An FTIR survey of contemporary pre-primed artist canvases

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Introduction

Historically, fabric supports for easel paintings have been made from linen or cotton fibres and primed using glue or oil-based layers. More recently synthetic fibres have become available for canvases, and synthetic polymer primers are now commonly used as preparatory layers. Many commercially pre-primed canvases are marketed with a 'universal primer' – intended to be suitable for both water and oil-based paints.

The characteristics of pre-primed canvases are being investigated in a collaborative project by the Queensland Art Gallery | Gallery of Modern Art in Brisbane and the Heritage Conservation Centre, Singapore. The study aims to enhance understanding of potential influences of canvas and priming type on conservation care. This presentation reports initial findings characterising binder and fibre type for 53 samples sourced in Australia and Singapore, including four oil-primed canvases.

Sample set

The 53 samples include 19 brands of pre-primed canvas produced in China, Australia, India, The Americas and Europe: Artfix, Claessens, Belle Arti, Frederix, Winsor and Newton, Caravaggio, Sydney Canvas Company, Art Spectrum, Clairefontaine, Mont Marte, National Art Materials, Jasart, Overjoyed (OVJ), Pebeo, Semco, Francheville, Phoenix, Talens and Colorpro. Samples were sourced from canvases sold by the metre, supplied stretched, bound in pads or adhered to paper-based boards. All were primed white except for three black samples.

Results: Fibre analysis

Fibre analysis supported by optical microscopy showed good correlation with the information provided by manufacturers. Most canvases (31) were cotton. Linen was used in 17 samples. Polyester (polyethylene terephthalate - PET) was found in 5 samples, including 2 as a cotton blend (Figure 1). The most visible differentiation between spectra of the two cellulosic fibres was the C=O ester band at c. 1730 cm^{-1} related to pectin content in the sample which is expected to be higher in ramie and flax than cotton (Garside & Wyeth 2003) (Figure 2). Although this simple distinguishing feature appeared a reliable indicator in the current sample group of fresh artists' canvases, it has been observed that this band can be strengthened by the carbonyl groups of oxycelluloses found in degraded materials and so will not necessarily provide consistent data (ibid).

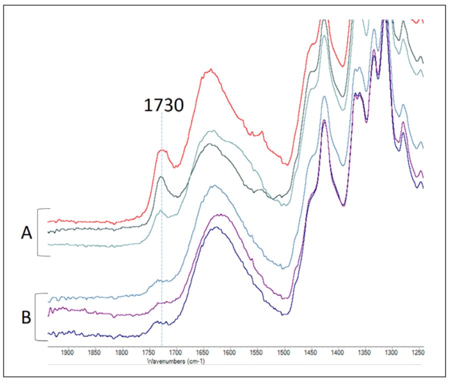

Figure 2. ATR-FTIR spectra comparing carbonyl ester band from linen (A) and cotton (B) canvas samples across a variety of brands.

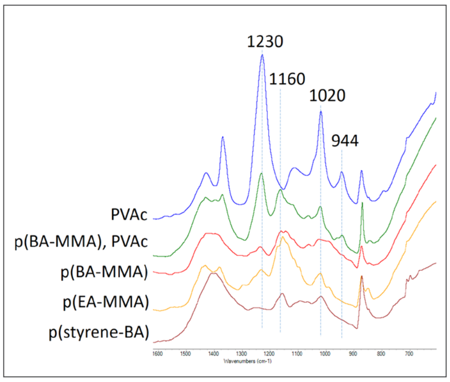

Figure 7. ATR-FTIR fingerprint region for primings highlighting key acrylic/PVAc bands

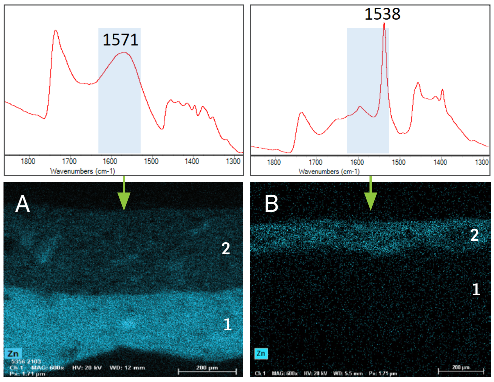

Figure 8. Cross sectional SEM-EDX elemental distribution of zinc and corresponding ATR-FTIR spectra with highlighted metal carboxylate band from surfaces of A. Claessens oil-primed linen; B. Artfix oil-primed linen.

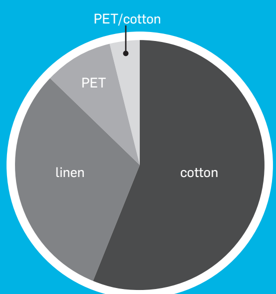

Figure 1. Distribution of canvas samples according to fibre type

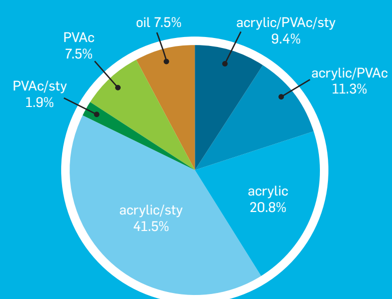

Figure 3. The percentage representation of each binder category as determined by ATR-FTIR

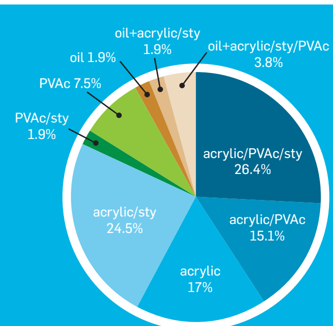

Figure 4. The percentage representation of each binder category as determined by Py-GC/MS. Some results reflect more than one layer of priming

Results: Priming layers

ATR-FTIR analysis of priming allowed characterisation of oil, acrylic, PVAc, and PVAc/acrylic copolymers with and without styrene. Further detail was provided with Py-GC/MS (including the presence of additives – not discussed here). Figures 3 and 4 show comparative data obtained applying the two techniques to the same sample set. The most notable differences relate to the oil-primed canvases and a significantly higher incidence of PVAc detection with Py-GC/MS. The Py-GC/MS results for oil-primed samples (and likely others) incorporate data from lower priming layers of differing composition not captured by the surface-only ATR-FTIR analysis. This reflects the difficulty of physically separating layers of priming when scraping surfaces to obtain sample for Py-GC/MS. The presence of different priming layers within single samples was confirmed by preparation of cross sections (Figures 5 and 6). It is also possible that PVAc detected with Py-GC/MS may be present below the limit of detection of FTIR in some samples, or that acetic acid traces derive from raw supplier or machinery impurities, rather than intentional addition of PVAc.

Acrylic based binders predominate regardless of analytical technique. Py-GC/MS identified numerous combinations of seven acrylic monomers. The most commonly represented copolymers were styrene-BA followed by BA-MMA.

A confident attribution of acrylic/ PVAc using ATR-FTIR required an acrylic peak at c. 1160 cm^{-1} together with PVAc peaks at c. 1230, 1020, and 944 cm^{-1}. Figure 7 illustrates the potential for confusion in copolymers with MMA.

Styrene was prevalent, detected in 62% of primings with Py-GC/MS (two more samples than identified with FTIR). Styrene is associated with yellowing on exposure to UV radiation (Standeven 2011:98).

FTIR detected amorphous zinc carboxylates (broad band centred 1571 cm^{-1}) at the top surface of one sample primed exclusively with oil where zinc oxide was only present in an underlayer, suggesting in situ formation and migration from the lower layer (Figure 8A). Crystalline zinc soaps (1538 cm^{-1}) were detected at the surface of two oil-primed canvases with acrylic/PVAc underlayers and no zinc oxide; zinc stearate was likely a constituent in the priming formulation (Figure 8B). Zinc soaps at the surface of pre-primed canvases may pose a risk to paint adhesion (Osmond 2018).

Initial binder results indicate most preprimed canvases are acrylic. The significant variability in their formulation and the high incidence of styrene and PVAc contrasts with a study of acrylic emulsion grounds by Ormsby et al (2008) and invites further research.

Experimental

ATR-FTIR spectra were obtained from both exposed canvas and primed surfaces of each sample using a Thermo Scientific iN10 microscope with DTGS room temperature detector coupled to an iZ10 diamond ATR bench accessory. Spectra are the sum of 16 scans over wavenumber range 4000-400 cm^{-1} at 4 cm^{-1} resolution. Scrapings of priming were also analysed using Py-GC/MS with a Shimadzu GC/MS QP2020 combined with a Frontier PY3030D pyrolyser unit with autosampler AOC-20i. Pyrolysis conditions: 600°C for 0.2 min; GC conditions 40°C for 5 min, ramped to 300°C at 10°C/min, hold 5 min. Oil-containing samples were derivatised with 3 µl of 25% TMAH in methanol. MS conditions: EI mode (70 eV), scan range: 50-600 m/z.

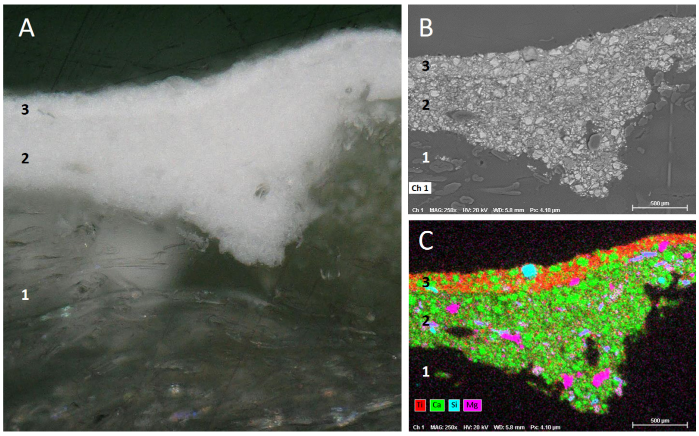

Figure 5. Francheville acrylic primed cotton canvas, p(styrene-butyl acrylate) embedded cross section. A. optical image; B. SEM-EDX elemental distributions of Ti, Ca, Si and Mg; C. SEM backscatter electron image. Layer 1: cotton canvas, Layer 2: chalk, magnesium/silicates (minor), Layer 3: titanium white, chalk (minor).Titanium white is only present in the topmost priming layer

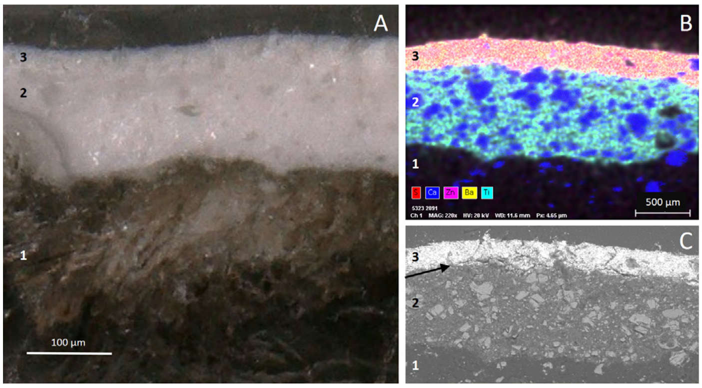

Figure 6. Artfix oil-primed linen canvas embedded cross section. A. optical image; B. SEM-EDX elemental distributions for S, Ca, Zn, Ba and Ti; C. SEM backscatter electron image. Layer 1: linen canvas; Layer 2: chalk, titanium white (acrylic/PVAc/ styrene binder); Layer 3: titanium white, barium sulfate, zinc stearate (oil binder). Arrow indicates cracking at interface of layers 2 and 3

Poster presented at IRUG13, Sydney 2018

Acknowledgement

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