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Photo-catalytic degradation of binding media of ultramarine blue containing paint layers. A new perspective on the phenomenon of "ultramarine disease" in paintings.

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Abstract

Failure of ultramarine blue paint layers in historic as well as modern paintings has been reported in the literature many times and is often referred to as "ultramarine disease" or "ultramarine sickness." The pigment itself is known to degrade hydrolytically when exposed to acids, but whether this is the primary cause of the failure remains unclear. This paper describes a study in which ultramarine blue paints using linseed oil and a urea-aldehyde resin as binding media were aged under simulated indoor conditions. The paints were analyzed using reflectance spectroscopy, scanning electron microscopy, and Raman and nuclear magnetic resonance spectroscopy. The urea-aldehyde resin binding medium was analyzed using size exclusion chromatography and Fourier-transform infrared spectroscopy. The study provides evidence of photo-catalytic degradation of binding media of ultramarine blue paint layers via free-radical processes, causing changes in reflectance while the pigment itself remains intact. It is believed that this is the primary process behind the degradation of ultramarine blue paint layers in paintings.

Keywords

Ultramarine disease; photo-catalytic degradation; acid hydrolysis; binder; paint; painting; linseed oil; urea-aldehyde resin; free radical process; hindered amine light stabilizer