

**Seth Irwin**  
Candidate for Masters in Art Conservation,  
Queen's University, Kingston, Ontario, Canada

**Randy Silverman**  
Preservation Librarian  
Marriot Library, University of Utah

## **A Comparison of Two Soot Removal Techniques: “Dry Ice Dusting” and Rubber-based Chemical Sponges**

### ***Abstract:***

Pressed by the exigency of a fire in the Sevier County Records Office (Richfield, Utah), in May, 2006, Randy Silverman employed an experimental cleaning technique called “Dry Ice Dusting” for removing soot residue from the surface of smoke-damaged ledger books. Visual observation suggested the technique was more effective than conventional surface wiping with rubber-based sponges but quantifiable analysis was impossible to consider at the time.

Accordingly a project was conceived to compare dry ice dusting with conventional rubber sponge cleaning for removing soot residue from the surface of smoke-damaged books. The study defined an experimental approach that standardized soot deposition on four types of bookbinding material (leather, fine and coarse cloth, and paper). The research compared the effectiveness of these two cleaning methods by measuring residual soot remaining on cleaned book surfaces with colourimetry, and surface abrasion using laser scan profilometry.

### ***Conclusions:***

Cleaning efficiency and abrasion using dry ice misting and rubber sponge cleaning were compared for soot removal from four types of bookbinding materials. Of the two cleaning systems, dry ice misting consistently excelled at preventing surface abrasion to the book covering materials and consistently cleaned very well. In a few instances the Gonzo® Wonder rubber sponge did slightly better at removing residual soot but with a significantly higher probability for causing surface abrasion, in some cases with a minimal number of wipes. One conclusion arising from this study is the certainty that dry ice dusting, when carefully applied, is less abrasive than traditional dry rubber sponge cleaning.

Clear characterizations of proper cleaning protocols for soot damaged books have yet to be proffered in the literature for either technique. As a result of this study it has been demonstrated that dry ice misting can be effectively used for cleaning in a non-abrasive manner if the nozzle is held approximately 18 inches from the book surface and the mist is played onto the object in a constantly moving motion. With the rubber sponge, thorough cleaning is achieved with approximately 20 passes over the soot-covered surface, with the caveat that complete cleaning is often accompanied by abrasion of friable surfaces. This was determined using the science of profilometry and colorimetry, where a link was observed between changes in colorimetric values and changes in surface topography. Finally, a standardized protocol for controlling the deposition of soot on different materials was established for conservation by relying on existing standards currently in use at the NRC Fire Research Program National Fire Laboratory in Almont, Ontario.

THANK YOU

**Randy Silverman**

***Preservation Librarian  
Marriot Library, University of Utah***

**Eric Gibbs and Alex Belaya Ph.D.**

***NRC Fire Research Program  
National Fire Laboratory, Almont Ontario***

**Nancy Binnie**

***Conservation Scientist  
Canadian Conservation Institute***

**Chris Pelow**

***Supervisor Of Surface Metrology Lab  
Novelist<sup>®</sup> Global Technology Centre Kingston, Ontario***

**John O'Neill**

***Professor of Paper Conservation and Acting Dept. Chair  
Queen's University MAC Program***

**H.F. Gus Shurvell**

***Science Advisor  
Queen's University MAC Program***

**Marilyn Laver and Rob Waller**

***Science Advisors  
Queen's University MAC Program***

**Randall Heath**

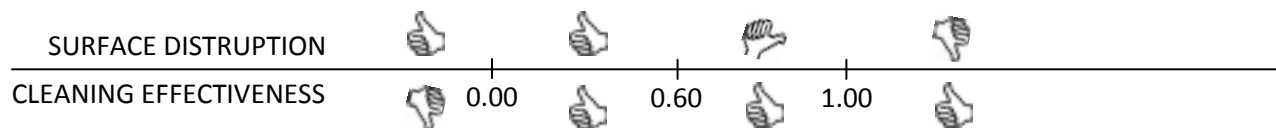
***Owner of Cold Sweep<sup>®</sup>  
Dry Ice Dusting Cleaning***

**Jason Church**

***Materials Conservator  
National Center for Preservation Technology and Training***

# A COMPARISON OF TWO SOOT REMOVAL TECHNIQUES

- ❖ < 0.00 - VALUES BELOW ZERO INDICATING THE SURFACE WAS DARKER AFTER THE CLEANING THEN BEFORE THE PROJECT BEGAN AND ALSO INDICATING THE POSSIBILITY THAT THE SURFACE STILL CONTAINS SOOT RESIDUE. BOOKS IN THIS CATEGORY DO NOT SHOW EVIDENCE OF SURFACE DISTRUPTION.
- ❖ 0 – 0.60 - VALUES BETWEEN 0.00 AND 0.60. THIS WAS THE GOAL RANGE FOR OPTIMAL CLEANING WITH MINIMAL CHANCE OF SURFACE DISTRUPTION.
- ❖ 0.60 – 1.00 - VALUES BETWEEN 0.60 AND 1.00 INDICATING COMPLETE SOOT REMOVAL BUT THE POSSIBILITY OF SLIGHT SURFACE DISTRUPTION NOT VISIBLE TO HUMAN EYE WITHOUT MAGNIFICATION
- ❖ > 1.00 - VALUES ABOVE 1.00 INDICATE THE POSSIBILITY OF SEVERE SURFACE DISTRUPTION VISIBLE TO HUMAN EYE.



## PAPER COVERED BOOK GROUP

### DRY ICE

SAMPLE #	CLEANING ABILITIES	ABRASION
P 1		
P 2		
P 3		
P 4		
P 5		

### SPONGE

SAMPLE #	CLEANING ABILITIES	ABRASION
P 1		
P 2		
P 3		
P 4		
P 5		

## LEATHER COVERED BOOK GROUP

### DRY ICE

SAMPLE #	CLEANING ABILITIES	ABRASION
LC 1	UNDETERMINED	UNDETERMINED
LC 2		
LC 3		
LC 4		
LC 5		

### SPONGE











SAMPLE #	CLEANING ABILITIES	ABRASION
LC 1	UNDETERMINED	UNDETERMINED
LC 2		
LC 3		
LC 4		
LC 5		

# A COMPARISON OF TWO SOOT REMOVAL TECHNIQUES











---

## TIGHT WEAVE CLOTH GROUP

### DRY ICE











SAMPLE #	CLEANING ABILITIES	ABRASION
TW 1		
TW 2		
TW 3		
TW 4		
TW 5		

### SPONGE











SAMPLE #	CLEANING ABILITIES	ABRASION
TW 1		
TW 2		
TW 3		
TW 4		
TW 5		

## OPEN WEAVE CLOTH GROUP

### DRY ICE

SAMPLE #	CLEANING ABILITIES	ABRASION
OW 1		
OW 2		
OW 3		
OW 4		
OW 5		

### SPONGE

SAMPLE #	CLEANING ABILITIES	ABRASION
OW 1		
OW 2		
OW 3		
OW 4		
OW 5		

Seth Irwin  
Paper Conservation  
Candidate for Masters in Art Conservation  
Queen's University  
Kingston, Ontario  
t. (+01) 505-577-1036  
sethai@aol.com

Randall Heath  
Coldsweep Inc.  
(801) 876-5432 office  
(801) 876-3315 fax  
(801) 791-5863 cell  
www.Coldsweep.com

Randy Silverman  
Preservation Librarian  
University of Utah Marriott  
Library  
295 South 1500 East  
Salt Lake City, UT 84112  
USA  
t. (+01) 801-585-6782  
f. (+01) 801-585-3464  
randy.silverman@utah.ed