
Capturing Dust: Microscopic Examination of Vellux® Fabric Used in Modern and Contemporary Paintings Conservation

by Jia-sun Tsang and Stephanie Barnes

Surface cleaning is typically the first, and sometimes only, course of action for the conservation of modern and contemporary artworks. In our work at the Museum Conservation Institute (MCI), we have found that Vellux fabric effectively removes dust and other deposits from painting surfaces without the problems and risks posed by liquid cleaning agents. This article will describe our use of Vellux fabric in combination with a HEPA vacuum for dry cleaning the surface of paintings.

We used this method to collect dust samples from paintings in two major exhibits. We then examined the samples to track patterns of dust deposition and to study the chemical and physical structure, and absorptive and abrasive properties of Vellux fabric. We hope this information will help other conservators develop cleaning techniques using Vellux fabric, tailored to their specific projects.

Introduction

Dust and airborne particulates are a persistent concern for museum professionals (1-4). Dust can make a paintings collection seem inadequately maintained, obscure the artist's intent and elements of the design, and contribute to chemical degradation of the paint media and support. Furthermore, dust can trap water vapor, contributing to staining, corrosion, mold, and mildew on paint surfaces.

Modern and contemporary paintings in particular often cannot be safely cleaned with water or other solvents. Cleaning solutions can drive the dirt deeper into uneven and unprimed supports, leach components from the paint film, and disrupt sensitive paint, mixed media, and collage elements. Conservators often use commercially available surface cleaning sponges and fabrics to remove dust and other deposits from the surface of artworks.

Yet despite their ubiquitous use in conservation, there is surprisingly little technical information on these cleaning materials (5-9). Conservation specialists have, of necessity, developed their own particular techniques and materials for dust removal to safeguard the objects under their care (8-10). For instance, removing dust from historic textiles presents different challenges than dusting an unvarnished painting with a soft, matte surface.

Dusting lightly with a soft, long-bristle brush works sufficiently well for a varnished painting, especially one that is heavily varnished. However, removing dust from complex modern and contemporary paintings is uniquely challenging due to the nature of modern synthetic paints, mixed media, and the artworks' often unconventional assembly and construction. New cleaning tools and techniques are needed to address the inherent complexities of these artworks and to protect the paint's physical and chemical integrity.

Dirt and Dust in Museum Exhibits

Dust is a reality of exhibit maintenance, and its proper removal is an integral part of the activities and training of building management, collection care staff, and preventive conservators. Highly attended exhibits naturally accumulate

the most tracked-in dirt and dust from visitors' clothing and footwear, as well as dust and particulates dispersed from the building's HVAC system (10-11).

It requires a team of museum collection specialists and conservators to routinely remove dust and check the condition of vitrine and frames. An optimal indoor climate (temperature 70°F ± 4°F; relative humidity 45% ± 8%) in combination with a clean and well-maintained air-handling system can reduce, but not wholly eliminate, dust (12).

Conservators use many tools to dust artworks: hake brushes, microfiber dusting cloths, microfiber-covered dusters with extendable arms, microfiber cloths made for cleaning electronic devices, cosmetic sponges, Mr. Clean™ Magic Erasers, and lint-free cotton pads, among others (5-9, 13).

In the last two years, members of the MCI paintings conservation team have used Vellux fabric to dry clean the surfaces of paintings in two large exhibits of modern and contemporary paintings and painted artworks at Smithsonian Institution galleries. Conservators of modern and contemporary art often borrow tools and techniques from conservators in related disciplines, such as anthropology, archaeology, paper, objects, and textiles. Using Vellux fabric to remove dust from paintings was adapted from the conservation of historic textiles, archaeological objects, fragile beadwork and basketry (14), and 3-D art installations. We have found this method so successful that Vellux fabric has become a staple of our surface-cleaning toolkit.

Use of Vellux Fabric in Paintings Conservation

Vellux fabric is a hypoallergenic, nonwoven, synthetic product often used as blanket material. Patented in 1970 (15) and trademarked in 1972 (16), the fabric is commonly sold as WestPoint Home Vellux blankets. It consists of a double inner layer of closed-cell polyurethane foam secured around an inner network of 100% terylene polyester webbing, with outer surface layers of flocked 100% nylon fiber. The diagram illustrates the internal structure of Vellux fabric as seen by our microscopic examination, which is consistent with product patent information.

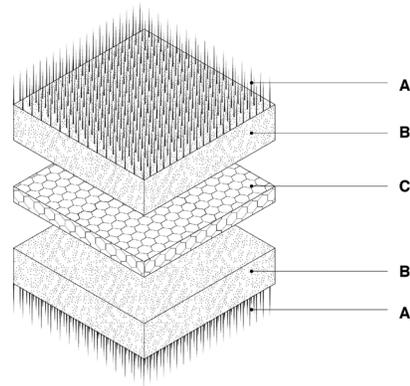


Fig. 1. Cross-section of Vellux fabric showing (A) flocked nylon fiber, (B) polyurethane foam, and (C) polyester membrane

Capturing Dust: Microscopic Examination of Vellux® Fabric, continued

This construction results in a material that will not stretch or shrink (< 1%), does not fray or easily shed fibers, and will not absorb moisture (15). Vellux fabric is about a quarter of an inch thick and has a distinctive airy, light, and soft feel. Care must be taken when purchasing products made of this fabric, as imitations sold online are of inferior quality or made from different materials.

For paintings conservation, we secure a layer of Vellux fabric over the nozzle of a vacuum cleaner with rubber bands or twine, providing a filter to trap dust and dirt as well as a soft barrier between the vacuum nozzle and the paint surface. A vacuum cleaner with a high-efficiency particulate air (HEPA) filter is recommended, as it releases less dust back into the air than a traditional vacuum cleaner. We also advise using a vacuum with adjustable suction, such as a Nilfisk vacuum with a rheostat, when working in close proximity to collections objects.

A layer of rigid plastic netting can be secured under the Vellux fabric so that the improvised filter will not collapse under vacuum pressure. A hake brush can be used to direct the dust toward the Vellux-covered vacuum nozzle. We have tested this device in our conservation practice, both in direct contact with the surface of artworks with robust paint films and with no direct surface contact. We also use Vellux fabric alone to dry-dust frames.

The main advantage of using a Vellux-covered vacuum nozzle over a dusting cloth or brush is that it collects loose dirt rather than redistributing it. Also, the Vellux fabric's tiny, soft nylon bristles do not catch or pull well-adhered paint, while its middle polyurethane layers trap soil. Vacuum cleaner micro-attachment kits are available with several small nozzles that are particularly useful for removing dirt embedded in small gaps in the paint.

A further advantage is that dirt trapped in the fabric filter can be examined microscopically to identify the source of the dust and to track patterns of deposition within the gallery space.

Microscopic Examination of Clean and Soiled Vellux Fabric

The following images show both the physical structure of Vellux fabric and the pattern of dust captured within the fabric's structure. We used our Canon G12 lab camera for macrophotographs, an in-house digital Hirox KH-8700 microscope to capture photomicrographs, and a Hitachi S-3700 N scanning electronic microscope for imaging and elemental analysis of soil samples.

The dust samples were collected from the exhibit *Kay WalkingStick: An American Artist* at NMAI (Nov. 7, 2015 to September 18, 2016) and the NMAAHC's Visual Art Gallery (Nov. 2016–present). These two highly attended exhibitions attracted visitors in multiple seasons in indoor environments set at the standard temperature (70°F ± 4°F) and relative humidity (45% ± 8%

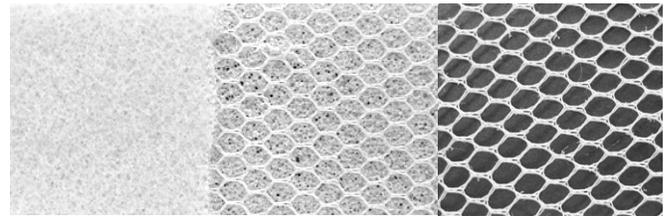


Fig. 2. Vellux fabric surface (left) with the top layer peeled back to expose the polyester webbing and inner polyurethane layer (center), and the middle layer of polyester webbing (right).

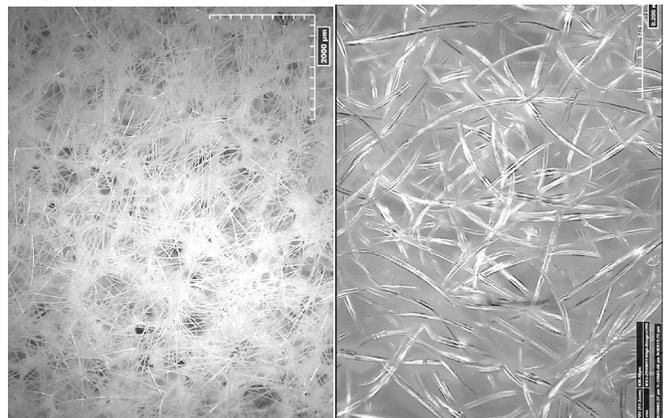


Fig. 3. Clean Vellux fabric showing surface layer of nylon bristles over polyurethane foam (left). Nylon bristles shown at high magnification (right). Individual fibers are approx. 0.02 mm in diameter.

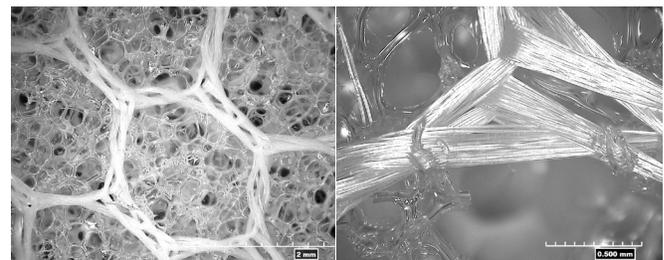


Fig. 4. Clean Vellux fabric showing exposed polyester webbing and layer of polyurethane foam visible below (left). High magnification of polyester webbing (right).

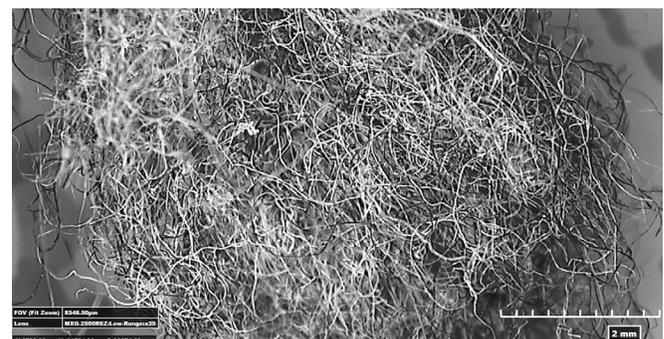


Fig. 5. Fibers collected on the surface of Vellux fabric. These fibers are too large and tangled to pass through the nylon and polyurethane layers of Vellux fabric.

Capturing Dust: Microscopic Examination of Vellux® Fabric, continued

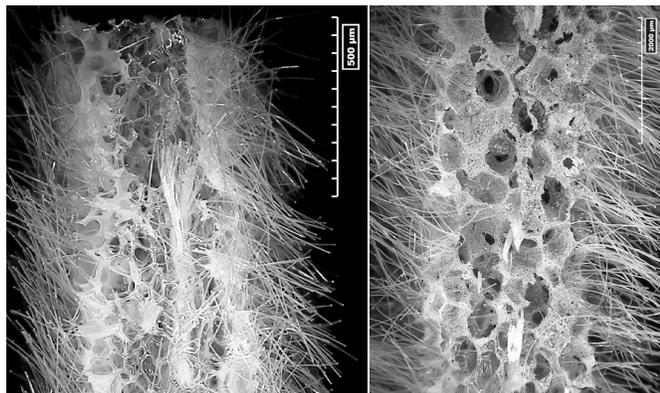


Fig. 6. Cross-section of clean (left) and soiled (right) Vellux fabric. Captured dirt is primarily visible in the layer of polyurethane foam.

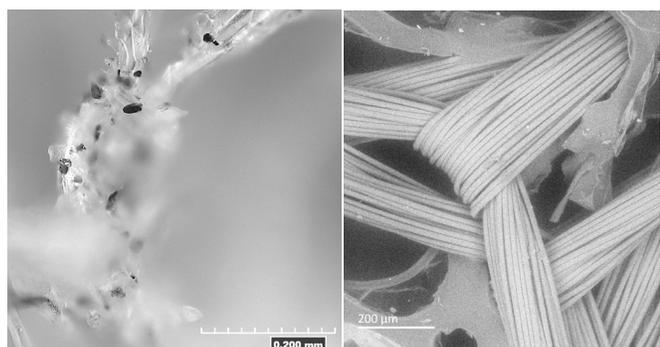


Fig. 7. Photomicrograph showing dirt captured in nylon bristles of Vellux fabric.

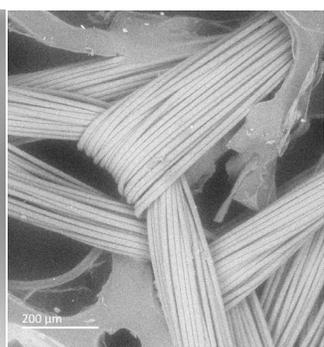


Fig. 8. Dirt particles captured in the polyester webbing of Vellux fabric. *Photomicrograph by Thomas Lam.*

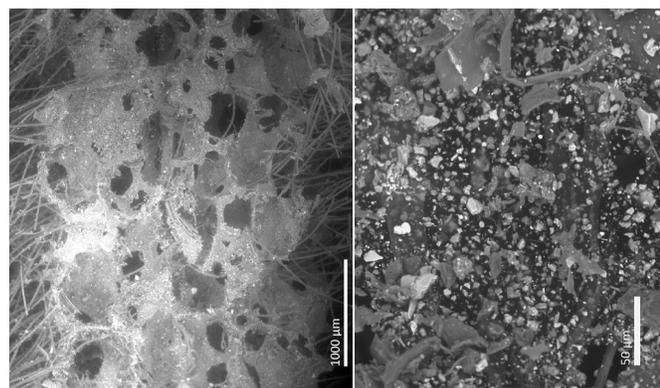


Fig. 9. Soil trapped in pores and channels of Vellux fabric's polyurethane membrane. *Photomicrograph by Thomas Lam.*

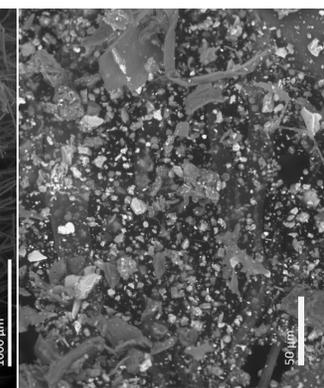


Fig. 10. Soil particles trapped in pores and channels of Vellux fabric's polyurethane membrane are predominantly Na, Mg, Al, Si, K, and Ca. *Photomicrograph by Thomas Lam.*

Discussion

The cross-section and close-up of the three layers of Vellux fabric, shown in the photomicrographs captured with a Hirox-KH-8700 microscope, are consistent with the diagram represented in the original patent, and FTIR analysis is consistent with the product's stated composition (13, 15).

The layers consist of an inner core of terylene webbing surrounded by polyurethane foam and finished with a surface of flocked nylon fibers approximately 0.02 mm in diameter. These tiny fibers act as microdusters when in contact with the surface of an artwork. The fibers are so soft they leave no visible abrasions or burnished marks on the paint surface. (Microscopic examination of the paint surface was not possible because paintings are still on display.)

Particulates are collected and stored in the double layer of polyurethane foam. Larger fibers from visitors' clothing and shoes cannot penetrate this membrane and collect on the surface of the Vellux.

SEM-EDX examination shows dust held in the polyurethane foam membrane that includes microscale particles of aluminum, silicon, and calcium.

We investigated several methods for using Vellux fabric in paintings conservation. A Vellux-covered vacuum nozzle can be used in direct contact with frames, strainers, and paint surfaces, provided the paint layer is stable and well-adhered. A vacuum with adjustable suction, such as a Nilfisk with a rheostat, provides an extra measure of control and should be used on its lowest setting. Vellux's surface layer of nylon fibers is soft enough to brush over paint surfaces without creating abrasions or burnished marks.

Alternatively, the Vellux-covered vacuum nozzle can be held slightly above the paint surface, and the rheostat can be adjusted to gently suction dirt without direct contact with the paint surface. A soft brush can be used to direct dirt toward the vacuum nozzle.

We found that both methods worked well for routine dirt removal in our galleries. Neither method is suitable, however, for use on very lean or powdery surfaces where original material can be disrupted, or for works with soft or sticky surface components.

Machine-washing and reusing Vellux is a matter of concern. Microscopic examination of used Vellux fabric indicates that dirt is not only trapped in the polyurethane membrane, but also adheres to the polyester webbing and nylon bristles.

The distribution of dirt in all three layers of Vellux fabric, and its tight adherence to fibers, suggests that machine-washing will not sufficiently remove deeply embedded dirt from Vellux fabric. Thus, at this time we cannot recommend that Vellux fabric dusters be washed and reused for conservation purposes.

Capturing Dust: Microscopic Examination of Vellux® Fabric, continued

However, since using a Vellux duster once and discarding it is neither frugal nor sustainable, we plan to repeat our examination of soiled Vellux fabric, using samples soiled with dust, insects, and mold, to see if there is a cleaning method or product that could render used Vellux dusters clean enough for repeated use.

Materials and Suppliers

HEPA filter vacuum cleaners are available from laboratory supply companies such as Lab Safety Supply, P.O. Box 1368, Janesville, WI 53547-1368, (800) 356-0783, and Nilfisk of America, 300 Technology Drive, Malvern, PA 19355, (213) 647-6420.

Vellux is available at [amazon.com/Vellux-Original-King-Blanket-Ivory/dp/B002KFZ4JU](https://www.amazon.com/Vellux-Original-King-Blanket-Ivory/dp/B002KFZ4JU) (accessed August 9, 2017).

Instrumental Methods

Hirox Microscopy

Photomicrographs were captured with a Hirox KH-8700 digital microscope with a 2.11 megapixel CCD sensor camera and high-intensity 5700K LED light and an MX (G)-2500 REZ lens.

The microscope was used to capture high-magnification images of clean and soiled Vellux fabric, with variable depth of focus, and to take measurements. Cross-sections were mounted on double-sided tape and examined unembedded.

Scanning Electron Microscopy

Imaging was carried out using a Hitachi S-3700 N variable pressure scanning electron microscope, operated in variable pressure mode with a working distance of 10 mm and an accelerating voltage of 7–15 keV for most samples.

Elemental analysis was executed using a Bruker XFlash 4010 energy dispersive spectrometer. Samples were uncoated and unembedded. SEM was used to capture high-magnification images of Vellux fabric's structure and embedded dirt.

FTIR Spectrometry

FTIR analyses were carried out using a Thermo Nicolet 6700 Fourier transform infrared spectrometer with Golden Gate diamond cell ATR. Spectra were referenced to the IRUG database of artists' materials and the HR Hummel Polymer and Additives library.

FTIR analyses confirmed that the chemical composition of our Vellux samples was consistent with published patent information.

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