Extended Abstract—Residues on Unvarnished Surfaces after Absorene Sponge Dry Cleaning

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INTRODUCTION

The accumulation of surface dirt, most commonly deposited through airborne pollutants, is a concern that affects all paintings that are not displayed or stored in glazed and sealed microclimates. A common conservation treatment involves the removal of this deposit, which alters the aesthetic quality of a work of art by shifting contrast and color values of the paint film (Eastaugh, 1990).

Surface cleaning is usually straightforward for paintings that have intact varnish layers, as the coatings protect the paint films and may facilitate the removal of dirt layers. However, removing surface grime from unvarnished artwork is often problematic as unvarnished paint films are frequently sensitive to solvent and aqueous cleaning methods (Perry, 1990; Mills et al., 2008; Ormsby and Learner, 2009). In such instances it is common to attempt dry cleaning techniques, although these also pose risks. Unvarnished paintings may be damaged by mechanical action produced by the manipulation of the cleaning material against the paint surface. Damage may involve abrasion, changes in gloss, dislodgement of pigment from underbound paint, or even future changes resulting from the aging of residues deposited by the cleaning material (Paerlstein et al., 1982; Estabrook, 1989; Sterlini, 1995; Brokerhof et al., 2002; van den Berg et al., 2008). This study examines the potential for residue deposition from Absorene sponges when they are used for dry surface cleaning.

EXPERIMENT

Absorene Dry Cleaning Soot Sponges (as opposed to Absorene Paper and Book Cleaner, which is a different material) are commercial natural rubber sponges that were selected for this study because of their frequent use on unvarnished modern and contemporary paintings. These paintings often incorporate materials such as raw canvas, exposed ground, paint, and paper.

Initial characterization of the sponge using attenuated total reflectance–Fourier transform infrared spectroscopy (ATR-FTIR) showed that the spectrum of the bulk material is consistent with that of natural rubber, with the addition of calcium carbonate. When the sponge was compressed and then released in the FTIR diamond cell holder, a residue was deposited on the diamond surface as the sponge contracted (Figure 1).
This residue exhibited an FTIR spectrum that was not chemically identical to the bulk sponge, but rather was more similar to an alkane material.

The sponge was further characterized by obtaining a thermal profile using evolved gas analysis (EGA). The EGA profile reveals the components in the sponge that are desorbed or pyrolyzed as the temperature is increased. Three distinct regions were exhibited for the Absorbe sponge (Figure 2, inset). The first region is composed of volatile and semivolatile materials, which can be isolated using thermal desorption–gas chromatography–mass spectrometry (TD-GC-MS) and was identified as containing long-chain aliphatic hydrocarbons. This is the material that is referred to here as the residue. The second region is a polymeric material, which was analyzed by pyrolysis-GC-MS (Py-GC-MS) and was identified as natural rubber (isoprene). The third region indicates nonvolatile materials, and a mass spectrum of this region revealed the presence of carbon dioxide, which indicates the pyrolysis of calcium carbonate, a component of the Absorbe sponge identified using FTIR.

The use of TD-Py-GC-MS on Absorbe sponges confirmed that natural rubber (isoprene) is the main component of these sponges as well as a fraction of semivolatile aliphatic hydrocarbons present (Figure 2). In this technique, the volatile and semivolatile components from a sample were thermally desorbed at lower temperatures (between 55°C and 250°C) than used in pyrolysis, thus leaving the bulk of the polymerized and less volatile
components unchanged. The Py-GC-MS was then performed on the remaining material. Most importantly, TD-GC-MS allowed the separation and analysis of components of the sample that generally would be lost in the multitude of peaks generated in a typical pyrogram because of their low concentration and, in general, lower molecular weight.

Test samples of paper of various textures, cotton duck, primed cotton duck, and painted cotton duck were prepared. These samples were then rubbed with Absorene sponges. The amount of pressure and rubbing time was varied in order to establish under what conditions, if any, residue deposition could occur. Rubbing duration and pressure was carried out at potential treatment levels and at longer and harder levels than normal treatment would generally involve (5, 20, 30, and 60 s at soft and hard pressure) in order to establish if residue deposition could be detected. All samples were brushed in order to remove loose particulate matter deposited by the sponge and then were examined under the microscope before analysis.

**DISCUSSION AND CONCLUSIONS**

This preliminary study shows that the aliphatic hydrocarbon material may be retained on some substrates when Absorene sponges are used to remove surface deposits. The results showed that with an increase in time and/or pressure there was an increase in deposition of the material on all surfaces tested (Figure 3). The rougher, more absorbent surfaces seemed to have more deposition than the smoother surfaces. Since Py-GC-MS of some of the samples with the most deposition did not show the presence of isoprene, it appears that the aliphatic hydrocarbons detected by TD-GC-MS are not produced from microscopic particles of the sponge. An investigation of potential submicroscopic particles is ongoing.

Although aliphatic hydrocarbons are essentially unreactive, their presence as residues could potentially change the chemical properties of a surface. This could result in increased hydrophobicity, which, along with changes in surface roughness, could affect the attraction potential of the surface for airborne grime. The amount of residue appears to decrease with decreasing pressure and duration of sponge application. Rougher, more absorbent surfaces (unprimed cotton duck and paper) exhibited greater residue deposition than smoother, less absorbent surfaces (primed cotton duck and paint). Deposition, therefore, may be contingent on characteristics of surface roughness and/or absorbency. Further research is required to increase our understanding of these phenomena.

**REFERENCES**


