Textiles for Emergency Salvage

The Absorbency of Micro-Denier Textiles, And other Standard Absorbent Materials

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INTRODUCTION:

When responding to an emergency water disaster, conservators may ask themselves:

"Where can I get maximum absorbent material, for minimum cost, and maximum results?

- local thrift for store used cotton T-shirts, quilts and flannel sheets?
- local fabric store, to buy bolts of cotton flannel or polyester fleece?
- home improvement store, to buy bags of microfiber scraps at very low prices?
- corner drugstore, where baby and adult diapers may be bought?
- local office cleaning company, for their stock of wipes for cleaning homes and offices?

APPLICATION TO PRACTICE:

The outcome of this research will inform the professional art conservation community regarding the choice of various microfiber fabrics in emergency situations for the removal of water, soot and assorted debris from the surface of fragile artifact surfaces.

Conservators of all specialties use microfiber fabrics to surface clean cultural material.

Manufacturers of microfiber fabrics offer various explanations for the success of their textiles in absorbing water and removing soil, including:

- ***specific fiber content*** (*percentage of melt-blown thermo-plastic fibers)* used in manufacturing the yarns to produce these fabrics.
- *sh**ape of the fibers*** produced before being twisted into yarns
- ***type of weave structure*** of a fabric
- ***surface charge*** between fabric surfaces and dirt particles
- ***finish added*** to the surface of the fabrics.

RATIONALE:

Microdenier fabrics are used by the conservation profession for cleaning all sorts of cultural heritage objects.

There is no extensive published comparative study within the conservation community of the fibers, the weave structures of fabrics, the mechanisms by which they remove soiling from surfaces, or a comparison of cleaning effectiveness to other commonly used absorbent materials.

Manufacturers websites are full of claims as to their effectiveness, including:

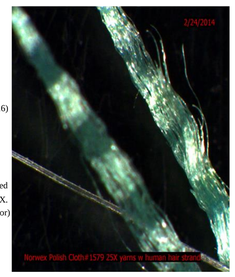
- ***capillary action*** combined with their extremely small size
- ***static charge*** generated by these synthetic fabrics on the soil particles
- ***abrasiveness*** of the fibers themselves
- ***unique surface shape of the fibers*** that form the yarns that make the fabric.

(*Cross-sectional view of bi-component, Star-shaped microfiber.*
Photo courtesy of E-cloth, accessed from website March 28,2016)

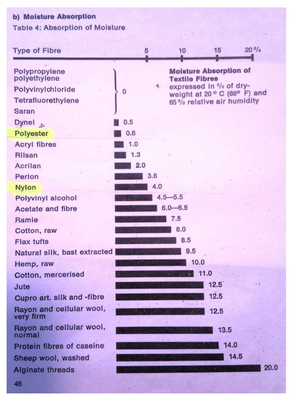
DEFINTION:

Microfibers are:

- ***measuring less than 1 denier*** (the weight in grams of 9,000 meters of fiber.
  (1. . Bede, M.J., Collier B.J., Tortora P.G., **Understanding Textiles**, Seventh Edition, Prentice Hall, Columbus Ohio, 2008, p45.)
- half as fine as silk, three times finer than cotton, eight times finer than wool, and can be one hundred times finer than a human hair. (2. . www.fabriclink.com/Dictionaries/Textile.cfm, accessed April 25,2-16)
- Almost any synthetic fiber can be made "micro-denier"
- the most common type is a blend called a **"bicomponent**" fiber of polyester core and nylon sheath. (Source: http://www.tex.in/education/nextiles/fib/mic/mic.html)



Microdenier yarn strand compared to a human hair at 25X. (Photo by author)



Standard denier synthetic fibers, including polyester and nylon are able to absorb miniscule amounts of moisture, .6% and 4.0%, as shown in this chart.

Bicomponent micro-denier fabrics commonly are made with a polyester core and nylon sheath.

(Source: Bohler & Weber KG, Pocket Book for the Drycleaner, Fachbuchverlag J. Kurz, Western Germany, 1969.) page 46.

Research Project Phase I:

1. Established a baseline with a set of commercially available microdenier cloths, collected from various commercial suppliers.
2. Documented them for further comparison using standard photography and photomicroscopy.
3. Determined Fabric Weight, in Grams/square meter:
   - Samples were conditioned to a standard atmosphere for textile testing (21 ±1 degree C, 70 ±2 degrees F, and 65 ±2% RH.)
   - 4" x 4" samples were weighed on a Fisher Scientific A-160 digital scale, as proscribed by the ASTM protocol.
4. Calculations for each 4" x 4" sample determined a range in weights from 80-GSM to 490-GSM.

The microdenier fabric selections were made with 3 parameters in mind:

- **Fiber content** (the % and choice of fibers, such as polyester, nylon, polypropylene, etc.)
- **GSM number**, that is, the weight of the fabric in "grams/square meter".
- T**ype of weave structure**, that is whether the fabric geometry is woven, knitted, or neither, called nonwoven.

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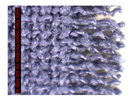
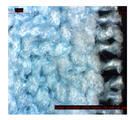
Imaging with appropriate photographic microscopy equipment documented the following selections: (All photos by author except as noted.)

Woven fabric structure:
Crepe weave, includes:
- **Mystic Maid** "Miracle Cloth"
- **Starfiber G-Terrycloth**



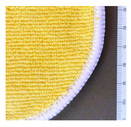
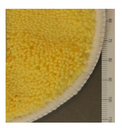

Waffle Weave includes:
- **Starfiber Waffle**
- **BroTex MFWB waffle**



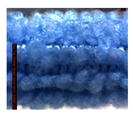
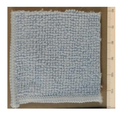

Knitted fabric structure includes:
Single or Double-faced Plush:
- **E-cloth dust mop**,
- **Microfiber Wholesale #844CL** Terrycloth,
- **Alclear AllRounder** Cloth,
- **SDI Double-Plush** Detailing Cloth

(Photo by Alclear)

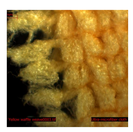
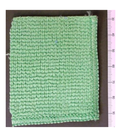
Cut/Uncut double-faced terrycloth includes:
- **CTA 4077**-Hi/Low Terrycloth
- **3M Detailing Cloth** #06016
- **Erie Cotton #1212**White terry

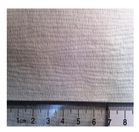
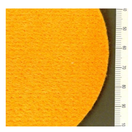
Uncut double-f aced terrycloth includes:
- **Triple-SSS terry**
- **PEL Fabric**
- **TALAS terrycloth**
- **SDI terrycloth**
- **Starfiber F-Terry**
- **BroTex MicroMop**

V-stitch Knit includes:
- **Microfiber Wholesale #T380CL**
- **Alclear #820227**
- **CTA Products #M104**

Nonwoven fabric structure includes:
- **Starfiber felt disc**
- **Disposable surgical wipe**

Reference fabrics:

Cotton Flannel

Cotton Terrycloth

Cotton Interlock Knit

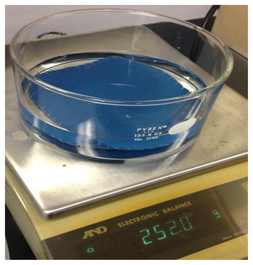
Phase II: the Performance Testing Phase

Phase II, the performance testing phase, with comparisons to other standard absorbent materials, was conducted at ***the Drycleaning & Laundry Institute, Laurel Md.***, **(DLI)** following the ***American Association of Textile Chemists & Colorists*** **(AATCC)** test method protocols for measuring absorbency.

The absorbency rate of the selected microdenier fabrics was measured in two ways:

1. **DLI Macy's Method (full immersion method) was run twice:**
   - Unwashed samples (that is as-received from suppliers)
   - same samples, pre-washed (as specified in AATCC#61-2013.)

This method is an industry standard developed in-house at DLI, used for most of the twentieth century, for commercial clients of DLI, worldwide.



Sample fully immersed.

Wet sample re-weighed to determine amount of water absorbed

2. Absorbency Test #2: AATCC #197-2013 Vertical Wicking of Textiles , U**nwashed samples, that is, as received from suppliers.**

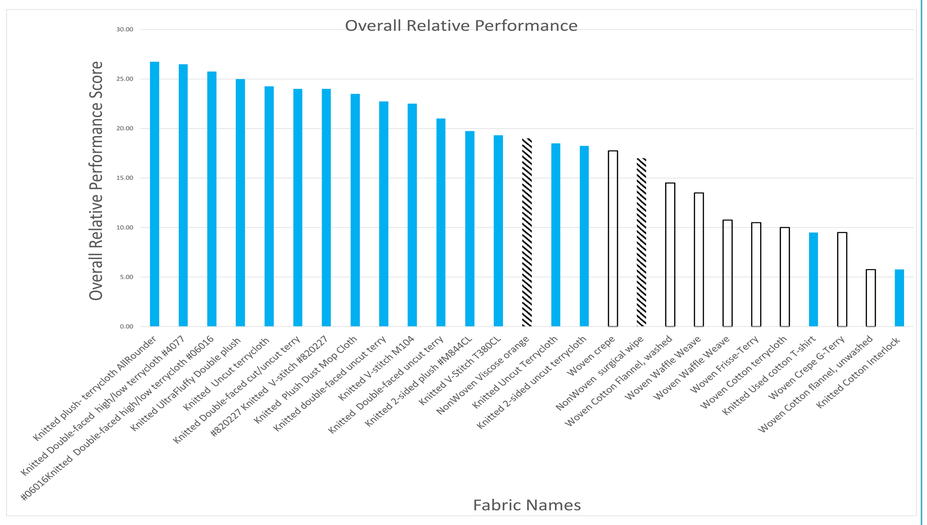
- 10 strips of the selected fabric as received from the supplier were cut into strips 165mm x 25mm, and set up with just the very bottom tips of the strips touching a dye-colored solution.
- Five strips were cut in the warp direction, 5 in the weft direction.

- Measurements of the height of the wicking were taken as per protocol: at 2 minutes, and again at 10 minute in the warp direction, then in the weft direction.

These measurements, in centimeters, were then added together, to create a score for each fabric sample.

Microfiber terrycloth after 2 minutes vertical wicking.

The absorbency and vertical wicking scores were then combined to give one final score to each fabric:



RESULTS:

- **ALL the microdenier fabrics outperformed the standard denier fabrics** in terms of moisture uptake, as measured by both immersion absorption and wicking capability.
- **ALL of the knitted microdenier samples —**of 27 fabrics tested (17 microdenier, and 10 standard denier fabrics) **- displaced more air, and adsorbed more** water, than both knitted and woven standard denier fabrics.

Both nonwoven samples – one of them microdenier, one of them standard denier - **outperformed all of the standard denier fabrics.**

STATISTICAL SUMMARY:

Microdenier fabrics' scores:

- **26.75 highest knitted microdenier absorbency score overall.**
- **17.75 lowest knitted microdenier absorbency score.**
- **17.75 highest woven microdenier absorbency score.**
- **9.50 lowest woven microdenier absorbency score.**

Standard denier fabrics' scores:

- **17.00 for the nonwoven surgical wipe.**
- **14.50 for prewashed woven cotton flannel**
- **10.00 for prewashed woven cotton terrycloth**
- **5.75 for non-prewashed woven cotton flannel and interlock knit**

Within these 2 groups, it is also apparent that:

- the ***knitted fabric structure is also superior* at moisture uptake than the woven structure**.
- ***With their lower diameter and sometimes-star-shaped geometry, microdenier fibers provide exceptional absorbency due to greater surface area available to adsorb moisture***.

APPLICATION TO PRACTICE:

When choosing fabrics for quick moisture absorbency, conservators should:

- ***Select microdenier fabrics of a knitted structure rather than a woven structure***
- ***Choose fabrics having a higher GSM.*** For greater moisture absorbency.
- Disregard fiber content percentages, since microdenier fibers' capacity for adhesion overrides the absorbency provided by traditional fibers.
- Consider f***abrics used in the auto detailing industry*** as they are exceptionally heavy, absorbent fabrics.
- When cost is the dominant factor, conservators might wish to choose ***disposable wipes of a nonwoven cellulosic nature***, or ***used cotton flannel sheets.***

FUTURE STUDY:

This research is intended as an initial study to facilitate future evaluations of the abrasiveness of microdenier fabrics when removing varying soil types from fragile artifact surfaces.

Their possible use as a sink for poulticing activities also remains to be investigated.

References:

AATCC Technical Manual, 2015:
-Test Method 61-203 "Colorfastness to Laundering: Accelerated"
- Test Method 197-2013 "Vertical Wicking of Textiles"
ASTM Annual Book of Standards, Section Seven Textiles, Designation D3776/ D3776M -09a, "Standard Test Methods for Mass Per Unit Area (Weight) of Fabric.
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