

A Hand-held Surface Suction Device: Design, Construction, and Application

ABSTRACT

Since the 1970s, suction devices have been used for the treatment of works of art on paper. Over the last three decades the concept of using suction in conservation has been accepted not only by paper conservators but also by conservators in other specialties.

Over time, the suction table has evolved into smaller suction devices for use in conservation treatments such as local stain reduction and washing. However, the existing devices have limitations: the treatment of mounted objects, objects on thick paper supports, or objects with sensitive media is restricted. Using the basic theory of suction-aided stain reduction, a hand-held suction device was designed and constructed that eliminates the disadvantages of traditional tabletop suction devices by introducing suction to the surface of an artifact to pull staining up and away from the support, rather than through it.

INTRODUCTION

Suction tables have assisted in the removal of stains and discoloration in works of art on paper since the 1970s. Their use is straightforward: a work of art is placed on a table constructed with a pattern of holes large enough to pass a liquid and draw air by means of a vacuum pump. Stain-reducing solvents are applied to the discolored area of the artifact and a vacuum pump pulls the solvent through the stain downward through the paper support and into a paper blotter that is resting beneath the object, taking degradation products with it (fig. 1).

Since the 1980s, suction table designs have been modified into smaller devices, such as suction platens and suction disks, for use in localized conservation treatment. The devices are useful for treating objects that cannot or need not sustain overall suction or aqueous treatment.

These devices are now used as a matter of course to conserve books, photographs, paintings, and textiles. Conservators use the devices to hold objects flat during treatment, and to wash, flatten, line, leafcast, and remove backings and adhesive.

Although these devices are enormously effective in many applications, they are of limited use in the treatment of mounted objects, objects on thick substrates, and objects with sensitive media. To overcome such limitations, a hand-held suction device was designed that significantly aids in the treatment of works of art on paper that have these specific treatment limitations. Using the device, it is possible to perform local treatments to the surface of a work of art by pulling solvents and discoloration away from the top surface of the object rather than through the substrate (fig. 2). This approach is useful for treating objects that require stain removal yet structurally do not allow, or cannot withstand, the pulling of the stains and solvent through the paper support. Mounted objects, objects on thick paper supports, or objects with sensitive media will benefit from stain removal with this device. Conservators can now choose to reduce stains that appear to sit on the surface of permeable papers using this hand-held suction device rather than pulling the stain through the unaffected parts of a support.

HISTORICAL BACKGROUND OF THE USE OF SUCTION DEVICES IN CONSERVATION

Conservators have used suction devices in treatment of works of art on paper for three decades. In 1974, Marilyn Kemp Weidner published an article titled "A Vacuum Table of Use in Paper Conservation" in the *Bulletin of the American Institute for Conservation* outlining the concept of suction use in paper conservation. In it, she described the construction of a suction table and how it might be used to treat paper artifacts. Vacuum pressure holds an artifact in place while a solvent is pulled through it and into an exhaust tube. Weidner constructed the first suction table at

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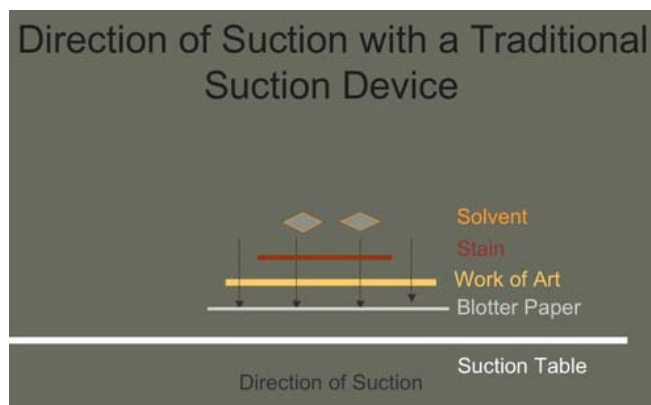


Fig. 1. Direction of suction on a suction table

the State University of New York Conservation Program, then in Cooperstown, New York (Widener 1984).

Since then, paper conservators as well as conservators in other specialties have accepted the use of suction in conservation. Widener's sample suction table inspired the design of a variety of devices that attach to a vacuum pump. Commercially available engineer-designed tables and individual practitioner-designed tables have become standard in conservation laboratories. In addition, smaller devices such as platens—used for book work and for convenient bench-top localized work—have been devised. The commercially available suction tables are extremely expensive. Because of this, many conservators design their own tables using materials from hardware stores. All of the designs have included the use of a vacuum or air pump, a filtering surface, and a support box to hold the filter while creating a plenum space. Materials used for the filter have included wire cloth, high-density polyethylene filter, fritted glass, and aluminum honeycomb panel, while the support boxes have been constructed using lumber, glass, stainless steel, and aluminum sheeting.

DESIGN AND CONSTRUCTION

A prototype of the hand-held surface suction device was built to experiment with the desired design and function of the handle. Multiples of the handle were cast in resin using the shape of an existing object as the pattern for a silicone mold, then a metal nozzle was fabricated for the mouth of the handle. The finished product attaches to a vacuum tube that is in turn connected to a positive displacement vacuum pump (figs. 3–4). The exterior shell of a Bissell TO GO Grab'n Go Cleaner, a carpet-cleaning device, was used for the prototype handle, as it was ergonomically pleasing. The shape of the handle was altered by building up areas with Ciba Araldite 1253 epoxy adhesive. This step was repeated until the desired smoothness, shape, and ergonomic fit was achieved.

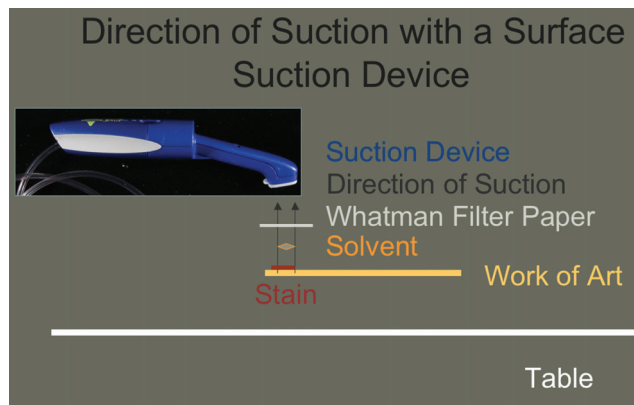


Fig. 2. Direction of suction with a hand-held suction device

To make multiples of the hand-held suction device, a negative mold, or pattern, of the handle was cast (fig. 5). To prepare the prototype for positive casting, a negative mold of the prototype was cast with Smooth-On Mold Max 30 silicone rubber. The liquid silicone mixture was poured evenly and slowly into the mold wall. Once the first half of the silicone rubber cured, the mold was released and inverted. The process was repeated to fashion the second half of the two-part mold. Once cured, the mold was released and the prototype was removed.

Using the mold, a positive replica of the handle was cast with Smooth-On Smooth-Cast 300, a polyurethane casting resin chosen for its chemical resistance to the organic solvents commonly used for stain reduction in paper conservation (fig. 6).¹

After the polyurethane cured to produce a smooth and hard surface, Teflon tubing, which was inserted through a recess in the mold prior to casting,² was friction-fit into tubing that attaches to a vacuum pump using a Banjo-clip coupling. The hand-held suction device attaches to a Gast 1023 vacuum pump, a positive displacement pump (fig. 7). This type of pump is commonly used for suction and vacuum/hot tables found in most conservation labs as it produces high air pressure and low movement of air. The



Fig. 3. Hand-held suction device, top



Fig. 4. Hand-held suction device, side

high vacuum pressure facilitates the migration of the liquid solvent through the paper base, and in this case, through the handle.

Airflow is affected by the thickness and porosity of the paper support and the cotton blotter paper used during treatment. A three-layer filter that fits on the end of the nozzle creates a plenum space. When vacuum pressure is applied to the surface of the work of art, air flows laterally through the layers of the filter. The nozzle for the device was constructed by formatting a three-inch diameter spice funnel. The narrow end of the funnel was adhered with epoxy into the mouth of the polyurethane handle. The three-layer filter was assembled with silkscreen fabric, mesh wire cloth and a stainless steel sink strainer held into place with epoxy at the wider end of the funnel.



Fig. 5. Cured silicone rubber mold with prototype



Fig. 6. Handle cast in polyurethane resin

APPLICATION

Once constructed, the hand-held suction device was used to treat a variety of works of art on paper. In the treatments, use of a device that draws suction from above rather than downward proved indispensable.

A Watercolor and its Treatment

The watercolor artist B. Schabacker painted this image of lilies and zebras on highly textured, thick wove paper (fig. 8). Prior to treatment, the object displayed slight surface soiling overall and discoloration of the paper support as the result of light exposure. Due to contact with poor matting and framing materials, the perimeter of the paper had discolored to a warm cream color. There was a dark brown stain located at the interface between the matted and unmatted areas. Due to the sensitivity of the media, it would have been imprudent, if not impossible, to perform an aqueous treatment. Instead, effective localized treatment was carried out with the surface suction device, and overall humidification or wetting could be avoided entirely.

After surface cleaning the paper support, areas of staining were locally reduced with applications of a 1% solution of hydrogen peroxide in water. Once sufficiently reduced, the areas were rinsed with a local application of deionized water. The areas were all treated using only the hand-held



Fig. 7. Hand-held suction device attached to a positive displacement vacuum pump



Fig. 8. Before treatment: B. Schabacker, Untitled [Lilies and Zebra], 1973, watercolor on machine-made paper, 64.5 x 55 cm

suction device (fig. 9). The suction also acted to remove residual bleaching solution (figs. 10–12). Since the stains were located at the surface, they were easily reduced from the surface, rather than by pulling degradation products through unaffected areas of the support.



Fig. 9. Detail illustrating the application of suction to the stain



Fig. 10. After treatment: B. Schabacker, Untitled [Lilies and Zebra], 1973, watercolor on machine-made paper, 64.5 x 55 cm

An Architectural Drawing and its Treatment

An architectural drawing by John Percy, Jr., sketched in 1950, was executed in graphite drawing on smooth-surfaced, thick illustration board (fig. 13). Prior to treatment, the paper support suffered from soiling, smudges, scuffs, fingerprints, and discoloration. There were seven circular stains located in the upper third of the object. The stains appeared to be the result of contact with an aqueous material, which was most likely dripped onto the paper. Stain removal on a suction table would have been the preferred treatment; however, the paper support was too thick to pass solvent.



Fig. 11. Before treatment, detail of upper right corner



Fig. 12. After treatment, detail of upper right corner

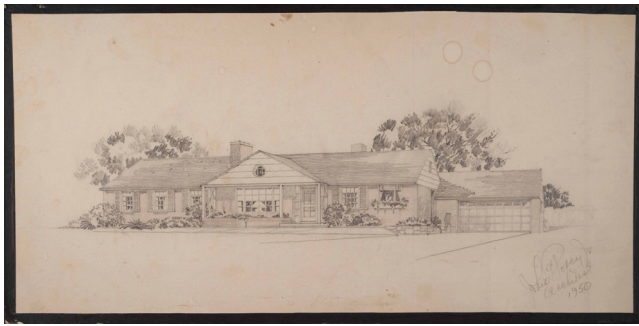


Fig. 13. Before treatment: John Percy, Jr., Untitled architectural drawing, graphite drawing on illustration board, 30.5 x 60.9 cm

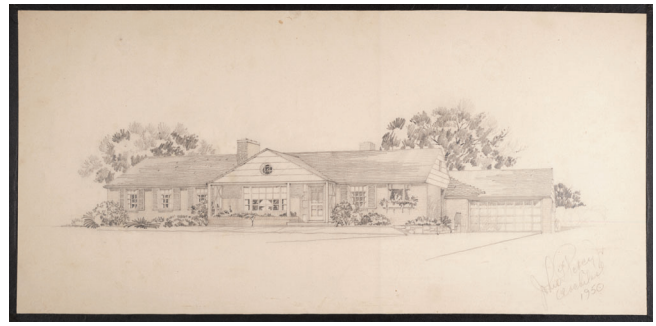


Fig. 15. After treatment: John Percy Jr., Untitled architectural drawing, graphite drawing on illustration board, 30.5 x 60.9 cm

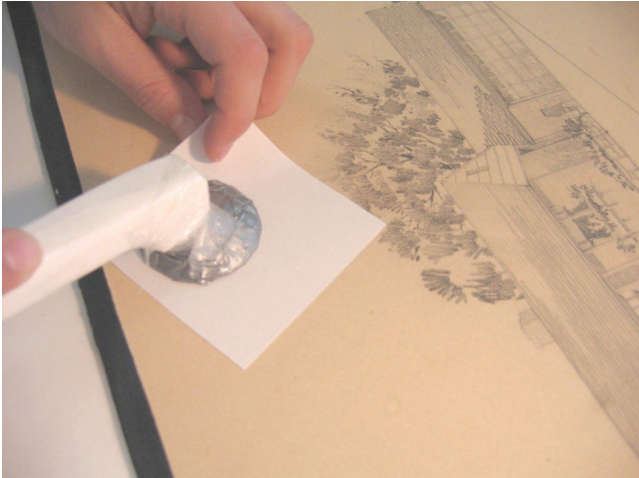


Fig. 14. Detail illustrating the application of suction to stain

After surface cleaning and minor tape removal, solvents were brush-applied to the areas of discoloration.³ A piece of Whatman filter paper was placed over the stain and suction was applied with the device to effectively reduce the aqueous stains (fig. 14). The surface suction device again proved successful, this time in removing staining from an impermeable surface (figs. 15–17).

CONCLUSION

The hand-held surface suction device greatly assists in the conservation treatment of works of art on paper. The device is especially useful in the treatment of paper objects on thick or impermeable paper supports and paper objects with sensitive media. The effectiveness of the device in these applications will lead to future applications that may include the treatment of mounted works of art and three-dimensional paper objects. The author's work is ongoing as treatment methods using the device are streamlined and perfected. In the future it is hoped that the device may prove useful for conservators working in other areas of specialization to treat textiles, ethnographic artifacts, and

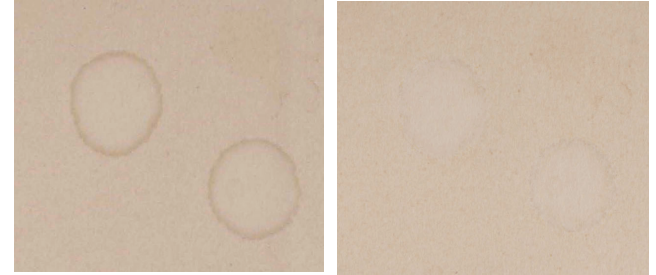


Fig. 16. Before treatment, Fig. 17. After treatment, detail detail

composite objects with complex, or selectively impermeable, components.

MATERIALS

Bissell TO GO Grab'n Go Cleaner

PO Box 3606
Grand Rapids, MI 49501
Phone: (800) 237-7691
www.bissell.com

Smooth-On Mold Max 30 silicone, Part A & Part B

Smooth-On Smooth-Cast 300

Smooth-On, Inc.

2000 Saint John Street
Easton, Pennsylvania 18042
Phone: (800) 762-0744
www.smooth-on.com

Teflon FEP (fluorinated ethylene propylene) tubing, 5/16" ID, 3/8" OD, 1/32" wall, semi-clear

McMaster-Carr
P.O. Box 4355
Chicago, IL 60680-4355
Phone: (630) 600-3600
www.mcmaster.com

Mesh filter, 14 Mesh .009
TWP, Inc.
2831 Tenth Street,
Berkeley, CA 94710
Phone: (800) 227-1570
www.twpinc.com

Banjo clip, locking cam level coupling, 1/2"
Banjo Corporation
150 Banjo Drive
Crawfordsville, IN 47933
Phone: (765) 362-7367
www.banjocorp.com

Gast 1023 vacuum pump
Museum Services Corporation
385 Bridgepoint Drive
South St. Paul, Minnesota 55075-2466
Phone: (651) 450-8954
www.museumservicescorporation.com

NOTES

1. Solubility tests using ethanol, toluene, acetone, xylene, isopropanol, and hydrogen peroxide were performed prior to casting.
2. Teflon was chosen for its size, flexibility, and resistance to chemicals.
3. Stains were reduced using deionized water, ammoniated water, and ethanol.

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