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Research on the Easel Painting *Emavs* by Ivan Grohar: Material Characterization

During conservation-restoration, the paint layer's response to non-polar solvents and heat revealed that the 131-year-old painting *Emavs*, by Slovenian painter Ivan Grohar (1867–1911), could not have been painted using the traditional oil technique attributed to it. As there are no detailed studies of Grohar's painting technique, and everything indicates the presence of wax in the paint, we decided to conduct a material analysis of the painting.

We examined the painting's surface non-invasively using a portable X-ray fluorescence spectrometer (XRF) and Raman spectrometers (RS). The elemental and material composition (pigments and fillers) of selected areas of the painting was determined. Using optical microscopy, we identified the layers present in cross-sections of the samples (ground and paint layers). We analysed their material composition (binders, pigments, fillers, and degradation products) using Fourier transform infrared (FTIR) and Raman spectroscopy (RS). The results confirmed the presence of wax and oil in the paint and ground layers. To determine the exact types of binders present we examined one sample using gas chromatography coupled with mass spectrometry (GC-MS). The palmitic-to-stearic acid ratio (P/S) revealed that the identified fatty acid esters are characteristic of natural drying oils, suggesting linseed oil was used. The presence of wax was visible on the chromatogram, but we could not determine its type. Using a portable FTIR spectrometer with the reflection technique, we further examined the surface of the painting and confirmed the presence of wax at all examined locations. In addition to the characteristic doublet bands in the methylene group vibration regions, we detected a carbonyl group vibration band, which indicates the presence of natural wax. However, this band could also be due to linseed oil, making it difficult to determine the exact type of wax.

The use of various methods revealed the *Emavs* painting's materials and technique, although the type of wax remains unclear. These findings alert conservators to the possibility of encountering the wax-oil technique in Grohar's works. This technique requires a different approach to conservation and restoration than that used for paintings created using the traditional oil technique. For art historians, the findings offer an interesting topic for researching a previously overlooked and relatively unknown painting technique in the 19th and the 20th Century Slovenian easel painting.

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