

ASM International Philadelphia "Liberty Bell" Chapter Newsletter



www.asm-philadelphia.com

Wednesday, November 20, 2002 (**Note- Wednesday night, not Thursday)

Young Members Night

Spouses and guests are invited and welcome.
Williamson Restaurant, Easton Road, Horsham, PA



Speaker:
DR. MICHELLE MARCOLONGO
Drexel University

Topic:
Functional Restoration of the Intervertebral Disc of the Spine
Using Hydrogel Polymers

Michele Marcolongo is Assistant Professor in the Department of Materials and Engineering at Drexel University, since 1997, and is Scientific Director of Orthopaedics Research Institute at Bryn Mawr Hospital, since 2001. Michele has a BS in Mechanical Engineering from the University of Delaware, 1986; MS in Mechanical Engineering from Drexel University, 1989; MS and PHD in Bioengineering from the University of Pennsylvania, 1992 and 1995. Prior to coming to Drexel, Michele had four years experience with Dupont Orthopaedics as a Biomedical Research Engineer and had four years experience with General Electric Aerospace in various engineering programs.

TOPIC: Functional Restoration of the Intervertebral Disc of the Spine Using Hydrogel Polymers

Over five million Americans suffer from chronic lower back pain making it the number one cause of lost workdays in the United States. With over 20 billion dollars spent each year for the treatment of lower back pain it is one of the most expensive health care issues today. While the causes of lower back pain remain unclear, it is believed that 75% of the cases are associated with degenerative disc disease, where the intervertebral disc of the spine suffers reduced mechanical functionality due to dehydration of the nucleus pulposus. The reduction in the ability of the disc to transmit loads evenly and efficiently between vertebral bodies leads to damage in the annulus fibrosus region of the disc. Fissures or tears in the annulus can translate into a disc that herniates or ruptures, resulting in impingement of the nerves in the region of the disc which manifests as lower back or leg pain, depending on which nerves have been affected.

Our general premise is that if the initial dehydration of the degenerated nucleus can be arrested and a fully hydrated state returned to the disc, then the degenerative process (including the associated pain) would be postponed or prevented and that mechanical function would be restored to the vertebral segment. To facilitate this approach, we are investigating replacement of the nucleus with a biocompatible, hydrogel polymer made from a copolymer of PVA with poly(vinyl pyrrolidone) (PVP). Previous studies in our laboratory have demonstrated that the addition of PVP to the PVA has resulted in a hydrogel system that exhibits reduced in vitro degradation as compared to PVA alone. The increased stability of these gels is due to hydrogen bonding between the PVA and PVP chains. These hydrogen bonds, known as inter-polymer complexes, serve as secondary, physical crosslinks and provide the networks with additional resistance to PVA dissolution from the gel. Further, the copolymer gel is a memory material, meaning that it is expected to exhibit predictable, reproducible changes in geometry from the hydrated to dehydrated states. We have exploited this material property in order to insert the implant into the nuclear cavity arthroscopically, enabling this procedure to be performed in a minimally invasive manner, implanting the dehydrated material and rehydrating to a desired shape and size in situ. We have characterized the dehydration/rehydration characteristics of the hydrogel, including a mechanical and surface chemical analysis of the changes that occur to the material as a result of the dehydration/rehydration process and are now exploring the biomechanical response of the spine to the insertion of the hydrogel implants. This technique may lead to a new clinical treatment for degenerative disc disease.

Technical Chairperson

Scott Nyce
Solar Atmospheres, Inc.

Dinner Menu

Fresh Fruit Cup
Hearts of Lettuce
Roast Tom Turkey
Baked Stuffed Potato
Winter Mix
Ice Cream Croquette

Social Hour

6:00-7:00 p.m.

Dinner

7:00 p.m. Price: Members: \$20.00

Retirees: \$12.00

Student: \$10.00



Reservations are
Necessary - Call:
(215) 643-3369
(OH-DE-FOX)

Please don't call if you
have already reserved via
our web site link at

www.asm-philadelphia.com

BUS FOR STUDENTS

We encourage all Drexel and University of Penn students to take advantage of free bus transportation from Philadelphia to our monthly meetings. Simply make your intentions to attend by bus known to Jonathan Thomas at jthomas@drexel.edu by the week prior to the meeting.

ASM Philadelphia Sustaining Members (2002-2003)

Ajax Electric Company
Allied High Tech Products, Inc.
Apollo Designs
B & G Manufacturing Co.
Edward A. Boll Co., Inc.
Buehler, Ltd.
Carpenter Technology Corp.
Conroy Engineering, Inc.
Consulting Engineers, Inc.
Delaware Valley Utility Advisors
Delvest Inc.
Dial Machine Company
Donovan Heat Treating Company

Dubose National Energy Svcs., Inc.
Dynatec Process Systems, Inc.
ECRI-MSLB
Electro-Science Labs
EMSL Analytical Inc.
Exelon PowerLabs
Forensic Sciences Inc.
Fredericks Company
Hoeganaes Corporation
Houghton International Inc.
InductoTherm Corporation
Kosempel Mfg., Inc.
Laboratory Testing, Inc.

Leco Corporation
Lehigh Testing Laboratories Inc.
Lindquist Steel Inc.
LTK Engineering Services
MMA Laboratories
Magna-Tech P/M Laboratories
Metlab
National Basic Sensor
Newage Industries, Inc.
Penn Stainless Products
Pressure Technology, Inc.
Quaker Chemical Corporation
Ramball Testlab, Inc.

Rex Heat Treat
A.L. Singmaster Personnel Svcs.
Solar Atmospheres, Inc.
SPS Technologies, Inc.
Superior Tube Company
Tinius Olsen Testing Machine Co., Inc.
Vacuum Furnace Systems
Robert Wooler Company

Institutional Members

Drexel University
Temple University
Villanova University
William Tennent High School

Chapter Officers 83rd Year

Don Jordan, Chairperson
Solar Atmospheres, Inc.

Jim Watters, Vice Chairperson
Delaware Valley Utility Advisors

Ron Smith, Secretary
Materials Resources International

Joel Muzik, Treasurer
Ramball Test Laboratories

Robert DeKalb, Executive Secretary
Robert Wooler Co.

Fred Klock, Exec. Treasurer
SPS Technologies

Advertisers in the 2002-2003 ASM Yearbook

Air Products	L&L Special Furnace Co., Inc.
Allied High Tech Products, Inc.	Laboratory Testing, Inc.
Apollo Designs	Leco Corporation
Athena Controls, Inc.	Materials Resources International
B & G Manufacturing Co.	Micron, Inc.
Bennett Heat Treating & Brazing Co., Inc.	Newage Industries, Inc.
Buehler Ltd.	Penn Stainless Products
Carpenter Specialty Alloys	Pressure Technology, Inc.
Consarc	Ramball Test Lab, Inc.
Consulting Engineers	Rex Heat Treat
Drexel Univ., Dept. of Mat. Eng.	A.L. Singmaster Personnel Svcs.
Duane, Morris & Heckscher	Solar Atmospheres, Inc.
Electron Energy Corp.	SPS Technologies, Inc.
Evans Heat Treating Co.	Struers, Inc.
Forensic Sciences, Inc.	Superior Tube Company
Hoeganaes Corporation	Tinius Olsen Testing Mach. Co., Inc.
Houghton International Inc.	Vacuum Furnace Systems, Corp.
Inductotherm Corporation	Westmoreland Mech. Testing Machine
Industrial Metal Treating	Williamson Restaurant
Kosempel Mfg. Co.	Robert Wooler Company

Welcome New Members...

Manny Butera	Matec Micro Electronics
Thomas B. Cameron	Dentsply Ceranco Inc.
Anthony A. Caiazzo	Material Science Corp.
Howard W. Cheetham	Consultant
Thomas W. Edwards	AG Fluoropolymers
F. J. Fahrendorf	P.M.F. Alloys Inc.
Alireza Hosseini	Student
Vikram J. Kaku	Temple University
Srinivasan Kesavan	FMC Corporation
Rob W. Kowalik	NAVAIR
Wade Krejdivsky	SPS Technologies
Samuel E. Lofland	Rowan University
Dennis McDonough	McDonough
Donald E. McGarrigan	Foster Wheeler USA Corp.
Matt McMichael	Bae Systems
Richard L. Orner, Jr.	Engineered Arresting Sys. Corp.
Michael J. Poland	Exelon PowerLabs
David R. Poulin	Specialty Resources Inc.
Dave Rohrbaugh	Vacuum Furnace Systems Corp.
Richard Snelson	Measurements Inc.
John T. Stasik, Jr.	RV Industries Inc.
Tim Steber	Solar Atmospheres, Inc.
Jim Turnure	R & B Inc.
Vern Wedeven	Wedeven Association Inc.



Chairperson's Message

November, 2002

This month's meeting will be Young Members Night, which is dedicated to both high school and college students. We are expecting our usual great turnout of students for this meeting, so please don't forget to make reservations by calling 215-643-3369 or via our web-site

at www-asm-philadelphia.com. Also, ***please be sure to note*** that this meeting is on ***Wednesday***, November 20th, not our traditional Thursday night.

We have an outstanding speaker and topic this month; Dr. Michele Marcolongo of Drexel University will discuss "Functional Restoration of the Intervertebral Disc of the Spine using Hydrogel Polymers". This is a great opportunity for us to experience the exciting link between bioengineering and materials engineering. This topic is especially well suited to young members still exploring their career paths.

Also of interest to young members will be a brief talk by high school student Marissa Berkowitz, who will give us an overview of her experience at this past summer's Materials Camp at ASM International Headquarters in Materials Park, OH. This is the third year in a row that the Philadelphia area has been represented by a local high school student at the week long Materials Camp, and we want to continue the tradition. This is a great opportunity for attending high school students to get first hand knowledge of this great program offered free by ASM International.

Don't forget that we have a \$25.00 drawing for any full time student in attendance this night. See you November 20th!

Don Jordan
2002-2003 Chairperson

Welding: Technology, Processes, Materials, Design, Quality A course offered by Drexel University – January 6-10, 2003

Drexel University is offering a professional course aimed at engineers who have to deal with welding problems and all of their aspects: technology, process, design, and quality. The course covers standard approaches to welding as an engineering discipline and relies on applicable standards like AWS, ANSI, and ASTM. The course will prepare engineers to meet the requirements for the qualification of welding engineers, as prescribed by AWS Specification B5:16:2000X. Although a one-week course is not sufficient for complete preparation, it can serve as an excellent basis for further individual effort toward this aim. Having this in mind, the course designers have chosen the AWS Handbook, Volume 1 covering all basic aspects of welding, as the course notes. This is also the reason for the very intensive schedule for the course, including 30 hours of lecture over 5 working days. The program is presented by the Department of Materials Engineering, Drexel University (S. Kalidini, R. Doherty, R. Knight, A Sedmak).

Outline of the Program

Welding Heat Sources and Arc Physics - Power sources, shielding gases, and arc stability.

Welding Processes - Flux core, MIG, TIG, laser, electron beam, subarc, friction, and others.

Welding and Joining Metallurgy - Structure, solidification, phase transformations, and weldability of typical engineering materials.

Weld Design - Structural fabrication requirements and mechanical properties.

Quality Assurance - NDE Processes - characteristics, advantages and limitations of each.

Practical Welding and Related Applications - Summary of design, safety, and quality assurance considerations.

Contact the Materials Engineering Department at Drexel University for additional information.

Phantoms Hockey

A Phantoms Hockey game is tentatively scheduled for Saturday, January 25, 2003 at 3:00 p.m. The cost is \$14 for adults and \$8 for kids under 14. Due to the non-refundable cost of reserving a block of tickets for groups, we would first like to get an idea of membership interest. If you are interested in attending, please contact Melissa Morris at mmm@solaratm.com by November 8, 2002.

MEI Course - "Metallurgy for the Non-Metallurgist" - Beginning November 12th, 2002

The Greater Philadelphia Section of The American Society for Nondestructive Testing and The Philadelphia "Liberty Bell" Chapter of ASM International is presenting the MEI course Metallurgy for the Non-Metallurgist.

When: Tuesday evenings 12 November 2002 through 4 March 2003
6:30 to 9:00 PM

Where: SPS Technologies -- Highland Ave. Jenkintown, PA

Cost: \$270.00 includes the 15 lesson course with 2.8 CEUs, Qualified ASMI instructors and a video presentation each week.

Who should attend:

This is an ideal first course for anyone who needs a working understanding of metals and their applications. It has been designed for those with no previous training in metallurgy, such as technical, laboratory, and sales personnel; engineers from other disciplines; management and administrative staff; and non-technical support staff such as purchasing and receiving agents who order and inspect incoming material. A basic understanding of chemistry and physics is strongly suggested.

Course overview:

- Presents a brief history of metals, providing insight into the discovery and use of pure metals and alloys thousands of years before the modern era.
- Provides an explanation of the unique physical characteristics of metals, including the reasons that metals behave differently than such non-metals as plastics, glass, wood etc.
- Explains the basis for the selection of different metals for specific engineering application.
- Describes how metals are alloyed to achieve desired properties.
- Provides details on one of the most important of all alloys - steel - and discusses how steel is heat treated to achieve various combinations of strength and ductility.
- Explains how metals are formed into the components that are used in our most important engineered machines and structures.
- Describes how metals are tested to determine critical properties, such as strength, ductility and toughness.
- Discusses why metals corrode, why different metals behave differently in corrosive environments, and how the corrosion of metals can be controlled.

For more information call Fred Klock or Bob Rich at 215 572 3485 Fax 215 572 3725

Return the lower portion of this form, with a check payable to "Philadelphia ASMI" to Fred or Bob at SPS Technologies; Highland Ave.; Jenkintown, PA 19046-2299 before 5 November 2002.

Name: _____ Work phone: _____

Company

Name: _____

Co.

Address: _____

Your Position: _____ ASM Member # (If Ap.) _____

Home phone & address: _____

The American Society for Nondestructive Testing recently ran a very interesting article about the manufacturing and testing of the Liberty Bell. Since it gives insight into the art of metallurgy in colonial times, we have decided to reprint it for our newsletter. It is too long to fit in one issue. What follows is Part 2.

Bells in the Colonial Community

Bells were utilitarian in colonial America. They afforded the quickest and most efficient way to communicate with the townspeople. They rang to announce the hours, church service, community events, convening of the legislature, public assembly, and to signify public mourning (tolling slowly with the clapper muffled in heavy cloth) as in the death of citizens of note or even at the abuse of colonial liberties. As the State House bell, the Liberty Bell rang for many of the events that eventually led to the American Revolution. In September of 1777, the one ton Liberty Bell was removed from its steeple in Philadelphia for a nine-month stint tucked under the floorboards of Zion Reformed Church in Allentown, Pennsylvania. As the British approached, the citizens of Philadelphia had spirited away any metal that could be recast as ordnance. All bells, including the bell from the State House, were brought down and hidden. During its long tenure in the State House belfry, cracks were noted in the bell and repairs in the manner of the day were made. But in February of 1846, the Liberty Bell was cracked for good. It rang its last in honor of Washington's birthday. It was removed from the steeple belfry and placed in Declaration Chamber of Independence Hall.

American Icon

The Liberty Bell played an anonymous role pretty much up until the fiftieth anniversary of the American Revolution. On that anniversary, many things, such as the old State House bell and Independence Hall itself, began to grow in importance for the American people. In the 1840s, the bell's association with the struggle for American freedom, in addition to its biblical inscription "Proclaim Liberty thro' all the Land to all the Inhabitants thereof" made its image a natural choice for abolitionists. It appeared in the frontispiece of the 1837 edition of Liberty and thereafter became a focus for anti-slavery groups. Finally, reeling in the aftermath of the Civil War, all factions of the country sought to celebrate a mutual history, that is to say, the American Revolutionary War. To that end, the Liberty Bell was toured in many regions of the country throughout the 1880s and 90s.

Fragile Structure

The Liberty Bell is a fragile structure principally because of a long crack. It's probable the propensity for cracking is a result of casting technology, or lack of it, in the mid 1700s. Multiple crucibles make a consistent alloy difficult and inherent in the process of adjoining pours are variations in crystal structure that produce resident stresses. Also, adjustments made by Pass and Stow, first for brittleness then for tone, may have left the strength of the alloy compromised. The long fine crack extends well beyond the drilled and pinned portion of the Liberty Bell crack we are so familiar with. It travels up through the word "Liberty" in the inscription and then upward and to the right well into the crown where it finally terminates under the yoke.

Nondestructive Testing of the Liberty Bell - Bicentennial Inspection

cont'd from page 3

In 1975, X-ray fluorescence to determine metallic content at the bell's surface was performed at ten different points around the rim. Again in 1975, radiography was done in preparation for a bicentennial move to a new site. Universal Technical Testing Laboratories, Inc. of Philadelphia, Pennsylvania was asked to make the radiographic examination. Forty single-section radiographs covering the entire bell were made using iridium-192 in 52 and 100 Ci source strengths in a gamma ray projector. Some previously unknown shrinkage separations and cracks around the shoulder of the bell were detected. New cracks and those known to exist were definitively charted for the first time as a result of these radiographs. At the same time, a single double-wall radiograph (at the time, the world's largest) was suggested by Ralph E. Turner, a former ASNT president. The large radiographic exam, performed by Technical Operations, Inc. of Boston, Massachusetts, was technically challenging and required special licensing from the Nuclear Regulatory Commission for the 670 Ci cobalt-60 source. Much of the setup for the test required custom fabrication. Fourteen sheets of film measuring 52 by 84 in. were stacked in a frame constructed specifically to accommodate film of such large dimensions. The source was shielded in a lead ball twenty-four inches in diameter and weighing two thousand pounds. A collimator confined the radiation to a five-foot beam spread and was aimed precisely with a rifle scope. Reinforcement and special rigging were required to move the source, shielding and containing structure (weight concentration over two tons) into place inside Independence Hall's 18th century structure. Six tons of high-density concrete block were hauled into place behind Independence Hall to provide shielding. The exposure took seven and a half hours and determined a crack in the bell's clapper and cracks and corrosion in tie rods in the bell's yoke.

Damage Assessment

Plans were already in place in April of 2001 to examine the bell's condition again as preparation for a move in 2003 to the new Liberty Bell Center now under construction. The exam schedule was expedited when the bell was hit repeatedly by a vandal with a hand sledge. Conam Inspection, Inc. of Sharon Hill, Pennsylvania

was asked to evaluate the damage with radiographic testing. Conam assembled a team of twelve that would invest over 300 hours in the preparation and execution of an eight hour inspection. Vince Roding, of the 1975 inspection team, also participated in the project. A total of six radiographs in 14 _ 17 in. and 10 _ 12 in. formats reproduced the film size and some of the positioning of the 1975 radiographs along with added perspectives. These radiographs were scanned, converting them to digital format. The images were then processed to enhance readability. Interestingly, the images from 1975 were also scanned and digitally enhanced. Allowing for improvements in film technology and some film degradation in the 1975 radiographs, the images were quite good and provided an excellent platform for comparison. Digitally acquiring the radiographs placed them in a permanent format that will not degrade over time. The National Park Service, most interested in pinpointing the active crack tip and determining substantial differences in the area around it, decided to investigate further with other NDT methods. The Boeing Company was asked to submit a proposal for evaluation of the bell. Boeing originally planned to develop an eddy current test to pinpoint the tip and to make an overlay plotting it. The overlay could then be used for future comparison purposes. In May 2001, Boeing began by mapping the bell with electrical conductivity to determine brittle areas. Ultrasonic testing was then used to determine laminar flaws. Laminar flaws are parallel to the surface but inside the structure and therefore not apparent in a surface inspection. Unfortunately, the bell surface was greatly attenuative. That is, much of the energy of the ultrasound wave was absorbed instead of reflected. Because of this, the sensitivity of the ultrasound inspection was diminished and only gross laminar flaws could be detected. Boeing also used liquid penetrant testing in areas around the blows from the sledgehammer attack. Extra care had to be taken in surface cleaning but it was "Probably the most revealing [test] in a direct and straightforward way ... It showed more clearly the crack damage around the sites of impact." (Andrew S. Lins, Chief Conservator of the Philadelphia Museum of Art and consultant to the National Park Service in the care of the Liberty Bell - April 10, 2002). Eddy current induces an electromagnetic field in the surface of the part. A variation in the field indicates a discontinuity. However, the Liberty Bell

exterior is noisy, with many small fractures and inclusions, probably as a result of casting. Eddy current tests conducted by Boeing on the exterior of the bell could not conclusively locate the crack tip. The bell's interior is relatively clean and therefore free of noise. Eddy current tests of the interior surface pinpointed the crack termination precisely. The National Park Service is still pursuing issues of material stability. Nondestructive testing methods of the types used in 1975 and 2001 will assuredly play a role in the ongoing care of the bell. NDT test results are now a permanent record of the condition of the Liberty Bell at the time of testing and will be used as points of comparison for future tests. Additional NDT methods are also under consideration. The NPS is investigating the use of strain gages permanently affixed across the active crack tip with the potential that they can be remotely monitored to immediately indicate any changes in the bell structure.

Conclusion

Today the voice of the bell is poignantly quieter. It is tapped annually on Martin Luther King Day. "It is only tapped - not rung or pealed. The bell's literal, physical fragility quite neatly parallels what many people think of as the conceptual fragility of human liberty in the face of war, holocaust, dictatorial regimes, discrimination, and etc. The bell tapping ceremony held annually on Martin Luther King Day is intended to be a reminder of the great sacrifices made throughout our history in the fight for human freedom." (Karie Diethorn, Chief Curator for Independence Park and the Liberty Bell - April 5, 2002)

TNT wishes to express its gratitude to Karie Diethorn, Chief Curator, and Phil Sheridan, Public Affairs Officer, of Independence National Historical Park and Andrew S. Lins, Chief Conservator of the Philadelphia Museum of Art, for their generous contributions of information and time. TNT would also like to thank Vince Roding of Vincent F. Roding NDT Training and Consulting, Ira Sherman, Senior Manager of Quality Systems and Processes, and Lou Truckley, Nondestructive Testing Specialist, of the Boeing Company, and Jon Kaus of Agfa NDT.

Copyright 2002 © The American Society for Nondestructive Testing, Inc. Reprinted with permission from [The NDT Technician: A Quarterly Publication for the NDT Practitioner](#).