

Gellan Gum:

Investigating Applications as a Solvent Gel

Jayne Vallieres

Master of Art Conservation Program, Queen's University

Introduction

Gellan gum has been introduced as a poulticing material in paper conservation, however little is published about the potential uses of gellan gum as a solvent gel. It is possible that gellan gum can be made into a solvent gel by introducing the solvent into the gel mixture before the gel sets or by applying the solvent onto the surface of the gel before it is applied in treatment. The goal of this research project was to make a usable solvent gellan gum in order to test its effectiveness in removing a very common tape adhesive, aged 3M Scotch #810 Magic Tape.

Experimental

Materials <ul style="list-style-type: none">Legion Stonehenge PaperFabriano Artistico Traditional White Watercolor PaperKelcogel CG-LA Gellan Gum3M Scotch[®] Magic[™] Tape 810Methanol, ethanol, 2-propanol	Sample Preparation <p>The scotch tape was applied to the paper samples before they were placed in the Despatch oven for 18 days at 80°C and 65% RH. After the samples were removed from the oven, the tape carriers were removed to expose the adhesive layer.</p>
Methods of Evaluation <ul style="list-style-type: none">Ultraviolet fluorescence photography was done after each application of gellan gumScanning electron microscopy (SEM) after two applications of gellan gumFourier transform infrared (FTIR) of aged adhesive before and after two applications of gellan gum	Execution of Experiment <ul style="list-style-type: none">Three formulations of 3% gellan gum were made: Control (no solvent), Coated (solvent brushed onto surface of gel), Solvent (solvent incorporated into gel matrix).Three solvents were tested with the gellan gum: methanol, ethanol and 2-propanol.The gellan gum gel was applied and left on each sample for 15 minutes.Each sample underwent two rounds of gellan gum application.



Figure 1: Samples with adhesive side facing up, covered by gellan gum, between Mylar, all under glass.

Results

- The solvent gel was most effective because the tidelines were contained within the area that the gel and paper substrate were in contact
- It is difficult to say which solvent was most effective as each caused the adhesive to move through the paper substrate.



Figure 2: Samples exposed to Ultraviolet light a) before gellan gum application b) after two applications of gellan gum

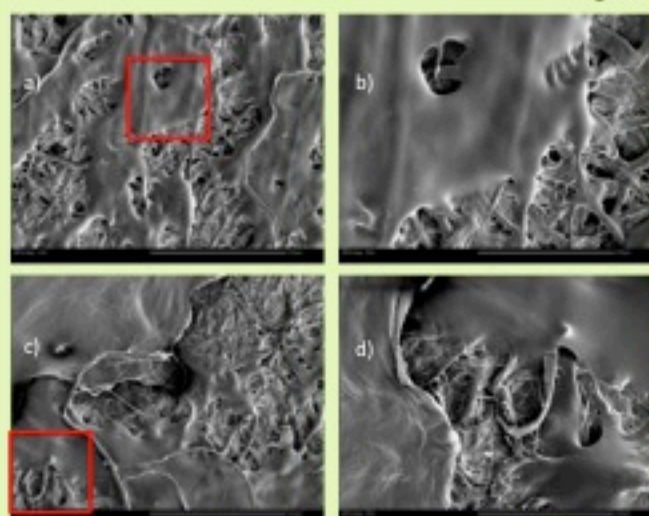


Figure 3: SEM images a) sample SE8 solvent - adhesive mass on paper (100x) b) Sample SE8 solvent - red box enlarged (250x) c) Sample SP8 solvent - gellan gum over adhesive mass on paper (100x) d) Sample SP8 solvent - red box enlarged 250x

- The SEM images show that adhesive residues remain on samples SE8 and SP8. See Figure 3 a) and c). Therefore the gellan gum, after two 15 minute applications, was not effective in lifting the adhesive off the paper substrate. This is also seen with the FTIR spectra below. See Figure 4 a) and b). The prominent acrylate peaks, labeled 'X' are visible on both of the treated samples.
- The gellan gum was effective in moving the adhesive through the paper substrate, creating tidelines visible upon exposure to UV. See Figure 2.
- If the gellan gum is not completely removed from the paper substrate, a residue will remain. See Figure 3 d) where gellan gum was purposely left on the sample. Note the visible difference in texture between the gellan gum and adhesive residues.
- If the gellan gum is fully removed immediately following treatment, it is fairly certain that no residues remain. See Figure 3 a), there is no gellan gum residue on the surface of the adhesive mass. The FTIR spectra in Figure 4 a) and b) also show that the characteristic peaks for gellan gum are missing from the treated samples.

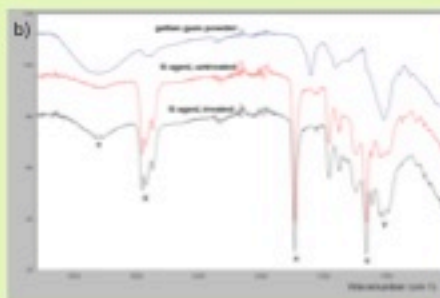
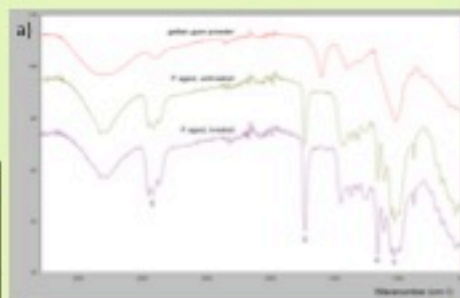


Figure 4: FTIR spectra a) Fabriano Artistico paper with aged 3M Scotch #810 Magic Tape untreated and FP4 treated compared with a spectrum of gellan gum powder b) Stonehenge paper aged 3M Scotch #810 Magic Tape untreated and SP4 treated compared with a spectrum of gellan gum.

Sample Legend

S - Stonehenge paper F - Fabriano Artistico Paper
M - Methanol E - Ethanol P - 2-Propanol
#1-10 indicate the sample within a set of samples

FTIR Legend
X - prominent acrylate peaks
Y - prominent cellulose paper peaks

Conclusion

It is possible to create a solvent gel using gellan gum. The solvent gellan gum was effective in solubilizing aged 3M Scotch #810 Magic Tape, however it appears that along with the poulticing treatment, mechanical means of removal are necessary. Further research could be done to look into the effects of the solvent on the characteristics of the gellan gum gel matrix.

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