Conservation of two contemporary Chinese woodblock prints with Gellan gum

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Context
Printed by artist Chen Qi just under twenty-five years ago, the two contemporary Chinese woodblock prints showed heavy foxing-like discoloration ranging from light yellow-octre to dark red-brown. A hybrid treatment combining traditional Chinese washing technique with the use of Gellan Gum was developed as a possible alternative for dealing with the particular challenges presented by water-soluble ink on Xuan paper.

Foxing

Foxing is a descriptive term based on a range of visual phenomena rather than on chemical information. Current hypotheses point to multiple causes but one common mechanism – localised cellulose oxidation. Oxidation is a degradation reaction that occurs slowly in pure cellulose but the rate and severity of the chemical process can increase significantly in the presence of a catalyst, such as impurities in paper and contaminants in the environment, as well as stress in the paper caused by local moisture condensation. Oxidation chemistry in cellulose also sets off other oxidation reaction cycles and catalyses acid hydrolysis.

Analysis

X-ray fluorescence (XRF) analysis indicated low levels of iron in both foxed and non-foxed areas of Qin No. 2. Organic origin of foxing could not be confirmed from Fourier Transform Infrared (FT-IR) spectra. Foxed areas tested to be slightly more acidic than non-foxed areas. To stabilise prints, washing, to which help remove catalysts and reactants in the paper and alkaline wash would reduce acidity and intensity of the foxing simultaneously. A reducing agent was to be considered if washing alone did not give satisfactory results.

Method

Humidification

The main challenge was to humidify the prints without creasing. Xuan paper is thin and absorbent and has a tendency to adhere to the support as soon as it begins to absorb moisture. This prevents the lateral movement of the paper as its cellulosic fibres expand and as a result, creates and retains creases. See Fig. 2. To overcome this problem, a traditional Chinese washing method was adapted to wet the print briefly but thoroughly before aqueous treatment.

Washing and reducing

Both treatment produced good results. While some discolorations are still visible, they are much less distracting and the prints show a natural brightness. Localised reducing treatment with sodium borohydride was effective but took longer than reduction on Gellan gel with borane tert-butyllamine. This helps to swell the adhesive layer and releases the linings. Water reservoir gathered on top of the painting is removed by rolling a clean white towel over the surface. Washing is usually done within minutes as Chinese papers are absorbent and the water-soluble ink cannot be wetted for an extensive period of time. Process may be repeated several times depending on the work.

Gellan Gum

Gellan is a polysaccharide produced by fermentation of a pure culture of Sphingomonas elodea. It comes in white powder form and makes gels similar to other rigid gels such as agarose.

Advantages:
- Can deliver moisture and draw out water-soluble degradation products from paper substrate
- Leaves no significant amount of residue after treatment
- Provides rigid support for the fragile Xuan paper during washing
- Rate of washing on the gel is even and controllable, efficiency comparable to immersion
- Accepts additives such as calcium hydroxide for alkaline wash or a reducing agent for reduction
- Can be reused if washed properly
- It has been tested extensively since 2003 by the I.C.A.L. laboratories of Rome with positive results on western prints and drawings.

Modifying Gellan gel

Gellan gel is a stable carrier for water as well as other additives, such as certain enzymes, deacidification agents, reducing agents and water miscible solvents. Gellan gel does not interfere with the effectiveness of additives but gradually releases them with the water from the gel to the paper object in contact. To make alkaline gel:

Gellan gum + calcium hydroxide ✓

To make reducing gel:

Gellan gum + sodium borohydride X

Borane tert-butyllamine was chosen in place of sodium borohydride for its slower and milder action, which did not disrupt gelling of the Gellan gum dispersion. It was also tested to be effective by I.C.A.L. in Rome.

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Artworks on loan from the Museo Educational Trust. Gellan gum sample for this project was supplied by CP Kelco.

References

Fig. 1  Qin No. 2, with extensive foxing especially on top half of print.

Fig. 2  Schematic of humidification.

Fig. 3  Traditional Chinese washing method delivers water onto recto.

Fig. 4  Wetting print on Perspex using adapted Chinese washing method.

Fig. 5  Setup for washing print on Gellan gel.

Fig. 6  Qin No. 2 after treatment.

Fig. 7  Gellan gel is a polysaccharide produced by fermentation of a pure culture of Sphingomonas elodea. It comes in white powder form and makes gels similar to other rigid gels such as agarose.

Fig. 8  Transformation Infrared (FT-IR) spectra. Foxed areas tested to be in both foxed and non-foxed areas of *Qin No. 2*. Organic origin of foxing could not be confirmed from Fourier Transform Infrared (FT-IR) spectra. Foxed areas tested to be slightly more acidic than non-foxed areas. To stabilise prints, washing, to which help remove catalysts and reactants in the paper and alkaline wash would reduce acidity and intensity of the foxing simultaneously. A reducing agent was to be considered if washing alone did not give satisfactory results.