and 1954 and were executed in when Appel was living in Paris. Paintings by Appel provide interesting surface characteristics: impasto medium-rich areas alternating with dry and cracking ones over a wide range of pigments. Similar paint compositions and pigment use have been identified, yet the paint layers respond differently to aqueous swabbing – some surfaces exhibit sensitivity while others do not. The works conserved in Amsterdam have proven to be complex cleaning treatments in the past (Burnstock et al. 2006).

SEM exploration of water extractable ions from surface
Droplets of water used to measure surface conductivity and pH were dried and observed using SEM-EDX. The obtained images are representative of the relative concentration of ions contained in a drop of water after lying on an area of the painting for 1 minute. For example, white paint, presenting a low conductivity produces a much smaller quantity of residues than the blue paint on Grande Fleur de la Nuit.

Results and Conclusion
L’Homme  Grande fleur de la nuit  Femme et oiseau

<table>
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<tr>
<th>Sensitivity</th>
<th>Conductivity</th>
<th>pH</th>
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<th>Conductivity</th>
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<td>6.8</td>
<td>None</td>
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<tr>
<td>Ochre</td>
<td>Very sensitive</td>
<td>310</td>
<td>5.9</td>
<td>None</td>
<td>210</td>
<td>6.0</td>
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<tr>
<td>Ultramarine blue</td>
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<td>1260</td>
<td>5.8</td>
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<td>1040</td>
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<td>Burnt Umber</td>
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Surface conductivity and pH measurements of the paintings were carried out using both deionized water droplets and agarose disks, depending on the fragility and sensitivity of the surfaces. The conductivity measurements on passages of ultramarine paint were the highest conductivity values by far (1000-1260 µS/cm) with comparable values on zones of efflorescence. Selective cleaning of the surface proved to greatly affect the measurements taken subsequently, suggesting that the ions are mostly present superficially and do not originate from the paint itself. Interestingly, some areas of colour presented an increase in conductivity after swabbing. This may also be related to the level and type of soiling present on the surface of the painting.

Despite being very similar paintings, composed of the same paint, by the same artist and at the same time, surface measurements differ greatly. High results might suggest a sensitive paint film, with formation of water-soluble salts (Silvester et al. 2014) or the formation of efflorescence. Inorganic analysis of the paints have revealed the presence of zinc, sulphur and chlorine on most surfaces with additional presence of aluminium on the blue paints, coherent with ultramarine pigments and explaining the highest conductivity values. On the contrary, low results might be the sign of a more protective medium of layer on the paint film and/or lack of superficial dirt. Modern oil paint films are complex and the exact interpretation of the measurements, conductivity or pH, may be difficult. However, when surface phenomena are not necessarily visible by eye or through basic conservation equipment, surface measurements can be viewed as an extra tool prior to intervention. The measurements are simple, cheap and free of risk and can be carried out when access to scientific analysis is not available.

References

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