

The Materials, Techniques, and Conservation Challenges of Richard Serra's Oilstick Screen Prints

ABSTRACT

The Gemini G.E.L. (Graphic Editions Limited) Archives at The National Gallery of Art, established in 1981, contains an example from each of Gemini's published editions. Of the more than 1,700 works in the Archives, 21 are screen prints made with oilstick by Richard Serra (b. 1939), published between 1985 and 1991.

Richard Serra's large-scale prints, with their densely layered, rich textural surfaces, expand the boundaries of traditional screen-printing techniques. The screen prints are created on a variety of papers: Japanese and Western, machine- and handmade. Printing begins with a traditional screen print in black ink. Subsequent layers incorporate oilstick, the generic name for a medium often called Paintstick (the Shiva brand of Jack Richeson & Co.), composed of pigment, linseed oil, and melted wax, and molded into large cylindrical sticks.

The printers at Gemini, working with Serra, manipulated the medium by heating the oilsticks, adding linseed oil, and casting the mixture into large bricks. The bricks of oilstick were pushed, in multiple layers, through a screen onto the original key print.

Due to their large format and experimental technique, these works are often challenging to store, handle, and display. The prints exhibit a variety of condition problems, including soft, tacky "inks" and textured surfaces that attract lint and dust. The surfaces are vulnerable to abrasion and deformation, especially during handling. Some prints have a white, hazy appearance from white crystalline particles that develop when free fatty acids migrate out of the oil paint and deposit on the upper layers of the image. The white efflorescence disfigures the prints' velvety black surface.

This research includes a survey and visual examination of Serra's oil stick screen prints from Gemini G.E.L., museums, and private collections. Scientific analysis, including pyrolysis gas chromatography/mass spectroscopy (Py-GCMS), was

used to characterize the media and identify components of the efflorescence. The information gained from this research informed the preservation and storage of these works.

INTRODUCTION

Richard Serra, best known for his large metal sculptures, has been making prints since the early 1970s. The prints are made as an artistic response to a finished sculpture or to Serra's surroundings. Like the sculptures, the prints are overwhelming in size and color. Layers and layers of black oilstick, built up on oversized paper, appear intensely textured and rich. Closely examined, the black topographical surface both absorbs and reflects light, creating an overall matte surface with spots of shine. Serra says, "I want my surfaces to be as anonymous as possible, so that they don't call attention to themselves... I want to avoid a surface which could read as gestural" (Shiff 2008, 59). He says, "You can cover a surface with black without risking metaphorical and other misreadings. The use of any other color would be the extension of coloration, with its unavoidable allusions to nature. From Gutenberg on, black has always been synonymous with a graphic or print procedure. I am interested in the mechanization of the graphic procedure; I am not interested in the paint-allusion gesture" (Serra 1994, 179).

Serra views printmaking as a collaborative process that can be refined over time (Rosenthal 1993). In the early 1970s, the artist began working with Gemini G.E.L. (Graphic Editions Limited), a Los Angeles print studio, to produce lithographs, etchings, and screen prints. Using technically innovative methods, they printed and published 22 oilstick screen-print editions between 1985 and 1991. The National Gallery of Art (NGA) established The Gemini G.E.L. Archives in 1981. Its holdings contain examples from the printed editions, with images and technical information included in The Gemini G.E.L. Online Catalogue Raisonné (National Gallery of Art 2013).¹

Due to their large formats and technically experimental media, Serra's works are often challenging to store, handle, and display. This investigation of the artist's materials and

Presented at the Book and Paper Group Session, AIC's 41st Annual Meeting, May 29–June 1, 2013, Indianapolis, Indiana.

screen-print techniques played a vital role in formulating new preservation strategies for works in the NGA's collection.

MATERIALS

PAPERS

The Gemini G.E.L. Online Catalogue Raisonné lists the paper used in each print, though the characterizations are often vague. Papers are described by type (Western, handmade, machine-made, and Japanese) or by manufacturer and brand (Arches Cover). The term "Hiromi Paper" refers to papers specially made for Serra in Japan and commissioned by Hiromi Paper International, Inc., in Santa Barbara, California. The heavyweight (500 gsm), kozo-fiber papers are made by two Japanese paper mills: Fuji Paper Cooperative in Tokushima Prefecture and Igarishi Paper Mill in Fukui Prefecture (Katayama 2012).

The typical sheet size for the prints is 93.98 x 182.88 cm (37 x 72 in.) and the largest print, *Robeson*, is on a paper support that measures 256.54 x 161.10 cm (101 x 65 in.). Prior to use, the papers were coated with either a clear acrylic screen-printing base (T. W. Graphics Series 7000) or a clear urethane. The clear base was diluted with water and sprayed onto the paper support. Coatings were applied to protect the paper from oil penetration and staining. Papers were initially coated only on the front side, but by 1990, both sides of the sheet were treated after printers discovered that oil was penetrating the sheet.

OILSTICKS

Oilsticks were first formulated by French artist Jean-Francois Raffaelli and marketed in the early 1900s by Winsor & Newton as Raffaelli Solid Oil Colours (Winsor & Newton 2011). Other manufacturers and brands include Sennelier Oil Sticks, M. Grumbacher, Inc. Tubeless Oil Paint, and Winsor & Newton Oilbars. In the 1940s, oilsticks were marketed and sold by the Shiva Company under the brand name Paintstik, and the medium is often called by this name. Gemini G.E.L. used primarily Shiva Artist's Paintstik, now manufactured by Jack Richeson & Co.²

Formulations differ between brands, but the medium generally consists of a colorant (pigment), a drying oil (linseed or poppy), and paraffin wax (Ellis and Yeh 1997). The materials are heated, mixed together, and then formed into cylindrical sticks. Oil on the exposed surface of the finished stick oxidizes to form a thin skin that must be peeled back before each use.

TECHNIQUES

Serra worked with Gemini G.E.L. for more than a year to devise the printing process, which was continuously adjusted during the entire period of their artistic collaboration (Wortz



Fig. 1. Half of an oilstick brick, 10.6 x 8.89 x 4.45 cm (4 x 3 ½ x 1 ¾ in.), made by melting oilsticks, adding linseed oil, and cooling in a mold

1986). Initially, Serra's drawings were made using the sticks as they came from the manufacturer. Given the oversized scale of the papers, application using the small sticks was a laborious task. A more efficient process was implemented and used in both the drawings and prints. Multiple oilsticks were melted and linseed oil was added to achieve the desired consistency. The mixture was then poured into bread pans and cooled, creating large bricks designed to be held with both hands (fig. 1). The addition of linseed oil softens the oilstick and allows it to be pushed easily through a tightly stretched mesh screen.

The design for each print was drawn with a brick of oilstick on the screen. The screen was then coated with a photosensitive emulsion and exposed to a light source. Light hardened the non-design areas so they would block ink. Any unhardened emulsion was then washed away and the oilstick was removed to create the stencil or image area.

This key image was screen-printed in black ink onto the paper support to create a base for subsequent layers of oilstick. The screen-printing ink also acted as an additional barrier to prevent oil from staining the paper support (Reid 2011). Oilstick was then applied in long, continuous, vertical strokes, either through the screen or directly over the screen-printed ink foundation. Each oilstick layer was dried for one to two weeks before the next was added. Occasionally, acrylic gel medium was applied by brush between the oilstick layers to create additional texture.

Different methods of oilstick application produced varied textures and surfaces. Oilstick pulled across the surface of the paper support created a smooth and continuous layer. Molten oilstick applied with a paint roller created high peaks when the roller was lifted away from the paper support. The most common method was pushing the oilstick through a screen. The screen texture is apparent when the surface of the print is viewed under magnification (fig. 2). In many prints, a combination of methods was employed. In the 1991 print *Double Black*, the first oilstick layer was applied directly onto

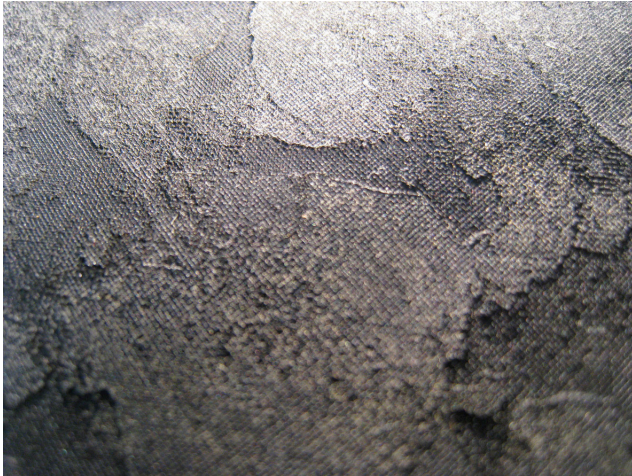


Fig. 2. Screen texture, specular light. Detail of *Clara Clara II* (1985), oilstick screen print on paper, 91.2 x 184.7 cm (35 7/8 x 72 11/16 in.), NGA 1989.55.72, gift of Gemini G.E.L. and the artist

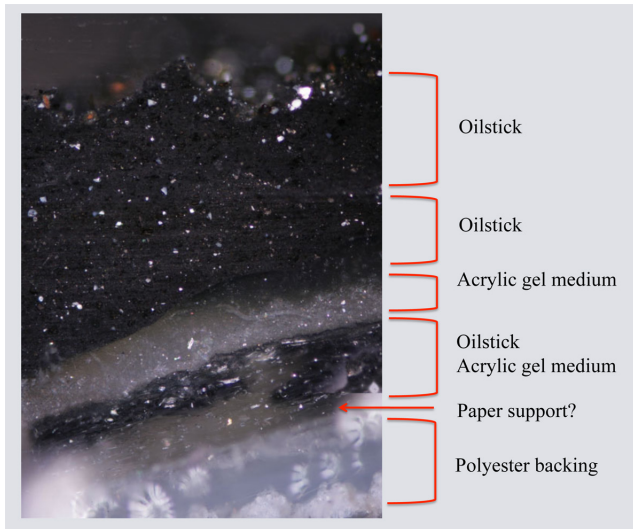


Fig. 3. Print cross section, visible light, polarizing light microscope. Composite of four images, each taken at 20x magnification. Print sample courtesy of Gemini G.E.L.

the black screen-printing ink, and subsequent layers were pushed through the screen.³

The thickness and texture of a print is primarily dependent upon the number of oilstick layers. Within an edition, each impression can vary in construction and have between two and seven layers of oilstick. For example, the catalogue raisonné entry for the 1991 print *Esna* states, “All prints in the edition received as few as two coats and as many as four coats of Paintstik” (National Gallery of Art 2013). In the cross section seen in figure 3, three layers of oilstick and two layers of gel medium are present. A polyester backing is visible as the bottom layer. The coated paper support disappears under the thick seams of oilstick and acrylic gel medium.

The texture variations of the prints are atypical of traditional screen-print surfaces. Because the construction of each print varies, the process more closely resembles monoprinting. Serra calls these works “multiple monotypes” (von Berswordt-Wallrabe and Breidenbach 1999, 28).

ANALYSIS

Analysis was performed to characterize the oilstick medium and to better understand its drying properties. NGA scientist Christopher Maines used pyrolysis gas chromatography/mass spectroscopy (Py-GCMS) to analyze oilstick samples taken from selected prints and from a black Shiva Jumbo Artist’s Paintstik purchased in 2011.

Py-GCMS analysis confirmed the presence of paraffin wax and linseed oil in all the samples (fig. 4). Long-chain hydrocarbons indicate the presence of paraffin wax. Palmitic, stearic, and oleic acid peaks are characteristic of linseed oil. X-ray fluorescence analysis of a black Shiva Jumbo Artist’s Paintstik, performed by Dr. Aniko Bezur at The Menil Collection, verified the presence of potassium and calcium associated with bone black pigments (Bezur 2011).⁴

Theoretically, the oilstick medium in Serra’s prints should be dry, since they were made more than 20 years ago. During the drying process, unsaturated fatty acids in linseed oil combine with oxygen to form hard, cross-linked films. Byproducts of the drying reactions include smaller compounds, the most abundant of which is azelaic acid. Oleic acid oxidizes to azelaic acid, and as oil paint dries, there is a decrease in oleic acid and an increase in azelaic acid (Mills 1966). The samples of oilstick taken from the prints were expected to have a high proportion of azelaic acid in relation to oleic acid.

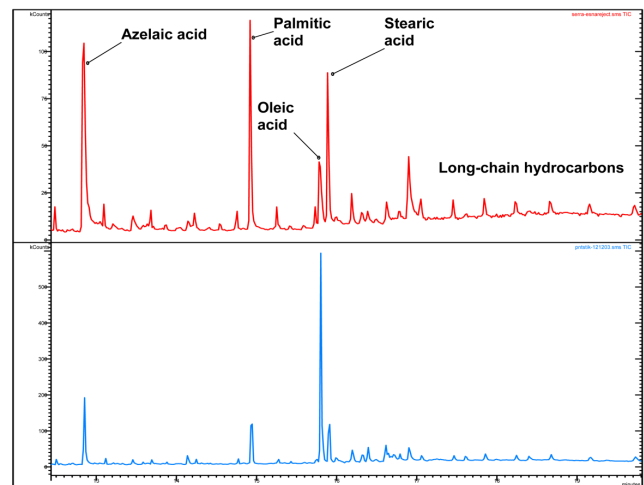


Fig. 4. Py-GCMS chromatograms. Top: Oilstick sample from *Esna* (1991). Print sample courtesy of Gemini G.E.L.). Bottom: Sample of ivory black Shiva Jumbo Artist’s Paintstik purchased in 2011

Py-GCMS analysis of oilstick from selected screen prints showed low amounts of azelaic acid, indicating a medium that is not fully dry. The presence of hydrocarbon waxes and the thickness of the oilstick layers, both of which may prevent oxygen from fully penetrating the paint, may explain this failure to dry completely. In addition, the waxes may act as plasticizers, keeping the oilstick soft and pliable (Maines 2012). As in the oilsticks themselves, a hard, dry film forms on the print's surface, while the interior remains tacky and malleable.

CONDITION ISSUES

Serra's oilstick screen prints present challenging preservation issues. Thick oilstick layers on oversized and heavy supports make handling difficult. Moreover, the tacky and malleable surfaces and interiors are problematic for handling and storage. Any pressure applied during handling and storage can cause surface deformations. Surface sheen is unintentionally created when the thick impasto surfaces become flattened and burnished (fig. 5). Other problematic issues include the textured surfaces' attraction for lint and dust and the yellowing of the acrylic coatings on the paper supports. Oil staining



Fig. 5. Flattened and burnished areas impart an unintended surface sheen. Detail of *Esna* (1991), oilstick screen print on two sheets of coated DHM-14 Japanese paper, overall size: 194.3 x 194.3 cm (76 1/2 x 76 1/2 in.), NGA 2000.177.69.a-b, gift of Lee and Ann Fensterstock

is often visible around the image on the front and back of the paper supports (figs. 6 and 7). It should be noted that Serra does not consider smudges, oil stains, and bleeding at the edges of the image to be disfiguring to the print (Shiff 2008).

Old mounts may also cause problems. The printers at Gemini experimented with several hanging systems for use during installation. A polyester woven material was common-

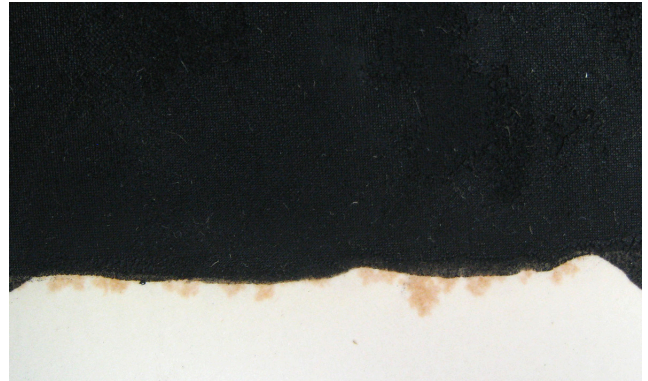


Fig. 6. Oil staining visible along the edge of the image. Detail, bottom right corner, of *Ernie's Mark* (1985), oilstick screen print on coated Exeter paper, sheet: 215.3 x 189.9 cm (84 3/4 x 74 3/4 in.), NGA 1989.55.64, gift of Gemini G.E.L. and the artist



Fig. 7. Oil staining visible on the back of the paper support. Detail of *Esna* (1991), oilstick screen print on two sheets of coated DHM-14 Japanese paper, overall size: 194.3 x 194.3 cm (76 1/2 x 76 1/2 in.), NGA 2000.177.69.a-b, gift of Lee and Ann Fensterstock

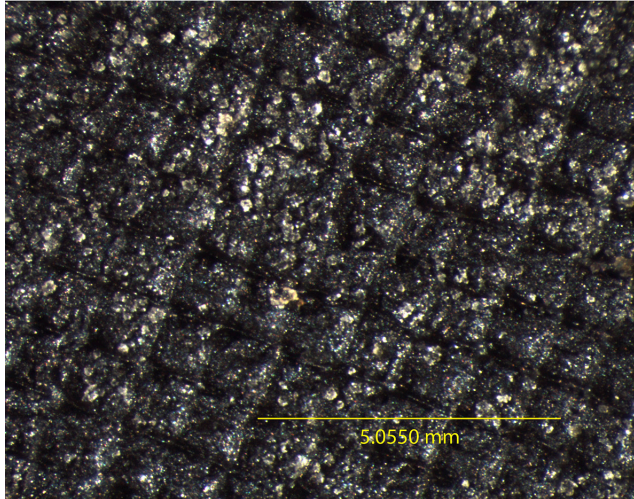


Fig. 8. Photomicrograph of fatty acid efflorescence crystals, 20x magnification, *Clara Clara II* (1985), oilstick screen print on paper, sheet: 91.2 x 184.7 cm (35 7/8 x 72 11/16 in.), NGA 1989.55.72, gift of Gemini G.E.L. and the artist

ly adhered overall to the back of the paper support and used to stretch the paper over a backing board. A second type of hanging system was constructed of polyester tabs attached to the back of the print. The tabs are meant to fit onto a wall hanging device or into slits in the backing board of a frame. The pressure-sensitive adhesives⁵ used to join the polyester fabric and the polyester tabs to the paper supports can be sticky.

The most disfiguring condition for these artworks is the formation of white fatty acid crystals, or efflorescence, which can disrupt their uniformly black surfaces. The white particles on the oilstick prints are similar to the fatty acid crystals that can be found on the surface of oil paintings. At first glance, efflorescence on the surface of the screen prints may look like dust and dirt particles, but under the microscope, small crystals are visible (fig. 8). White, needle-like crystals may develop in small patches (fig. 9). In some heavy deposits, efflorescence appears as a white haze over a large expanse and is apparent when viewed in raking or specular light (fig. 10). Residues found on interleaving sheets have been identified as fatty acids or fatty acid components (Bezur 2011).⁶

Free fatty acids in oils are semi-volatile at room temperature. The fatty acids can migrate into the upper layers of oil paint and deposit on the surface as white crystals (Ordonez and Twilley 1998; Rimer et al. 1999). The semi-volatile free fatty acids are also a cause of the hazing or blooming on the glazing of oil paintings (Williams 1989; Shilling, Carson, and Khanjian 1998). Many conservators and scientists have hypothesized about the formation of fatty acid efflorescence in oil paints, but the actual mechanism is still unknown.

Serra's manipulation of the oilstick—by heating, cooling, and adding oil—changes its manufactured properties and creates conditions that may promote crystal formation.

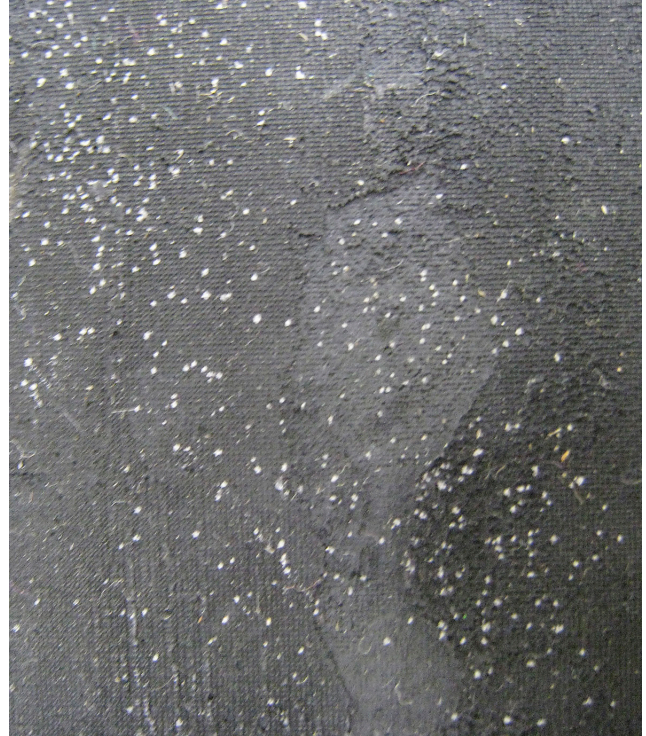


Fig. 9. Clusters of white fatty acid efflorescence. Under magnification, these clusters are visible as white, needle-like crystals. Detail of *Double Black* (1990), right panel of two parts, oilstick screen print on coated DHM-14 Japanese paper, overall (irregular): 179 x 180 cm (70 1/2 x 70 7/8 in.), NGA 2000.177.102.a, gift of Lee and Ann Fensterstock



Fig. 10. Fatty acid crystals appear as a white haze over a large expanse of the print when viewed in specular light. Detail of *Double Black* (1990), right panel of two parts, oilstick screen print on coated DHM-14 Japanese paper, overall (irregular): 179 x 180 cm (70 1/2 x 70 7/8 in.), NGA 2000.177.102.a, gift of Lee and Ann Fensterstock

However, efflorescence also occurs in unaltered oilstick, so its formation seems to be inherent to the medium and/or caused by environmental conditions. Factors such as high heat, moisture, physical/thermal changes in the paint film, pigments with large oil content, unvarnished surfaces, and nonabsorbent substrates may promote or contribute to fatty acid crystal formation (Koller and Burmester 1990; Williams 1989; Rimer et al. 1999). More research is needed to understand the conditions in which the fatty acids migrate through the oilstick medium and deposit on the surface. A complete scientific investigation is beyond the scope of this research.

STORAGE

In 2002, the paper conservation department at the NGA evaluated the storage conditions of the Serra screen prints in the collection. Upon acquisition, the screen prints were housed in folders with cover sheets and stacked one on top of another in flat files. Over time, the cover sheets—made of purified wood-pulp paper—stuck to the surface of the tacky oilstick, and oil stains were observed on the folders. Alternate vertical storage options were rejected because of limited space. At this time, the prints were rehoused in folders with silicone release paper on top and polyester film beneath, where they remain to the present day (Karnes and Walsh 2002).

This study aimed to devise optimal storage for the oilstick prints through a review process of storage and handling practices at other institutions. A survey, conducted at museums and private collections, found a range of storage environments.⁷ Housing methods included:

- Paperboard boxes (Each print was stored individually in a paperboard box with a paperboard lid.)
- Folders (Prints were stored in folders with interleaving papers and stacked in flat files.)
- Frames with glazing (glass or acrylic sheets)
- Frames without glazing
- Frames without glazing, covered with:
 - plastic sheeting wrapped around the frame
 - a paperboard box lid
 - a paperboard box lid with air-permeable inserts
 - an acrylic box lid with vents

Fatty acid efflorescence on the print and/or hazing on the cover sheet or glazing was observed more frequently when the print was covered or enclosed. Of 46 oilstick works examined, 13 works enclosed in frames with glazing or stored in folders had fatty acid efflorescence. Eight impressions of the 1985 *Clara Clara II* were examined in three different types of housing: paperboard boxes, frames covered with plastic, and folders in flat files. The prints had varying degrees of efflorescence, but the print covered with plastic had the most visible and disfiguring deposits.

As part of this study, an experiment was designed to produce the exudate that could develop into the white crystalline deposits similar to those seen on the Serra oilstick prints. Samples of oilstick from a stick of Shiva Jumbo Artist's Paintstick and from manipulated bricks were spread on glass slides. Some samples were covered with glass slips, and some were left uncovered (fig. 11). The slides were placed in an environmental chamber with cycling temperatures and constant humidity.⁸ White residues formed on the surface of uncovered oilstick samples and a white exudate (fig. 12) formed on the underside of the glass slips of those that were covered. Py-GCMS analysis verified the presence of free fatty acids in the exudate from the glass slip. This experiment, while preliminary, informed housing methods.

Storage solutions needed to meet several criteria to mitigate condition issues. Appropriate housings would:

- Prevent dust, dirt, and lint accumulation.
- Prevent physical damage to the oilstick surface and paper support.
- Provide air exchange. Oxygen is needed to promote cross-linking of oils in the oilstick. In addition, semi-volatile free fatty acids will continue to migrate from the oilstick, and

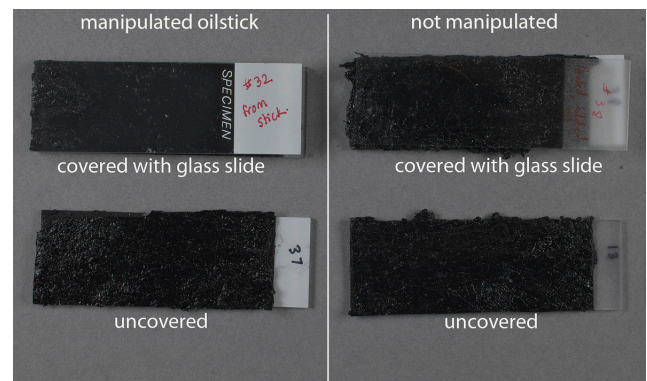


Fig. 11. Oilstick samples applied to glass slides. Slides were placed in an environmental chamber and exposed to fluctuating temperatures and high relative humidity.

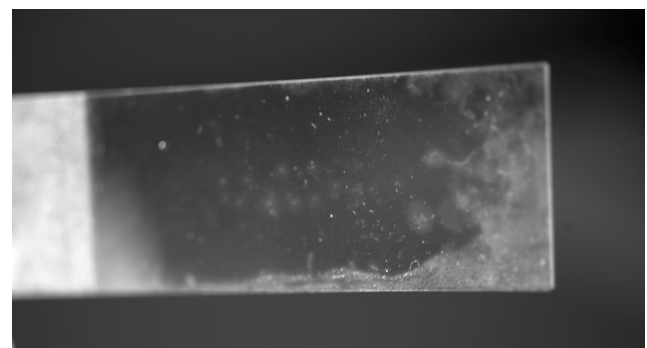


Fig. 12. White exudate formed on the underside of the glass slide covering an oilstick sample.

air movement may reduce their deposition on the print surface (Maines 2012).

- Stabilize temperature and relative humidity. Environments with high heat, high humidity, or cycling temperatures induce hydrolysis and promote fatty acid crystal formation (Williams 1989).
- Provide flat storage. Flat storage can prevent sagging of the paper support. If the print is stored vertically, its weight must be fully supported.

These considerations were kept in mind when preparing two screen prints, *Clara Clara I* and *Muddy Waters*, for storage after exhibition in 2011. The prints were attached to backing boards with Japanese paper hinges, which were adhered with wheat starch paste and distributed evenly around the perimeter of each print.⁹ The framed prints were fitted with custom breathable covers to protect the artwork from dust, dirt, and physical damage (fig. 13).

Custom crafted by NGA framers, each lightweight, sturdy cover fits over the frame, providing approximately five inches of air space above the artwork. The perimeter of the cover is constructed from corrugated paperboard and paper honeycomb panel; both are lightweight materials that provide structural stability over long expanses. Honeycomb panel, which is attached to the interior of the cover and rests against the face of the frame, offers extra stability. The center of the cover is constructed with MicroChamber paper with the carbon side facing away from the art and is reinforced on the exterior with a honeycomb panel cross brace. Microchamber paper was chosen for its ability to allow air to permeate the art and facilitate the drying process of the oilstick. Additionally, the MicroChamber paper may trap volatile fatty acids migrating from the oilstick and prevent deposition on the surface.

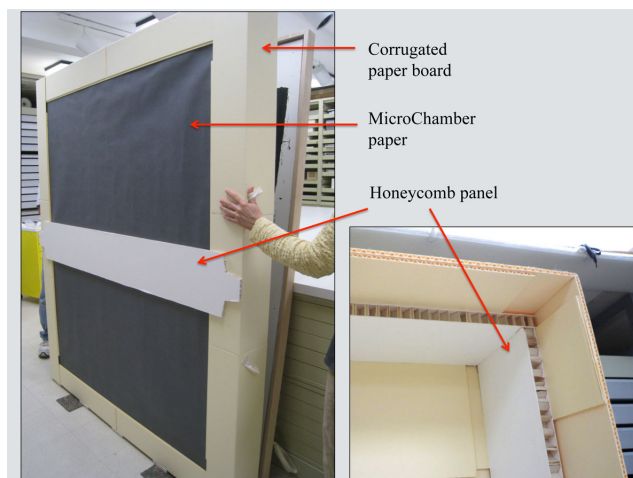


Fig. 13. Left: Custom fitted cover for a framed oilstick screen print. Right: Detail of the interior. Honeycomb panel lines the interior and rests against the face of the frame.

The two prints, now covered, hang vertically on screens in storage. Because of the heavy media, the prints may sag over time. Their condition will be monitored periodically. Space constraints dictate that the other prints in the collection remain in the flat files. Ideally, each print would be stored flat on a shelf or in its own drawer with a permeable covering.

CONCLUSIONS

Richard Serra and Gemini G.E.L. created unique and experimental prints with characteristics that are unlike those of traditional screen prints. This storage survey of oilstick works in museum collections across the country informed decisions about storage of the oilstick screen prints in the National Gallery of Art's collection. Appropriate storage environments should mitigate condition issues associated with the oilstick screen prints. The following are suggestions for storage based upon this research:

- Store each print individually on a flat surface.
- Cover with a permeable material. Provide air space above the artwork.
- Stabilize temperature and relative humidity.

ACKNOWLEDGMENTS

I would like to thank The Andrew W. Mellon Foundation for funding my fellowship and this research. I am grateful for the support of the National Gallery of Art paper conservation department, particularly Kimberly Schenck, Marian Dirda, Michelle Facini, Jenny Ritchie, Hugh Phibbs, and Michelle Stein. Special thanks to Christopher Maines, Melanie Gifford, and Michael Palmer of the NGA scientific research department; Gemini G.E.L., especially James Reid and Xavier Fulmat; Judith Brodie, Charles Ritchie, Bethann Heinbaugh Jay Kreuger, Mervin Richards, Michael Skalka, Ana Alba, Dana Cranmer, Dr. Aniko Bezur, and Richard Frumess. Thanks also to the many conservators, registrars, and curators at the institutions I visited during the storage survey.

NOTES

1. www.nga.gov/gemini/home.htm. Many entries in the Catalogue Raisonné may be incomplete.
2. The Shiva Brand was founded by Ramon Shiva in the 1920s. The company was sold in the 1960s and ownership of the Shiva and Paintstik trademark has since transferred between many companies: Standard Brands Paint Company (SB), Delta Technical Coatings, Dick Blick, and Markal/LA-CO Industries. In 2002, Jack Richeson purchased the formulations and the trademarks and now manufactures the Shiva Artist's Paintstik. LA-CO Industries continues to make the Markal Standard Paintstik, though this product is for industrial and agricultural use and does not utilize the same quality of pigments

as the artist sticks. More information about LA-CO Industries and the Standard Paintstik can be found at www.laco.com/documents/lacoindustries_75anniversary.pdf. Michael Skalka, National Gallery of Art, and Darren Richeson, Richeson and Co., Inc. 2013. Personal communication.

3. *Double Black*, 1991, NGA 2000.177.102. See Gemini G.E.L. Catalogue Raisonné entry.

4. XRF analysis was performed by Aniko Bezur at The Menil Collection prior to the exhibition *Richard Serra Drawings: A Retrospective*, March 2–June 10, 2012.

5. 3M product #950, 5mm high-tack adhesive transfer tape. Gemini G.E.L. Online Catalogue Raisonné.

6. Dr. Aniko Bezur identified the efflorescence sampled from an interleaving sheet on a Serra oilstick drawing using FTIR. Results suggest the presence of a compound related to palmitic acid. Palmitic acid may be present, but some aspects of the spectrum suggest that a soap of palmitic acid is present, rather than palmitic acid itself. Smaller quantities of stearic acid are also possibly present.

7. Many thanks to the conservators, curators, and registrars at the following institutions: Bergen Art Museum; Colby College Museum of Art; Cranmer Art Conservation; Gemini G.E.L., Glenstone; Harvard Art Museums/Fogg Art Museum; Hirshhorn Museum and Sculpture Garden; Los Angeles County Museum of Art; Museum of Fine Arts, Boston; National Gallery of Art; Princeton University Art Museum; The Art Institute of Chicago; The Baltimore Museum of Art; The Brooklyn Museum of Art; The Getty Research Institute; The Metropolitan Museum of Art; The Museum of Contemporary Art, Los Angeles; The Museum of Modern Art; and The Philadelphia Museum of Art.

8. The experimental design was based on the experiment performed by B. Rimer et al (1999). Oilstick samples were prepared in replicates of three and exposed to temperatures cycled from 4°C to 38°C at 85% relative humidity for a period of two weeks.

9. In some cases, wheat starch paste cannot be adhered to the coated papers or onto prints where oilstick extends to the edges. Heat set or emulsion adhesives such as BEVA or Lascaux can be used.

REFERENCES

Bezur, A. 2011. Personal communication. The Menil Collection, Houston, Tex.

Ellis, M. H., and M. B. Yeh. 1997. Categories of wax-based drawing media. *WAAC Newsletter* 19(3). <http://cool.conservation-us.org/waac/wn/wn19/wn19-3/wn19-308.html> (accessed 29 September 2010).

Katayama, H. 2012. Personal communication. Hiromi Paper International, Santa Barbara, Calif.

Karnes, C., and J. Walsh. 2002. Memo: Storage of Richard Serra "Paintstik" prints on paper. July 25, 2002. National Gallery of Art, Washington, DC.

Koller, J., and A. Burmester. 1990. Blanching of unvarnished modern paintings: A case study on a painting by Serge Poliakoff. *Cleaning, Retouching and Coatings: Technology*

and Practice for Easel Paintings and Polychrome Sculpture: Preprints of the Contributions to the Brussels Congress, J. S. Mills and P. Smith, eds. London: International Institute for Conservation of Historic and Artistic Works. 138–143.

Maines, C. 2012. Personal communication. National Gallery of Art, Washington, DC.

Mills, J. S. 1966. The gas chromatographic examination of paint media, part I: Fatty acid composition and identification of dried oil films. *Studies in Conservation* 11(2): 92–108.

National Gallery of Art. 2013. *Gemini G.E.L. Online Catalogue Raisonné*. www.nga.gov/gemini/home.htm (accessed 23 August 2013).

Ordonez, E., and J. Twilley. 1998. Clarifying the haze: Efflorescence on works of art. *WAAC Newsletter* 20(1). <http://cool.conservation-us.org/waac/wn/wn20/wn20-1/wn20-108.html> (accessed 20 September 2010).

Reid, J. 2011. Personal communication. Gemini G.E.L., Los Angeles.

Rimer, B., I. Fiedler, M. A. Miller, M. Cunningham, and J. D. J. van den Berg. 1999. Investigation of fatty acid migration in alizarin crimson oil paint in two works by Frank Stella. *1999 AIC Paintings Specialty Group Postprints*. St. Louis, Mo.: Paintings Specialty Group of the American Institute for Conservation of Historic and Artistic Works. 1–14.

Rosenthal, M. 1993. *Artists at Gemini G.E.L.* Newport Beach, Calif.: Harry N. Abrams.

Serra, R. 1994. *Writings/interviews*. Chicago and London: University of Chicago Press.

Shiff, R. 2008. Drawing thick: Serra's black. In E. Schneider, *Richard Serra: Drawings—Work comes out of work*. New York: Kunsthau Bregenz. 56–63.

Shilling, M. R., D. M. Carson, and H. P. Khanjian. 1998. Evaporation of fatty acids and the formation of ghost images by framed oil paintings. *WAAC Newsletter* 21(1). <http://cool.conservation-us.org/waac/wn/wn21/wn21-1/wn21-106.html> (accessed 18 October 2011).

Williams, S. R. 1989. Blooms, blushes, transferred images and mouldy surfaces: What are these distracting accretions on art works? *Proceedings of the 14th Annual IIC-CG Conference, IIC-Canadian Group, Ottawa*. Toronto: The Toronto Area Conservation Group of the International Institute for Conservation of Historic and Artistic Works—Canadian Group. 65–84.

Winsor & Newton. 2011. <http://www.winsornewton.com/resource-centre/product-articles/artists-oilbar> (accessed 27 April 2011).

Wortz, M. 1986. Richard Serra: Prints. *The Print Collector's Newsletter*, March–April: 5–7.

von Berswordt-Wallrabe, S., and S. Breidenbach. 1999. Work generates different kinds of work: Development and process in Richard Serra's graphic work. In *Richard Serra: Druckgrafik: Werkverzeichnis 1972–1999 [Prints: catalogue raisonné 1972–1999]*. Düsseldorf: Museum Kurhaus Kleve. 23–36.

FURTHER READING

- Amien.org. 2006. "Efflorescence" from some conservators' points of view. [amien.org/forums/showthread.php?106-\"Efflorescence\"-from-Some-Conservators'-Points-of-View&p=328#post328](http://amien.org/forums/showthread.php?106-\) (accessed 2011).
- Fine, R. E. 1985. *Gemini G.E.L. art and collaboration*. Washington, DC: National Gallery of Art.
- Gemini G.E.L. 1982. *Richard Serra at Gemini 1980–1981*. Los Angeles: Gemini G.E.L., 1982.
- Gemini G.E.L. 1988. *Richard Serra at Gemini 1983–1987*. Los Angeles: Gemini G.E.L.
- Rose, B., M. White, and G. Garrels. 2011. *Richard Serra drawings: A retrospective*. New Haven: Yale University Press.

IM CHAN

Andrew W. Mellon Fellow in Paper Conservation
National Gallery of Art
Washington, DC
imnaychan@gmail.com