Daniela Vogel
Art Conservation Program

The Impact of Microlight™ Microspheres on the Mechanical Properties of the Acrylic Medium High Solid Gel

Introduction

Paint losses in high impastos are a common problem for conservators treating modern and contemporary paintings on fabric supports. Inherent adhesion problems can cause large pieces of paint to delaminate from the support and in the worst case to be lost. The reasons for this is, in most cases, the weight of the material, which makes the support sag, putting paint layers at risk. Therefore, it is important to consider the density of the fill material used when choosing a fill material for an area of loss in thick paint layers.

Low-density bulking agents offer important weight reductions for a given volume of binder. As they are lighter-weight materials made of small, hollow glass, ceramic or plastic spheres, Microspheres promise the greatest weight reduction compared with other low density bulking agents.

The aim of this study was to assess the impact of Microlight™ microspheres on the mechanical properties of High Solid Gel by Golden. The results obtained were compared to those for Becker's Latex Spackle, a commercial acrylic filler, sometimes used for filling losses in thick paint layers.

Experimental

Materials Tested
High Solid Gel (Matte) (HSG)
HSG + Microlight (50% PVC)
HSG + Microlight (60% PVC)
Becker's Latex Spackle

- Microlight by WestSystems is a commercial mixture of inorganic and thermoplastic microspheres of sizes varying from 5 to 75 μm. Its chemical composition is unknown.

- High Solid Gel by Golden Artist Colours is an acrylic gel based on methylmethacrylate/butylacrylate copolymers. It is said to offer lower shrinkage than other acrylic gels and to hold peaks very well.

- Becker's Latex Spackle by Beckers Farg is an unknown acrylic polymer containing calcium carbonate ($CaCO_3$), magnesium peroxide (MgO_2) and talc

Tests Performed
Handling properties – Qualitative analysis of mixing, spreading, holding of peaks, smoothing
Shrinkage behaviour – Thicknesses of the same samples were compared fresh and after 48 hours of drying.
Density – Samples of 20mm^2 were cut out of a casting with a scalpel blade. Length, width and thickness of all samples were measured with a micrometer. The volume was calculated and the mass determined. The density was calculated as follows: $\rho = m / V$.
Ageing – The samples were thermally aged at 70°C at 50% RH for 52 hours and exposed to elevated UV-light intensities in a UV chamber set at a constant 1.10kwm^{-2} intensity and 50°C for 120 hours. (≈ 400 Museum years of natural aging)
Colour stability – This was established in CIELAB space. Seven points along each casting were analysed before and after aging.
Flexibility – This was determined by the Mandrel bending test on unaged and aged samples
Tensile Strength – This was measured on unaged and aged samples using a uniaxial tensiometer.

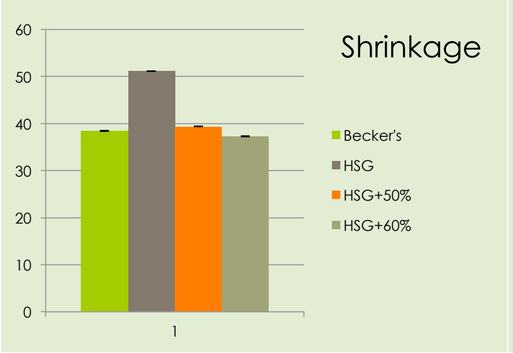
Acknowledgements:
A special thanks to Wendy Baker, George Bevan, Michael Doutre, Ashley Freeman, Richard Gagnier, Eric Hagan, Helen McKay, François Michel, Alison Murray, Golden Artist Colours, and Carr McLean.

Results

Handling Properties & Shrinkage

Becker's	Peanut butter consistency. Ready mixed. Easily spread with a micro spatula. Holds peaks well. Easily smoothed with water. Formation of some drying cracks.
HSG	Mayonnaise consistency. Ready mixed. Easily spread. Holds peaks well. Foams slightly during smoothing with water. No formation of drying cracks.
HSG + 50% PVC	Consistency between HSG and HSG+60% PVC. Mixing difficult. Easily spread. Holds peaks well. Foams far less than HSG during smoothing with water. No formation of drying cracks.
HSG + 60% PVC	Peanut butter consistency. Mixing difficult. Easily spread, but air bubbles form and remain visible after drying. Holds peaks well. Easily smoothed with water. No foam formation, no drying cracks.

Shrinkage & Density



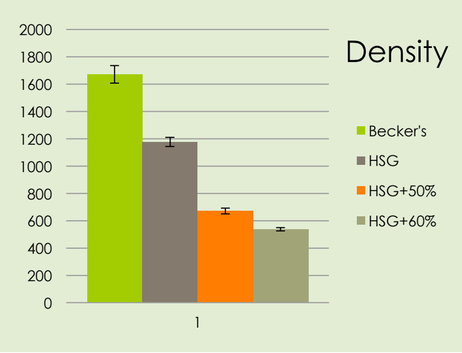


Fig. 1) The Becker's Latex Spackle sample sink s in water, because of its comparatively higher density; the other three samples float.

Colour stability

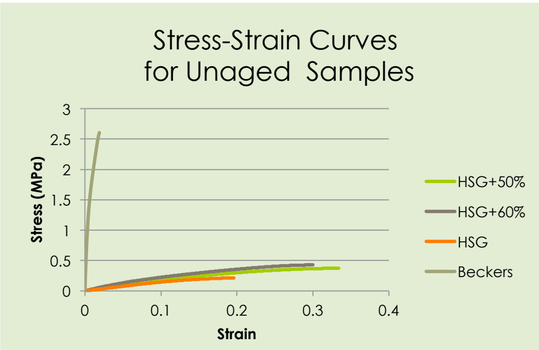
Becker's: $\Delta E^* = 7.2 \pm 0.16$	HSG+ 50%: $\Delta E^* = 14 \pm 0.86$
HSG: $\Delta E^* = 7.0 \pm 0.67$	HSG+60%: $\Delta E^* = 16 \pm 1.5$

Flexibility

Samples failed at a folding radius (in mm):

	Becker's:	HSG:	HSG+ 50%:	HSG+60%:
Unaged	114	Did not fail.	2.36	2.36
Aged	145	Did not fail.	5.91	5.91

Tensile strength



Interpretation:
The tensile strength of Becker's is more similar to that of aged oil paint; that of HSG and its mixtures is more similar to that of acrylic paints.

Fig. 2) Torn HSG + 50% PVC sample during tensile testing

Conclusion

- Adding of Microlight to High Solid Gel (HSG) has an impact on its mechanical behaviour, as well as on its shrinkage and density.
- Whereas HSG samples did not fail during tensile and Mandrel bending tests, the mixtures of HSG with 50% and 60% Microlight did fail.
- Adding 50% Microlight to HSG reduced its density by more than 40%. More than 50% weight reduction per volume was obtained when 60% Microlight was added.
- The shrinkage behaviour of HSG was reduced from 51% to ca. 38% . There was no significant difference between adding of 50% and 60% Microlight.
- In comparison with Becker's Latex Spackle, the handling properties were similar, but those of Becker's were considered to be better; however, Becker's was the only filler that formed drying cracks. The next best results were obtained by HSG+50% Microlight followed by HSG+60% Microlight.
- Shrinkage behaviour between Becker's and HSG mixtures with Microlight did not show significant differences. HSG shrank the most.
- Becker's had the highest density of all fillers. It was 3.1 times higher than that of HSG+60% Microlight and 2.5 times higher than HSG+60% Microlight™
- Colour changes after aging were perceptible. Further tests concerning the chemical stability of the fillers tested need to be undertaken.
- HSG and its mixtures with Microlight were found to have a lower modulus of elasticity than samples of Becker's. Therefore, they are not appropriate for filling losses on aged oil paintings.

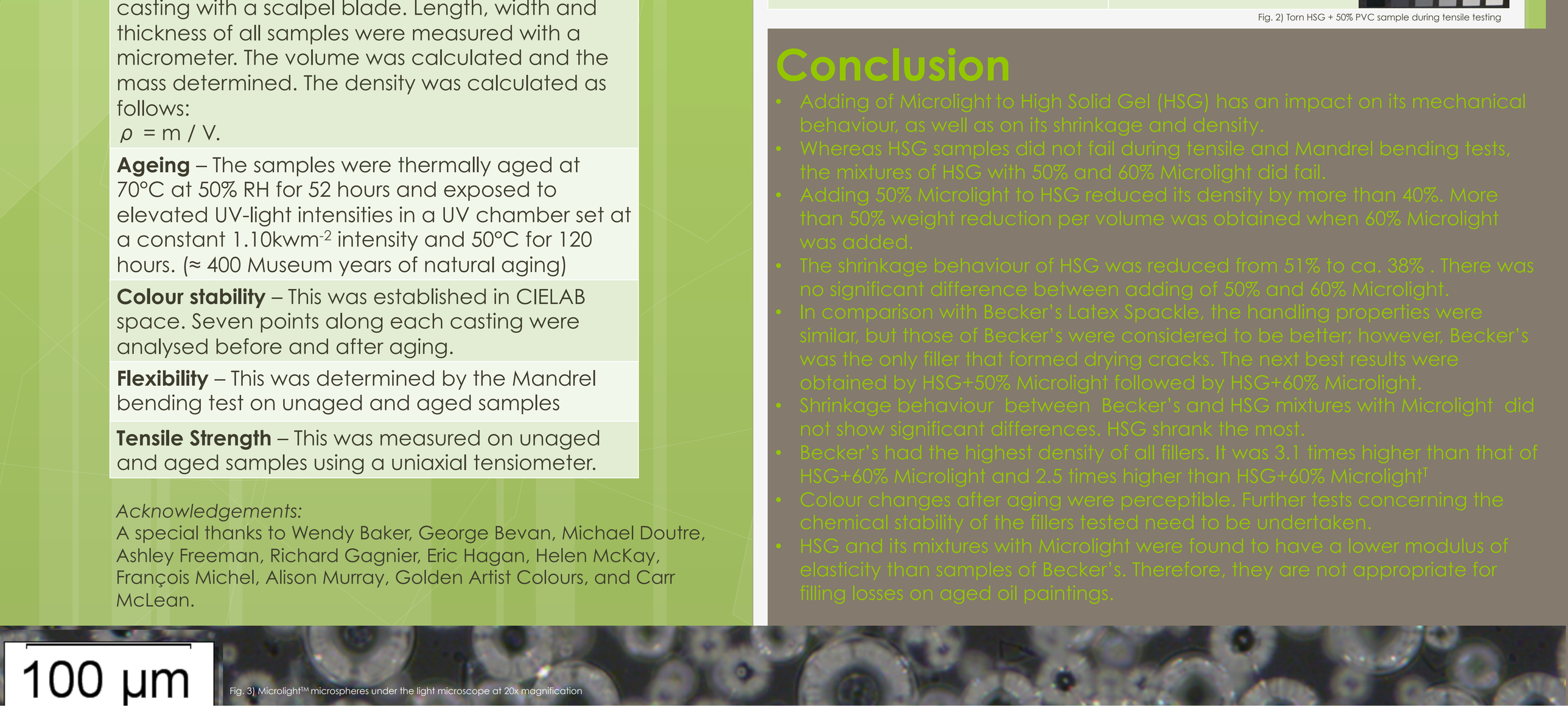


Fig. 3) Microlight™ microspheres under the light microscope at 20x magnification