Microfiber Shedding: Hidden Environmental Impact

The Invisible World of Automotive Textiles

E-Textiles Series: Smart Fabrics for Women’s Sports Apparel

Developments in Eco-Friendly Textile Pretreatments

Accelerated Laundering and Finish Durability: Does One Cycle Equal Five Home Launderings?
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Pretreatment is an inevitable part of textile processing, in which desizing, scouring, and bleaching are the most important processes from a manufacturing point of view, as the quality of further processing depends on them. More environmentally friendly methods of desizing, scouring, and bleaching fabrics can include the use of enzymes, ultrasound, and even CO₂ to replace chemicals, energy, and solvents.

54 Accelerated Laundering and FinishDurability: Does One Cycle Equal Five Home Launderings?
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Accelerated laundering tests are much desired by the industry, since they save time, money, energy, and water. AATCC TM 61: Colorfastness to Laundering: Accelerated, using a Launder-Ometer to measure color change approximating that obtained in five cycles of laundering, is widely used throughout the industry as an accelerated laundering test for various finishes; however, that use has not been studied under laboratory conditions. The current study sought to compare the effects of laundering using a top-loading washing machine and accelerated Launder-Ometer testing to discover if such a test could mimic the effects of that laundering on the durability of water- and oil-repellent finishes to multiple home launderings. The study found that while an accelerated laundering test may suggest a convenient method for assessment of finish durability, any simple correlation with numbers of conventional home launderings cannot be assumed, and may vary greatly even with two very similar finishes.
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Dear Members,

After more than 20 years as the leader of AATCC’s staff, Executive Vice President John Y. “Jack” Daniels retires from AATCC in March of 2018. As he contemplates the end of the weekly 250-mile commute to his home in Greenville, SC, from the AATCC Technical Center in Research Triangle Park, NC, Jack wants to share with all of you how grateful he’s been to be a part of this Association, and to get to work with AATCC’s members.

Many Thanks! Musings from an Old Staffer

As I finally see the proverbial light at the end of the tunnel, I wanted to thank the many volunteers and staff members who have been so unselfishly supportive of my role as executive vice president. I’ve heard it said, one should never miss an opportunity to say, “Thank you!” I don’t want to miss this opportunity.

Looking back over the past 21 years, I want to thank the multitude of people that have made my job so enjoyable and meaningful; so many of you have inspired me more that you will ever know. Obviously, I cannot thank each of you in the short space I’ve been allowed, so I will concentrate mainly on our past presidents, whom have been so helpful to the staff and me at AATCC.

First, had “Sweet Ole Bill” (previous Executive Director William R. “Bill” Martin) not hired me as AATCC Laboratory Manager back in 1974, I dare say I would not have been considered for my current position, Executive Vice President (previously Executive Director), many years later. Past President Fred Jones led the search committee leading to my hiring, way back in 1995-1996. During that time, there was a big debate as to the future direction for the Association. After a lot of consternation and evaluation of candidates, I finally landed the job. I credit Nolan Etters, who unfortunately is no longer with us, as the driving force behind my hiring. I must add quickly, however, that the individual leading the charge for an alternative candidate became one of my biggest helpers and a truly good friend over the years, and for that I am truly grateful. You know who you are, Roland!

Back in those days, we held February committee meetings. I attended the February 1996 meetings while still working for Springs Industries, shortly after accepting my new position to take over as Executive Director the following month. At that February Council meeting, I was reintroduced and informed that the Council had approved the Association’s first PC-based membership database software, iMIS, and that I would be responsible for its successful implementation. After months of customized programming and training (with occasional gnashing of teeth by many staff members), we were able to implement iMIS. (iMIS served us well for fifteen years, and then we transitioned to our current system, MemberMax, to save considerable costs.) At about that same time, we also introduced AATCC’s first website and email system—seems like a million years ago, now!

Nelson Houser was AATCC President from 1997-1998, just as the Asian currency crisis hit America’s shores. Nelson had as his presidential theme the concept of AATCC’s interfacing with many like-minded textile organizations. Reaching out and cooperating with other groups would be a way of enhancing AATCC.

We soon began exhibiting at ShanghaiTex, ITMA, later at ITMA-Asia, Techtextil, IFAI Expo, and other major industry events. At the same time, we increased our participation with other associations in conducting joint programs, such as with INDA, [TC]^2, Society of Dyers and Colourists (SDC), SGIA, and others over the years.

Nelson has continued to help the staff in many of our education activities, including our webinars, which Nelson helped inaugurate with a series of presentations he delivered on the various dye classes. Nelson has been a great friend to the Association, and to me personally, and was the first and one of only two recipients to receive the special AATCC Education Award, in 2015. Nelson has been our “go-to” member for all questions dealing with dye applications. The US lost more than half of the American textile manufacturing industry during those early years, but with Nelson’s and others’ tremendous leadership, AATCC survived!
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It’s hard to adequately describe a man such as Charles E. Gavin III, the AATCC President (1999-2000) who served after Nelson. Charles’ strong leadership and bent for philanthropy led to AATCC’s launching of the AATCC Foundation Inc., even during troubling financial times. Charles was the first contributor to the AATCC Foundation, and helped secure other large donations from long-time supporters, Hugh and Phil Patrick. Hugh Patrick had also been a past president, and became Treasurer following Don Robinson’s retirement from the position after 25 years.

Charles and Hugh, among others, were instrumental in the Association’s acquisition of the American Dyestuff Reporter in 1999, which was merged with Textile Chemist & Colorist to launch AATCC Review. In 2001, AATCC Review received an Apex Award for “most improved” publication! Our many-times award-winning magazine continues to this day as AATCC’s flagship publication.

Charles has remained a great friend and guiding figure on the Board of Directors for AATCC Foundation, which has gained now more than $1 million in donations, including hundreds of donations from AATCC members. Several additional large donations have come again from Charles and Carol Ann, among others. We now have 16 named scholarships, including the Charles E. Gavin III Family Scholarship. What foresight Charles had so many years ago, and what a great friend he has been to AATCC, and to Marsha and me! Some of my fondest memories are of visits Marsha and I have made (along with a number of our Association’s and Foundation’s leaders) to Belle Meadow Farms, Charles’ beautiful home in Wartrace, TN.

Another good friend who made a major impact upon AATCC is John Darsey, AATCC President during 2001 and 2002. Many may remember it was John’s idea that AATCC become much more involved in retail activities. John’s leadership led to the formation of the Concept 2 Consumer® group. AATCC trademarked the name, and through this group we now conduct, with the help of many great volunteers, the very successful C2C Student Design Competition and the relatively new C2C Student Merchandising Competition. Plans are now in the works to establish a new student design competition in cooperation with the Runway of Dreams Foundation. From John’s initial vision, we now have specific conferences, articles in our magazine, educational tracks at our International Conference, and specific scholarships through the AATCC Foundation, all targeted to this sector of the AATCC membership. John deserves a great vote of thanks for his foresight.

John, fond of practical jokes, was responsible for my leaving my wallet at the soda counter at a gas station in Maryland on a road trip (along with Roland Connelly and Peggy Pickett) to New York City. I had to have Peggy “sponsor” me on that trip and pay for my meals and frequent beers. I fondly recall John’s and my pioneering video Skype calls while he was president—everyone up and down the halls of the Technical Center could hear me yelling at the computer, “Can you hear me now?”

It was during John’s presidency that we saw continued mergers of local sections and a reduction in staff due to the relentless bad economy and the dot.com bust. However, during that time we also witnessed: the Association’s Council’s approval for all committee and board meeting minutes to go electronic; the launching of AATCC Proficiency Testing Programs, now quite popular and lucrative; as well as the launching of the AATCC Outstanding College Graduate of the Year program. The long-awaited 75-year history book of AATCC, Dyeing for a Living, was finally published—about five years late—with help from several volunteers and staff.

Even with the US textile manufacturing industry still crumbling around us, the Association made the bold decision to begin the remodeling of the AATCC Technical Center, at that time about 40 years old. Over the next couple of years, that would lead to new roofing, ceiling tiles, lighting, HVAC, boiler, the remodeling of lower floor women’s restroom, a splash of paint, refinishing of laboratory cabinets, some new carpet here and there, and the installation of a smoke alarm system and an emergency generator. I recommend such refurbishment be done about every 40 years, whether the Technical Center needs it or not!

Roland Connelly came to me shortly after my arrival and said that even though he had promoted the hiring of another individual, he would throw his support behind me and my efforts. Roland kept
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his word, and there have been few who have provided as much service to our Association, and to me personally, as Roland. The man with the Blaze Orange tie never turns us down!

I asked Roland during his presidency (2003-2004) to take on the arduous task of amending the AATCC Constitution. Staff came armed with a graduate-student study conducted by students of the University of North Carolina, Chapel Hill’s Kenan-Flagler Business School. The study indicated that change was desperately needed to allow the Association to operate much more nimbly in a global environment. The amending rules of the AATCC Constitution make such changes purposefully difficult, to make sure that amendments to our primary governing document happen infrequently, and with great care. Roland appointed Fred Cook, another future president, to chair this task, and—with the help of many volunteer leaders, and a year of numerous ad hoc meetings and letter ballots—Fred and Roland helped transform the governance of AATCC from an overly large rubber-stamping Council of approximately 60 geographically elected representatives, to a much more flexible Board of Directors with 21 members, based in large part on their functional jobs within the Association, and to a smaller extent on geographical representation.

The new Constitution also provided for the election of a new President-Elect, whom after two years would automatically rotate up to become President, and subsequently Immediate Past President. That change has served the Association extremely well. Our officers are very competent and well-trained for their duties.

The amendments also included the formation of Interest Groups, officially sanctioning Concept 2 Consumer® group mentioned earlier, as well as a new Materials Interest Group, along with the renaming of our historical dyeing and finishing interests into the Chemical Applications Interest Group.

Roland continues to speak at many of the Association’s programs, including the Color Management Workshop. Roland was a founding participant of the original Color Measurement Workshop, nearly 40 years ago. He was the second recipient of the AATCC Education Award for this outstanding service!

Roland also brought to AATCC our popular UV Calibration Fabric Program, and has helped many of our technical staff on a vast number of color measurement questions and training. During his term as president, and with the help of many great volunteers and leaders, AATCC witnessed: the launching of our first distance training program (we now have more than twenty test method trainers globally teaching AATCC and ASTM textile testing); the elimination of the Association’s Advertising Department, with commensurate outsourcing to Chris Shaw Media in the UK; the development (with the NCSU College of Textiles) of CDROMs on Basics of Dyeing and Basics of Fibers, precursors to our current online Textile Fundamentals; the development of the online Buyers Guide; the first Technical Supplement published jointly with ASTM Committee D13, as well as downloadable test methods from the AATCC website; the launch of the first AATCC online newsletter; and the co-location of the AATCC International Conference & Exhibition with the American Textile Machinery International Exhibition (ATME-I) in Greenville, SC, USA. Many thanks to Roland, for becoming a great friend and for keeping his word—if he would just leave the Blaze Orange ties at home!

Bob Lattie, “the ubiquitous Bob,” has been a stalwart in the Association’s efforts to become more international (today, approximately 25% of our members are from outside the United States). Bob led the AATCC Global Interaction Committee, seeking ways for AATCC to become more of a global player, when I first began this job. Later, Bob became chair of the AATCC International Test Method Committee and led the US Technical Advisory Group (TAG) for ISO TC 38-Textiles, which AATCC and ASTM D13 co-manage.

Bob’s expertise in the international test methods arena is legendary, and during his tenure, many AATCC test methods were incorporated into ISO. Bob represented AATCC and the US textile testing interests extremely well over many years. Bob told me frequently that if there were a meeting anywhere in the world concerning textile testing, he would be there!

AATCC formed our first international local section in India, and Bob was a guest speaker at the inaugural program. Bob represented AATCC at several SDC annual meetings, and could always be counted upon to find a good watering hole.
During his presidency (2005-2006), Bob, with the help of John Darsey, assisted AATCC to acquire the assets of the Computer Integrated Textile Design Association (CITDA), but alas, that group had been suffering, and we were never able to resurrect its activities.

During Bob’s presidency, the Association launched the initial online digital article archives, (now provided through Textile Technology Complete by EBSCO), in the Members-Only portion of the AATCC website. The Association, with the help of many volunteers and staff, also launched the inaugural C2C Student Design Competition and gained 86 students from 25 colleges and universities. With the strong encouragement from Fred Cook, that same year, the Materials Interest Group launched their first Student Engineering Competition, which is currently under study for improvement.

With the continual drive to become more international, AATCC exhibited for the first at ShanghaiTex, and began offering a new Developing Nations discounted membership.

A key financial decision was made during Bob’s presidency, that of terminating the AATCC Pension Plan and enhancing the Association's supplemental 401(k) Plan. Although painful at the time, this decision has saved the Association hundreds of thousands of dollars, while attempting to keep the staff “whole” regarding their retirement benefits.

Fun things occurred as well! Who can forget Dick Aspland dressing up and playing William Henry Perkin, as the Association and AATCC Foundation celebrated the Sesquicentennial of Mauvine—the discovery of the first synthetic dye!

AATCC Foundation acquired the Charles H. Stone Scholarship at this time, from the recently merged Piedmont, Palmetto, and Northern Piedmont Sections, to offer its first scholarship, followed quickly with a another very generous gift from Charles and Carol Ann Gavin, to form the Charles E. Gavin III Family Scholarship. Enjoy a well-deserved retirement Bob!

Another talented AATCC President (and beer drinking buddy—I have many) Martin Bide, has been of terrific help as well. During his presidency, Martin primarily focused on the Association’s long-term relationship with the SDC, as well as with the Association’s publications efforts. Martin served a term as Publications Committee Chair and currently serves as our first Editor-in-Chief for AATCC Journal of Research.

As an educator, Martin has been called upon numerous times to represent AATCC at annual SDC events, and has spoken at a number of AATCC activities in India and China for the Association. We considered forming a local section in mainland China, but alas, legal issues in China precluded that. Martin, along with Nelson, are two of our few remaining US members who have worked in the dye manufacturing industry, and have experience in matters pertaining to dyes and their physicochemical properties. Along with Harold Freeman, they have helped in discussions pertaining to the Colour Index, which the Association jointly publishes with the SDC. Martin has recently been working with a graduate student to help AATCC evaluate dyes that might lend themselves for new test method verification fabrics. In addition, he is currently authoring a new coloration book for AATCC, targeted to the retail audience. Martin has also provided book reviews, talks, and general support for AATCC.

I remember the joy I had several years ago at a series of AATCC committee meetings: as Martin walked into each committee meeting, I introduced him as our nation’s newest citizen! Martin and I also shared a wonderful adventure traveling through India with Jayakumar “Kumar” Gopalakrishnan, our first international test method trainer. I remember the admonishment I received from Kumar when I jumped out of the car to take a picture of a wild elephant that stood near the side of the road: Kumar screamed at me, “You’re going to get us killed!”

I greatly appreciated Martin’s serving as chair of the Employee Benefits Committee—a subject near and dear to the staff and me. Martin always demonstrates good balance in the deliberations.
pertaining to important matters for the staff, such as health and dental insurance, life insurance, retirement funding—and obviously, their associated costs.

During Martin’s presidency (2007-2008) many good things occurred with the help of our great volunteers: The AATCC Technical Manual was translated into Mandarin through an agreement with the CTIC in Beijing; we began placing emphasis on and were successful in gaining C2C-related student chapters at schools with programs in textile fashion and design; new CD videos for demonstrating key AATCC test methods were developed; and the William R. Martin Jr. Walkway was built and dedicated with purchased and inscribed bricks from our members, with donations going to the general scholarship fund of AATCC Foundation. Also during Martin’s tenure as president, student chapters were launched in India, and numerous joint programs were held in the US and internationally with partnering organizations.

What can one say about the gentleman from Georgia? Fred Cook had three major themes for the Association as AATCC President (2009-2010): expansion of the organization’s base, globalization enhancement, and partnerships. As a fellow Georgian (I was born in Kentucky, but grew up in Decatur, GA), Fred and I have had a long-lasting friendship (he always reminds me of Colonel Sanders, who started his chicken business not far from where I was born in London, KY).

Fred took over the AATCC presidency after a very troubling economic recession, during which time our officers asked me to cut operating expenses by 25%—a heartbreaking and painful task for any organization. Fred had a similar philosophy to Nelson’s, that of our continuing to engage with other industry groups, and cited Ben Franklin’s “Gentlemen, we must all hang together, or surely we will all hang separately.” It was during this time that we began in earnest to develop membership recruiting outside the US with contracted representatives.

During Fred’s presidency, we significantly increased interactions with ASTM, negotiated to resell ASTM textile standards, and included ASTM test methods in our in-house Introduction to Textile Testing workshops, as well as into our International Test Method Training Program. Fred helped launch the Student Materials Competition and worked diligently to develop the newly formed Materials Interest Group.

During Fred’s term, we also co-located the AATCC International Conference with MEGATEX in Atlanta and began participating in Outdoor Retailer Shows. To reach more international members, the Association launched our webinar series, and developed our online Textile Fundamentals educational series through the NCSU College of Textiles. If I could just get Fred to put down Facebook for a few minutes and check his email!

AATCC President Mike Tyndall is perhaps one of my oldest friends. During my early years as AATCC Laboratory Manager, Mike did a summer internship with AATCC, as he was finishing his degree from NCSU. Mike has truly been helpful in his willingness to speak at many AATCC’s programs and has been an extremely good friend to the staff. The support that AATCC has enjoyed in the way of participation in our many committees and events from our members at Mike’s employer prior to retirement, Cotton Incorporated, has been a godsend for so many of our activities. Since he was located close to the Technical Center, Mike has always been willing to help out on a minute’s notice. His wisdom and experience in textile chemistry and product development, and his willingness to call on members of the global textile industry on AATCC’s behalf, have been invaluable to AATCC.

During Mike’s presidency (2011-2012), he called on Fred Cook to chair a five-year strategic plan, and launched a retail survey to learn of that sector’s impressions of AATCC and their use of AATCC test methods.

Mike has been a frequent representative to SDC meetings, and along with Martin and Bob, has a penchant for English ale! How many knew Mike once played in an opening band for Steppenwolf?

A love for textile chemistry, teaching, and writing on a diverse array of chemistry topics, has always been Peter Hauser’s calling. Another local AATCC President, Peter (2013-2014) has been just a call away and a frequent visitor to the Technical Center. During Peter’s presidency, the Association launched the new AATCC Journal of Research, publishing peer review papers that were once carried in AATCC Review in their own journal.
As a key element of his presidency, Peter sought to bring AATCC to Latin America. He and Maria Thiry, AATCC Publications/Membership Director, exhibited at ColombiaTex and at the FLAQT Conference, both in Medellin, Colombia. We continued to strengthen our relationship with kindred bodies as the ColombiaTex event was coordinated with our friends from SPESA and [TC]².

Peter was also willing to travel to both China and India, on behalf of AATCC, to present papers at joint programs we conducted with textile groups and universities in those countries. During many of his own travels for the College of Textiles, Peter served as a wonderful ambassador for AATCC, and kept an AATCC membership PowerPoint presentation ready to share. Peter also participated in annual SDC events for AATCC, and is another I've found to enjoy a pint of England's finest brew!

Peter was on hand to lead our celebration of the 50th anniversary of AATCC's Technical Center during the 2014 committee meetings. I hope to see all of you at AATCC's centennial celebrations in 2021, when we open the time capsule located in the lobby of the Technical Center!

We enjoyed the Association's second female president in our 96-year history with Sandy Johnson (2015-2016). Not only that, Sandy was a dyer in the early part of her career! Those two characteristics for our presidents have been few and far between! Sandy was an absolute joy as President and worked diligently with volunteers and staff to develop our first Retail Lighting Summit. This area of activity for AATCC is expected to increase substantially, and Sandy, Roland, and a few others are hard at work on our second program and other related activities pertaining to color measurement and perception of LED lighting.

Equally important, Sandy was very instrumental in helping review and design customization for the new Zengine by WizeHive electronic scholarship portal. The new portal will allow the more than 90 submitting students to upload their applications, personal and faculty letters of support, and copies of transcripts to AATCC Foundation, which now provides more than $70,000 in scholarship and research grant funding each year. Scholarship committee reviewers can log onto this platform to retrieve the students' application information. The new portal represents a great savings in time, compared to the previous procedure of manually scanning and emailing these many items to the various scholarship committee members.

Bert Truesdale is serving as the current AATCC President (2017-2018). For the past two years, I have noticed the thoughtful responses Bert, as president-elect, has always offered on numerous questions to the Board of Directors. Bert is an actual “mill-man”—once an archetypal AATCC member. Bert and I have a tendency to show up at AATCC committee meetings looking like the Bobbsey twins in our khaki trousers, blue shirts, yellow ties, and navy blazers.

Bert represented and helped host the Association's reception and dinner at the recent ISO/TC38 meetings in New Orleans, LA, USA. Under Bert's leadership, we are working to provide our members a searchable online resource of the vast collection of American Dyestuff Reporter (ADR) issues from 1917 to 1998, containing the early history of textile manufacturing and industry in the United States, as well as the history of AATCC, textile chemistry, and the development of AATCC test methods in the prior century.

Like President Jones, who hired me in 1996, a key aspect of Bert's presidency is that of finding my replacement, considering my retirement at the end of February 2018. Bert has appointed Sandy Johnson to lead the search committee for that purpose.

Unbelievably, Bert also has a penchant for English Ale! He represented AATCC extremely well at this year's Day of Celebration with the SDC and sat with the Mayor of York at the banquet.

Although he did not serve as AATCC President during my tenure, the Association and I have been very fortunate to have former AATCC President Warren Perkins currently serving in the position of Treasurer. Warren has worked tirelessly to make
An Executive Search Committee has been formed to hire a new AATCC Executive Director. The members of the committee include: Sandy Johnson, chair; Peter Hauser; Nelson Houser; Mike Tyndall; Kerry King; and Bert Truesdale. The committee is soliciting resumes/CVs. Individuals interested in this position should contact Amy Holland, AATCC’s Business Services Director, at amy@aatcc.org.
AATCC Welcomes New Members Joining in May, June, and July 2017

By Genevieve Bot

Central Atlantic Region
Delaware Valley Section
Senior members:
Konstantina Avramidis, vp of pd, production and qa, Stella and Dot
Bill Babe, sales and marketing manager, Liquid X Printed Materials
Marie Davis, The Children’s Place
Andrew Turner, The Children’s Place
Robert Zehr, senior research chemist, Church and Dwight Co. Inc.

New York Metro Section
Senior members:
Angela Domsitz, product and education extension manager, Woolmark Americas Inc.
Victoria Gehring, Gehring Textiles
Julie Katzenberger, QA Management

Midsouth Region
Piedmont Section
Senior members:
Aric Axness, Sanitized Inc.

Winne Chang, product sourcing and tech design, Belk Inc.
Anne McLean, business development representative, Organic Dyes and Pigments
Timmy Thompson, Ronile Inc.

New England Region
New England Section
Senior members:
Chris Gaudette, manager of specifications and testing, Orafol Americas Inc.
Erin Kirkpatrick, managing scientist, Exponent

Southeast Asia Region
Senior members:
Brian Ng, lab manager, SGS Hong Kong Ltd., Hong Kong
Sahifur Rahman, managing director, Barakaat Fashion Ltd., Bangladesh
Li Ping Song, quality inspector, Shanghai Wewei Textile Co. Ltd., China
Jindan Wu, lecturer, Zhejiang Sci-Tech University, China
Li Gen Zeng, lab director, Wujiang Fuhua Fabric Co. Ltd., China
Qi Zhong, associate professor, Zhejiang Sci-Tech University, China
Student member: Karan Arora, Pearl Academy, India

Southern Region
Gulf Coast Section
Senior members:
Christopher Harris, general manager, Parthenon Prints Inc.
Edith Sanford-Tuazon, quality assurance manager, Central Garden and Pet

Western Region
California Section
Senior members:
Dave Brewer, Image Options
Leanne Luce, ceo, Continua Apparel Co.
Student members: Kevin Cullen, University of California, Berkley
Mary Reilly, Academy of Art University

Student Chapters
North Carolina State University: Bhavya Singhi
Independent Members—Worldwide
Senior members:
Dixon Graham, managing director, Advanced Dyeing Solutions Ltd., United Kingdom
Alexander Gruener, global marketing and business development manager, Emtec Electronic GmbH, Germany
Giselher Gruener, general manager, Emtec Electronic GmbH, Germany
Jo Van Landeghem, qss officer, Creamoda, Belgium
Courtney Lucansky, product manager, EuroCentra Inc., USA
Gerardo Alarcon Rios, chemical engineer, Robama SA de CV, Mexico
Elena Tchernin, global communications and public relations, Emtec Electronic GmbH, Germany
Philip Yeung, president, Society of Dyers and Colourists, United Kingdom
Asha Zimmerle, product manager, EuroCentra Inc., USA

New Corporate Members
Belk Inc., a private department store company based in Charlotte, NC, USA, is the home of Modern Southern Style, with 293 Belk stores located in 16 US Southern states and a growing digital presence. Belk is a portfolio company of Sycamore Partners, a private equity firm based in New York. Belk and www.belk.com offer a wide assortment of national brands and private label fashion apparel, shoes, and accessories for the entire family, along with top name cosmetics, a wedding registry, and a large selection of quality merchandise for the home.

Emtec Electronic is a developer and manufacturer of lab and online testing instruments, located in Leipzig, Germany. Together with a worldwide sales network, emtec is active in about 80 countries. The company was founded in 1995 by Giselher Gruener. In Leipzig, emtec has about 28 employees. Worldwide, emtec has 30 independent representatives, who are responsible for sales and service activities. The major target of emtec is the development of innovative testing devices, which help to optimize processes and products in the pulp and paper, nonwovens, and textile industries. The roots of emtec are in the pulp and paper industry.

Since the company was founded, about 15 different testing devices have been developed and successfully introduced to the market. One of them, the Tissue Softness Analyzer (TSA) is also a helpful tool in the nonwovens and textile industries. The device can measure the three parameters that mainly determine textile hand. From these three parameters, a product- and market-specific hand value can be calculated. The availability of the three individual parameters offers great possibilities in process and product optimization.

EuroCentra Inc. is the first source for all bulk buyers who trade in shoes, casual and sports clothing, sleepwear and underwear, knits, foundation garments, and swimwear. The right look at the right time is just one secret to their success. Their experts know each market, and hence the target groups, precisely. Because of a tight-knit collaboration with producers, they can ensure designs are realized reliably, quickly, and in line with high ethical standards—with a keen eye on the quality of the material and workmanship. And where others continue to focus their efforts on maintaining social and ecological guidelines, EuroCentra is already in the process of improving these guidelines in accordance with the Business Social Compliance Initiative (BSCI), without compromising the optimal value for money.

The Woolmark Company is the global authority on wool. Through their extensive network of relationships spanning the international textile and fashion industries, they highlight Australian wool’s position as the ultimate natural fiber and premier ingredient in luxury apparel. The Woolmark logo is one of the world’s most recognized and respected brands, providing assurance of the highest quality, and representing pioneering excellence and innovation from farm through to finished product. The Woolmark Co. is a subsidiary of Australian Wool Innovation, a not-for-profit enterprise that conducts research, development, and marketing along the worldwide supply chain for Australian wool on behalf of about 55,000 woolgrowers that help fund the company.
People

Daniels to Retire in 2018

After 21 years of service, Executive Vice-President John Y. “Jack” Daniels will retire from AATCC on March 2, 2018. In 1974, early in his career, Daniels joined AATCC as the laboratory manager for the Association’s Technical Center in Research Triangle Park, NC, USA, working with numerous test method development committees in developing new methods, improving existing test methods, and managing the development of technical symposia. After five years in this position, he moved on to a successful career in the textile industry.

Beginning in 1979, Daniels went to work with Springs Industries (now Springs Global) in Fort Mill, SC, USA. He received his MS in Textile Chemistry from North Carolina State University in 1981. In 1984, Daniels obtained an MBA from Winthrop University in Rock Hill, SC, USA while still working at Springs.

Shortly after receiving his MBA, Daniels moved into marketing with Springs Industries, and worked as Director of Product Development for the Springmaid Fashions Division, while still located in Fort Mill. He advanced to Business Unit Manager for the Distributor/Fabricator business of Springs Window Fashions, in Middleton, WI, USA.

In the early 1990s, Daniels became Director of Automotive Fabrics for the Clark-Schwebel subsidiary of Springs Industries, in Anderson, SC, USA. He and his team developed new silicone coated nylon and fiberglass fabrics, led and developed the automotive quality systems requirements for this new business, and gained significant sales after just three years from the start of initial development.

In March of 1996, Daniels returned to AATCC, where he had been active as a volunteer for many years, and accepted his current position in charge of the staff and operations, first as Executive Director and later as Executive Vice-President, working closely with Association officers, members, and staff.

Soon after starting in this role, Daniels led the creation of AATCC Foundation, the charitable arm of AATCC, for which he serves as president. In 2016, with help and tremendous support from members and non-members alike, AATCC Foundation reached the million-dollar mark in contributions, and now provides 13 scholarships focused on textile design, merchandising, sciences, and engineering.

Throughout his years in the industry, Daniels served on many research committees, and as vice chair and chair of the Technical Committee on Research, and chair of the Executive Committee on Research.

Daniels has served on the Service District Advisory Committee for Research Triangle Park, the Owners & Tenants Association of Research Triangle Park, and the Central Carolina Bank Durham Advisory Board, prior to their merger with SunTrust. He also served as an adjunct faculty member for the Textile Extension Department at the College of Textiles at North Carolina State University, and currently is a member of ASTM Committee D13-Textiles, the Southern Textile Association, the Council of Engineering and Scientific Society Executives, and the American Society for Association Executives. He serves locally as the treasurer for his college fraternity’s alumni association.

An Executive Search Committee has been formed to hire a new AATCC Executive Director. The members of the committee include: Sandy Johnson, chair; Peter Hauser; Nelson Houser; Mike Tyndall; Kerry King; and Bert Truesdale. The committee is soliciting resumes/CVs. Individuals interested in this position should contact Amy Holland, AATCC’s Business Services Director, at amy@aatcc.org.
Gavin Retires from MFG Chemical
MFG Chemical is partnering with Platte River Equity III L.P., a Denver-based private equity firm, which has completed a recapitalization of MFG Chemical. The recapitalization will provide an opportunity for several family shareholders to retire from the company including AATCC past president and AATCC member, Charles E. Gavin III. Gavin, founder of MFG Chemical, will focus on charitable activities and other interests. The company will continue to be led by the current President and COO, Keith Arnold. Grace Matthews, a Milwaukee-based investment bank, advised MFG Chemical on the recapitalization. Based in Dalton, Georgia, USA, MFG Chemical is a leading surfactants, polymers, and specialty chemicals manufacturer. The company offers a diverse range of technical formulation capabilities on both a proprietary and contract manufacturing basis. Its strong formulation expertise has enabled the company to pursue a range of applications, notably in the oilfield and water treatment sectors. The Gavin family will maintain a significant ownership position in the company going forward.

Cassill Retires from NC State University
Professor Nancy Cassill, retired in June 2017 from her position as associate dean for Academic Programs in the College of Textiles (COT) at North Carolina State University. Her work enhanced the reputation of the department of Textile and Apparel, Technology, and Management (TATM), the College, and the University and helped strengthen the textile and apparel industry in North Carolina, the US, and around the world. Cassill worked closely with the Academic Programs staff in evaluating all activities and made great strides in developing processes around key areas aligned with the COT Strategic Plan. In addition, she led the development of a soon-to-be-announced, multi-faceted corporate partnership to support academic programs and research missions. Cassill served as president (1997-1998) of the International Textile and Apparel Association, and has frequently served as an academic program reviewer for leading textile-related academic programs.

Eubanks Retires After 27 Years in Textiles
Tiffany Eubanks, Owner and Designer for Inspired Digital Solutions, retired in June 2017 after 27 years in the textile industry. Eubanks started out as a color separator and worked her way to a position as a textile CAD designer with Tietex International where she stayed for over 12 years. She worked for six of those years as Project Manager for a digital printing project, and she created over 50 digital print designs for digital printing. She was honored to be part of AATCC, CITDA, and The Color Marketing Group. Now as owner/designer for Inspired Digital Solutions, Eubanks designs graphics for a variety of end uses and projects. She looks forward to being a part of her local Artist Guild, and spending time with her four children, creating, and studying the arts. Eubanks also plans to retain membership with the AATCC as a retired member in hopes of contributing her years of knowledge down to the next generations.

AATCC International Representative Joins Leverstyle
Calvin Lam joined Hong Kong-based garment manufacturer Leverstyle in February 2017, as vice president, Production Department. Lam has worked in the textile industry for more than 16 years, including the areas of textile testing, textile wet processing, visual color evaluation, laboratory accreditation and operation management, new product development, training, and consultancy. He most recently held
the title of Business Development Director of Global Softlines at Intertek. Lam graduated from Hong Kong Polytechnic University with a PhD in Colourimetry and a BSc (Hons) in Textile Chemistry. He served on the AATCC Board of Directors as an International Regional Board Member from 2013 to 2016 and was a member of the AATCC Executive Committee of Research (ECR) from 2009 to 2011. He currently serves as an associate editor for the AATCC Journal of Research and heads the AATCC Global Membership Office in Hong Kong.

Ju Joins AATCC as International Representative

Jeong-Kyun Ju will head the AATCC Global Membership Office in Korea, offering membership services and membership payment in local currency for the convenience of our members in Korea. Ju is Team Manager of the Standardization Team at the Textile Testing Department for FITI Testing & Research Institute, Korea. The AATCC International office was previously held by FITI Team Manager, Wonha Ji, who has moved to a new department at FITI. Ju joined the company in 1999. His team is responsible for domestic standards development cooperation and international standards cooperation. They have various partnerships with international standards organization such as AATCC, ASTM, and ISO. Ju worked in the field of textile physical testing, functional testing, geotextile testing, product certification, market research, and education. He graduated from KonKuk University majoring in fiber engineering and earned both a Master’s and a doctorate degree.

Access Your Library

As an AATCC member, hundreds of magazines and journals and thousands of articles are at your fingertips, all in a searchable archive! You can even set up an alert to tell you when your name—or your company’s—is mentioned in the industry literature.

Log in at www.aatcc.org and click on the “Article Archive” menu

AATCC—Textile Knowledge at Your Fingertips!
AATCC Global Training—Bangladesh

AATCC Section News
AATCC local section meetings give everyone the opportunity to “visit AATCC.” You do not need to live or work in the hosting section. Bring a friend or colleague to see what AATCC technical and networking programs are about! Invite them to join AATCC!

California Section
In May, Sustainability Pillar Chair Krystle Moody hosted a tour of Mango Materials. Mango Materials is a bio-plastics company with a mission to transform waste gas streams (from landfills and wastewater treatment plants) into affordable, biodegradable materials while also creating a positive environmental impact.

In June, the California Section hosted the Student Engagement Pillar Technical Meeting at VF Outdoor Inc. AATCC California Section Industry Student Liaison and Color Perception Pillar Co-Chair Lisa Cram hosted a presentation and discussion with three guests followed by a Q & A session.

In August, California Section members met for a happy hour social at the Fuzio Embarcadero Bistro in San Francisco, CA, USA.

In early September, the California Section hosted the Chemical Applications Pillar Technical Meeting. Bill Morris (AATCC California Chemical Applications Pillar Chair) and The North Face Sustainability Team hosted a presentation and discussion on “Highly Fluorinated Chemicals” by Arlene Blum, executive director of The Green Science Policy Institute, at VF Outdoor Inc.

For additional information about the AATCC California Section, visit www.aatcc.org/mem/resources/california
The California Section also maintains several social media sites:
Facebook www.facebook.com/AATCCCA
LinkedIn discussion group www.linkedin.com/groups/8475187
Instagram www.instagram.com/aatcc_ca/?hl=en
Hudson Mohawk Section
The AATCC Hudson Mohawk Section hosted a golf outing in June, at the Mohawk Valley Country Club in Little Falls, NY, USA.

For additional information about the Hudson Mohawk Section, visit www.aatcc.org/mem/resources/hudsonmohawk

New England Section
In June, the New England Section hosted a golf outing at the Cranston Country Club, in Cranston, RI, USA. The golf outing was followed by a banquet at the Venus de Milo Restaurant in Swansea, MA, USA.

For additional information about the New England Section, visit www.aatcc.org/mem/resources/newengland

Northwest Section
The AATCC Northwest Section held a technical meeting in April in Tualatin, OR, USA, followed by a visit to Parklane Mattress, including a tour of the production floor and overview of materials used in their products.

For additional information about the Northwest Section, visit www.aatcc.org/mem/resources/northwest

The Northwest Section also maintains a Facebook page www.facebook.com/aatccnw

Piedmont Section
The Piedmont Section officers met in June via teleconference. Piedmont Section officers are:

Chair: Lee Lemere
Secretary: Kevin Jenkinson
Treasurer: Len Farias
Scholarship Committee Chair: Billy Gardner
Scholarship Committee: Billy Gardner, Lee Lemere, Kermit Holsthauser, Ann Laidlaw

The officers agreed to conduct another meeting in November, during the AATCC Committee Meetings, to finalize planning for the upcoming technical seminar, tentatively scheduled to take place at the Charlotte Motor Speedway in Charlotte, NC, USA. A program is being developed for the seminar. The section also planned to conduct a formal election of new officers for 2018/2019, possibly via SurveyMonkey.

For additional information about the Piedmont Section, visit www.aatcc.org/mem/resources/piedmont
AATCC’s Textile Coloration Conference to Focus on Issues Facing the Supply Chain
September 13-14
Charlotte, NC, USA

Managing Today’s Textile Coloration Challenges: From Fiber to Fashion is designed to bring together brands, retailers, mills, and suppliers to hear all sides of the story and work together to understand each other’s challenges and propose effective ideas.

Sessions for the conference will include: Color, Performance, and Cost—the Bermuda Triangle for the Brand/Retailer; What Fibers are You Dyeing and How: Best Practices; Modern Coloration Methods and Sustainability; and Emerging Trends and Markets.

Mike Abbott with HanesBrands will kick off the conference with “Challenges Faced by a Brand: A 20,000-foot Perspective.” He will share insight regarding complexity of sourcing, and responding to market changes and challenges associated with color, blends, and fastness properties.

Additional presentations include:

- **Piecing Together the Color Puzzle—Fashion, Performance, Sustainability**
  Bryan Dill, Archroma US Inc.

- **Cotton: Minimizing Inputs for Maximum Results**
  Mary Ankeny, Cotton Incorporated

- **Dyeing Cotton and Cellulosic Fibers—Begin with the End in Mind**
  Ron Pedemonte, DyStar LP

- **Polyester—The Chameleon of the Modern Textile World**
  Jay Hertwig, Unifi Manufacturing Inc.

- **Dyeing Polyester and Key Polyester Blends**
  Nelson Houser, M. Dohmen USA

- **Nylon Overview and Recent Challenges in the Nylon Raw Material Supply Chain**
  Harrie Schoots, Ascend Performance Materials LLC

- **Dyes and the Dyeing of Polyamide, Select Polyamide Blends, and a Brief Description of Wool Dyeing**
  Pat Browne, Huntsman Textile Effects

- **Understanding Dyeing Equipment**
  Barry Brady, Organic Dyes and Pigments

- **Digital Textile Printing—Status Update**
  Kerry King, Spoonflower Inc.

- **Water, Energy, and Color in the Dyehouse: Where Does It Go?**
  Chuck Stewart, Eastman Chemical Co.

- **Repreve: Quality through Consistency in Recycled Fibers**
  Alex Gudac, Unifi Inc.

- **Reshoring Apparel in the Carolinas**
  Eric Henry, TS Designs

- **The Journey of Responsible Materials: Fiber, Dyestuffs, Quality & Beyond**
  Matt Swartz, Patagonia

- **Environmental Risk and Sustainability—Are We Just Treading Water?**
  Henry Boyter, Center for Environmentally Sustainable Textile and Apparel Businesses (CESTAB)

- **Matching Heather Fabrics—What Could be Easier?**
  Keith Hoover, Under Armour

- **Keys to the Future of Smart Textiles**
  Allison Bowles, North Carolina State University

- **Ultra-Portable Color Measurement**
  Ken Butts, Datacolor

- **Performance Proliferation—The Next Chapter in Apparel**
  Jimmy Rowe, Cotton Incorporated

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www.aatcc.org/evnt/dyeing_technology_conf

Southern Textile Research Conference
September 17-19
Myrtle Beach, SC, USA

The theme for the 2017 Southern Textile Research Conference (STRC) is “Value-Added Textiles for Fashion and Function.” David Hinks, dean of the North Carolina State University’s (NCSU) College of Textiles, will deliver the keynote speech. Other presentations include:
Webinar: Natural Dyes and the Farm-to-Fashion Movement
October 4, 11:00 am (EDT)

As a growing way to compete with large brands, and as a means for designers to produce unique products, farm-to-fashion circular economy is a growing movement throughout the country. A basic component of this economy is the need for locally grown natural dyes to develop specialized high margin, low-volume businesses. This webinar will discuss the present status and research on natural dyes as it pertains to the artisanal community. The presentation will broadly encompass both plant and insect natural dyes. As well, special focus will be provided on Japanese indigo, partly due to the popularity of denim, and partly due to current re-shoring activity of major US textile mills.

Ajoy K. Sarkar and Jeffrey Silberman, both with the Textile Development and Marketing Department at the Fashion Institute of Technology, present the Natural Dyes and the Farm-to-Fashion Movement Webinar.

Sarkar earned his undergraduate education in India and his MS and PhD degrees in textile sciences from the University of Georgia. His expertise includes fibers, textile coloration, finishing, product development, textile analysis, and application of textile technology to design. His research focus is sustainable textiles/fashion and smart protective textiles. Sarkar has authored over forty publications and is a co-author of a well-regarded textbook, J.J. Pizzuto’s Fabric Science. A member of AATCC, Sarkar serves as an associate editor for the AATCC Journal of Research and is also a member of the International Textile and Apparel Association (ITAA).

Silberman has simultaneously served as a consultant to the International Cotton Advisory Committee (ICAC) Secretariat, and as Executive Director to the International Forum for Cotton Promotion (IFCP) from 2001-2016. He is an international textile consultant specializing in natural fiber program development and demand enhancement strategy. Prior to building his consulting firm, Silberman was a director of marketing for Cotton Incorporated, and before that, the technical director for United Merchants and Manufacturers Inc. Silberman holds a Master of Textiles degree from North Carolina State University, College of Textiles, a BS in Textile Marketing and Design from Philadelphia University, and Advanced Management Program Certificates from the Wharton School of Business in Finance and Accounting, Marketing Management from the Columbia Graduate School of Business, and Environmental Law from New York University.

The registration fee is $149 for nonmembers and $99 for members (individual and corporate).

Ajoy K. Sarkar
Jeffrey Silberman

www.aatcc.org/evnt/online/webinars/natural-dyes-webinar

AATCC individual and corporate members please email Kim Nicholson at nicholk@aatcc.org to receive your member discount promotion code.
LED—A Balancing Act—Don’t be left in the Dark
October 18-19
Cleveland, OH, USA

Lighting is moving rapidly to LED sources in the retail industry. This change directly effects what consumers see and ultimately purchase. To ensure that retailers, manufacturers and suppliers are not left “in the dark,” AATCC has organized its second LED Conference to explore new ways to achieve value while limiting risk when switching to LED lighting.

Join AATCC for round two of the LED Summit on October 18-19 at the DoubleTree in downtown Cleveland, OH, USA. Industry experts from around the country will gather to light up the stage with instrumental information for working in harmony with LED lighting. No matter what phase your company is in regarding transition to LED lighting, there is tremendous value in attending this conference.

Mark Lien with the Illuminating Engineering Society will be the keynote presenter. In Lien’s presentation, Illuminating the Future of Lighting, he will analyze the changes that LED’s bring to users in terms of color, controls, and integration. In his abstract, Lien notes that with change comes opportunity, but only for those who understand and can prepare. Join us as we learn how to navigate and prepare for the transition.

Our star acts include:

- **Light… Color… Action… - Understanding Light and Color Basics**
  Eric Haugaard, CREE Inc.

- **LEDs vs Conventional Sources, What are the Differences?**
  Naomi Miller, Pacific Northwest National Laboratory

- **Will I Make Money with LEDs: Balancing Economics with Quality and Performance**
  Speaker TBA

- **Lasting Light—Sustainability for a Decade**
  Tom Boyle, Current, powered by GE

- **Why do Standards Matter?—Update on International Color and Lighting Standards**
  Roland Connelly, RoLyn Group Color Consultants

- **Controlling Color at the Speed of Light**
  Ann Laidlaw, ACL Color Consulting LLC

- **The Impact of Light Source Spectrum on Product Appearance and Sales**
  Steve Paolini, Telelumen

- **LED Hindsight—You Learned What?**
  Andrew Fraser, Consumer Testing Laboratories Inc.

- **Thinking Outside the Lightbox with LED**
  Tim Williams, Color Solutions International; Kimmy Schenter, Nike; and Jensey Lund, Ketra

- **What is a Lumen?—Educating the Public**
  Roland Connelly, RoLyn Group Color Consultants

- **Flipping the LED Switch, An Implementation Plan for Retailers and their Supply Chain**
  Ken Butts, Datacolor

- **Let’s Talk Numbers—Adoption Rate of LEDs in US and Worldwide**
  Mary Yamada, Navigant

- **The Pocketable Shop Window: Displays and Online Product Presentation**
  Michael J. Murdoch, Rochester Institute of Technology

- **Gauging Expectations—Is the Color True?**
  Kim Shaw, Tommy Hilfiger
Upcoming Section Events

AATCC local section meetings give everyone the opportunity to “visit AATCC.” You do not need to live or work in the hosting section. Bring a friend or colleague to see what AATCC technical and networking programs are about! Invite them to join AATCC!

**Gulf Coast Section Meeting**

**September 26**

New Orleans, LA, USA

Behnam Pourdeyhimi, executive director of the Nonwovens Institute, and Jim Loftus, director of education and technical affairs of the Association of the Nonwoven Fabric Industry (INDA), will make presentations at the AATCC Gulf Coast Section Meeting at the USDA Southern Regional Research Center in New Orleans.

**Prospective Texas Section Meeting**

**November 1**

Dallas, TX, USA

AATCC members in Texas will be meeting at the Haggar's Corporate Office to hear Keith Hoover of Under Armour give a presentation about Under Armour's vision of “local for local” textile and apparel production. AATCC Student Members will present their fashion designs and poster presentations. A tour will be given to students. Members may gather for dinner or happy hour.

**AATCC/SGIA Digital Textile Printing Conference**

**November 29-30**

Durham, NC, USA

Designed to address the needs of the sign/banner, apparel, and home furnishings market segments, topics will focus on image workflow and design, technology and markets, sourcing and supply chain, and case studies. Riveting speakers and compelling presentations make this a must-attend conference for anyone involved in digital printing!
Mark Your Calendar
Make plans now for upcoming events and opportunities. For details, visit www.aatcc.org.

September 13-14
Managing Today’s Textile Coloration Challenges: From Fiber to Fashion
www.aatcc.org/evnt/dyeing_technology_conf

September 17-19
Southern Textile Research Conference
http://thestrc.org

September 26
Gulf Coast Section Meeting
www.aatcc.org/mem/resources/gulfcoast/

October 4
Webinar: Natural Dyes and the Farm-to-Fashion Movement
www.aatcc.org/evnt/online/webinars/natural-dyes-webinar

October 18-19
LED—A Balancing Act—Don’t be left in the Dark
www.aatcc.org/evnt/conferences/LED

November 1
Potential Texas Section Meeting
https://twitter.com/AATCC_Texas

November 14-16
Fall Committee Meetings
www.aatcc.org/evnt/meetings

November 29-30
AATCC/SGIA Digital Textile Printing Conference
www.aatcc.org/evnt/conferences

March 6-8, 2018
AATCC International Conference
www.aatcc.org/ic

Ongoing
AATCC Webinar Series
www.aatcc.org/evnt/online/webinars

UV Calibration Reference Fabric Program
www.aatcc.org/test/verify/UV

Global Test Method Training
www.aatcc.org/evnt/workshops/global

Proficiency Testing Programs
www.aatcc.org/test/verify/proficiency

Remote Participation
To facilitate global participation, AATCC offers remote access to select meetings. Please register at the AATCC website to get the call-in number. All remote-participation meetings will be held Tuesday, November 14. Refer to the meeting schedule for specific times.

• C2-S1/TAG, International Test Methods/ISO TC38 Technical Advisory Group
• RA63, Water Resistance, Absorbency & Wetting Agent Evaluation
• RA106, UV Protective Textiles
• RA111, Electronically Integrated Textiles

Speakers
Several committees will host speakers in addition to holding their regular business meetings. Refer to the meeting schedule for day and time of each presentation.

Networking Reception
November 14, 5:30-6:30 pm
Mingle with industry colleagues over complimentary hors d’oeuvres and a drink. Registration includes one drink ticket. A cash bar is also available.
TCR Meeting  
November 15, 5:30-6:30 pm

Attend the Technical Committee on Research (C3) meeting for a brief report from each committee and interest group—a great way to catch up on anything you missed.

Registration  
Deadline: November 8, 2017

Pre-register by November 8 to facilitate meeting preparations. Online registration and a downloadable form are available from the AATCC website. Only on-site registration will be accepted after November 8.

Accommodations  
Deadline: October 16, 2017

Discounted rates of US$149 per night are available at the Sheraton Imperial Hotel and Convention Center located at 4700 Emperor Blvd, Durham, NC, USA. Use the reservation link on the AATCC website or contact the hotel directly at +1.919.941.5050 and mention the AATCC meetings. Make reservations by October 16, 2017 at 5:00 pm EST to ensure availability.

AATCC Fall Committee Meetings

Unless otherwise noted, meetings are held at the Sheraton Imperial Hotel and are open to all

* Closed meeting (committee members only)  
+ Meeting held at the AATCC Technical Center  
^ Remote participation also available (all times noted for Eastern Time Zone)

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<thead>
<tr>
<th>Tuesday, November 14, 2017</th>
<th>Schedule of Meetings</th>
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<td>8:45-9:30</td>
<td>C17SC</td>
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<td>Education Advisory Board Subcommittee</td>
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<td>8:45-10:15</td>
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<td>10:15-11:45</td>
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<td>11:30-1:00</td>
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<tr>
<td></td>
<td>AATCC Foundation Annual Meeting*+</td>
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<td>1:00-1:45</td>
<td>RA45SC</td>
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<tr>
<td></td>
<td>Finish Analysis Subcommittee</td>
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<td>C11</td>
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<td>Committee on Conferences</td>
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<tr>
<td>1:00-2:30</td>
<td>RA60</td>
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<tr>
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<td>1:45-2:30</td>
<td>RA106</td>
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<td>UV Protective Textiles^</td>
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<td>1:45-3:15</td>
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<td>RA92/RA43</td>
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<td>Interaction of Dyes &amp; Finishes/ Professional Textile Care</td>
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**Tuesday, November 14, 2017**

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<tr>
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<td>RA59</td>
<td>Fibrous Test Materials</td>
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<td>RA36</td>
<td>Color Measurement</td>
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<td>3:15-4:00</td>
<td>RA49</td>
<td>Insect Resistance</td>
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<td>RA33</td>
<td>Colorfastness to Atmospheric Contaminants</td>
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<td>Electronically Integrated Textiles Subcommittee</td>
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**Wednesday, November 15, 2017**

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<tr>
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<td>RA87</td>
<td>Applied Dyeing and Characterization of Dyes</td>
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<td>RA89</td>
<td>Hand Evaluation</td>
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<td>8:00-9:30</td>
<td>RA31</td>
<td>Antimicrobial Activity</td>
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<td>8:45-9:30</td>
<td>RA56</td>
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<td>RA32</td>
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<td>C1-S16</td>
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<td>Building &amp; Grounds*+</td>
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<td>Concept 2 Consumer* Interest Group</td>
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<td>RA75</td>
<td>Evaluation of Materials &amp; Products for End Use Performance</td>
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<td>2:30-3:15</td>
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<td>Lightfastness and Weathering</td>
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**Thursday, November 16, 2017**

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All Day Adventures in Activewear

2018 AATCC Concept 2 Consumer® Student DESIGN Competition

Showcase your talent in design to win cash and prizes!

- Design a line of 3-6 apparel pieces for a specific outdoor or indoor athletic activity (cycling, running, group fitness, hiking, etc.) that must be able to transition to everyday wear
- Research the specific chosen athletic activity and related products currently in the market, define your target consumer group, and describe how the designs meet their needs
- This new line should enhance the athletic enthusiast’s experience while also transitioning to everyday wear
- Incorporate 2 or more surface designs within the apparel line—Make the designs functional and exciting!
- Undergraduate or graduate students are eligible; may enter as individuals or as teams of up to four members
- All individual and team members must be AATCC members to enter; join online or submit application and US$35

Awards
Team entries will divide the prize among all members.

- 1st place: US$1,000 from AATCC, US$100 Spoonflower Gift Certificate, & 1 year of CLO 3D Fashion Design Software
- 2nd place: US$750 from AATCC, US$100 Spoonflower Gift Certificate, & 6 months of CLO 3D Fashion Design Software
- Honorable Mention (2 prizes): US$100 from AATCC, US$50 Spoonflower Gift Certificate, & 3 months of CLO 3D Fashion Design Software

Sponsors: Spoonflower, CLO Virtual Fashion

Judging
All portions of the entry must be received on or before April 11, 2018; winners will be announced by May 14, 2018.

Questions?
Contact Bliss Coleman; colemankaatcc.org

Refer to the Competition Entry Checklist as a helpful guide:
www.aatcc.org/stu/awards-competitions/c2cdesign-competition

2018 AATCC Concept 2 Consumer® Student MERCHANDISING Competition

The 2018 AATCC Concept 2 Consumer® Student Merchandising Competition is a poster competition that will allow students the opportunity to demonstrate their skills in business, marketing, and merchandising.

- Conduct a business model, determine a marketing strategy, and develop merchandising tools for an integrated new apparel line focused on and inspired by a specific outdoor or indoor athletic activity (cycling, running, group fitness, hiking, etc.)
- The new line must transition from athletic activity to everyday wear
- You must incorporate a use case and supply chain of a realistic technology (e-textiles, chemical technologies, materials technologies, etc.)
- Research the specific chosen athletic activity and related products currently on the market

Sponsors: Spoonflower, CLO Virtual Fashion
Students

- Students do not need to design the product but do need to at least describe the product line. Explain how the product line is unique and competitive.
- Undergraduate or graduate students are eligible; may enter as individuals or as teams of up to four members.
- All individual and team members must be AATCC members to enter; join online or submit application and US$35.

**Awards**
Team entries will divide the prize among all members.

- 1st place: US$1000 from AATCC, US$350 from Cotton Incorporated
- 2nd place: US$750 from AATCC, US$100 from Cotton Incorporated
- 3rd place: US$250 from AATCC, US$50 from Cotton Incorporated

**Optional Sponsored Award**
Entries that choose to incorporate 75% or more of cotton in their apparel line are eligible for an additional US$500 sponsored prize from Cotton Incorporated.

**Judging**
Entries will be judged based on content, creativity, completeness, thoroughness, and presentation of poster.

All portions of the entry must be received on or before April 24, 2018; winners will be announced by May 31, 2018.

**Questions?**
Contact Manisha Patel; patelm@aatcc.org
Refer to the Competition Entry Checklist as a helpful guide:
www.aatcc.org/stu/awards-competitions/c2c-merchandising-competition

**AATCC Student Chapters**

**University of Delaware: Fashioning Innovation at the University of Delaware**

The University of Delaware student chapter hosted "Fashioning Innovation" in May 2017. The purpose of the event was to highlight the importance of technology and innovation in the apparel industry.

A panel of experts discussed how technology and innovation are changing the fashion industry. Participates in the panel included: Meg Burich, a leader in the field of wearable technology and the marketing director for digital sports at adidas; Linda Farquhar, founder and CEO of entreDonovan, an apparel company using cutting-edge technology to

![Fashioning Innovation: Maya Rochefort, president. Image courtesy of University of Delaware.](image1)

![Fashioning Innovation: Panelists 2017. Image courtesy of University of Delaware.](image2)
produce custom clothing; Ben Greenspan, a doctoral student in the Biomechanics and Movement Science Program with a background in mechanical engineering and a specialty in 3-D printing; and Emma Sidoriak, an apparel designer at GK Elite Sportswear, a company that designs and produces garments for Olympic athletes. Mary Hopkins, an associate at W.L. Gore and Assoc., formerly with DuPont, moderated the discussion.

In addition to the panel, there was a fashion show featuring garments designed by apparel design majors in partnership with UD’s interdisciplinary Biomechanics and Movement Science Program. The garments were adaptive and accessible for individuals with physical disabilities or special needs.

The event also included presentations from such exhibitors as W.L. Gore and Printed Solid, a 3D printing company.

GCUF (Government College University, Faisalabad)

In May, members of the AATCC GCUF Chapter, including graduate PhD students Ali Ahmad Khan, Fatima Batool, and Maria Jannat, as well as Abdul Mustaan and faculty advisor Shahid Adeel, visited Noor Fatima Textiles. They met Zafar Iqbal, the QA and QC manager for Noor Fatima Textiles and Naseer, the assistant manager. These textile professionals discussed textile processing and recent updates in textile technologies with the students. The chapter members were able to visit the company’s processing unit and observe the entire processing of fabric from desizing to mercerization, then dyeing and printing, to calendaring. Every step was described by Muhammad Kashif, the laboratory technician in charge of QA and QC. During the meeting with Zafar Iqbal, chapter members discussed their projects involving natural dyeing processes, mordanting, and finishing steps, and asked if Noor Fatima Textiles could provide laboratory facilities for fastness testing to perform the tests according to ISO/AATCC methods. Iqbal promised the students to provide the testing facilities to perform their tests. He also provided fabrics for their research into natural and synthetic dyeing.

In June, faculty advisor Shahid Adeel, along with AATCC GCUF members Muhammad Abdul Mustaan and Muhammad Hussan, visited Harris Dyes and Chemicals, Faisalabad, Pakistan, to observe the formulation of pigments, their synthesis, and application. The CEO of Harris Dyes and Chemicals, Muhammad Abbas, who is a renowned dyer and frequently assists with the students’ research projects, discussed the implementation of natural and synthetic pigments using various fabrics through utilization of radiation technology.
Microfiber Shedding: Hidden Environmental Impact

By Kilara Le

DOI: 10.14504/ar.17.5.1

If a ray of sunlight shines through a window and one looks closely, there are many small fibers, or microfibers, floating in the air. They may be synthetic in origin or natural fibers such as cotton, wool, or hair; however, most are shed from textile materials used in our homes and clothing. While somewhat ethereal when revealed by a sunbeam, once microfibers enter the water system through cleaning or rainfall, they are swept into our streams and oceans and become part of the aquatic environment. Many of these synthetic microfibers, just like larger pieces of plastic waste, are not biodegradable. They are migrating across the globe and creating what Nicholas Mallos, director of the Trash Free Seas Program at the Ocean Conservancy, describes as, “one of the most abundant sources of plastic pollution in the ocean.”
Understanding the Problem

As his job title suggests, Mallos is involved in bringing awareness to this most-recently recognized crisis in the marine environment, which parallels the issue of visible plastic pollution. The latter has gained greater public attention and awareness over the last few years from ominous photos of floating “plastic soup” and from brands such as adidas’ Ultraboost Uncaged Parley shoes that incorporate recycled plastic made from ocean waste. He says that, unlike the larger plastic pieces floating in the ocean that are often a result of poor waste collection and management, particularly in rapidly developing economies, microfiber pollution has been traced to wastewater sources, a lot of it likely shedding from clothes in washing machines used in developed economies.

Ecologist Mark Brown was one of the first to make this connection with his research, according to Steph Karba, environmental researcher at Patagonia Inc. Studies conducted by other global researchers confirm that with every washload of clothes, fibers are released. Most wastewater treatment facilities have filtration technologies with capture rates ranging up to 99%; however, due to the significant volume of daily wastewater entering plants, the 1% that is not captured can result in a lot of fibers escaping into the local environment.

Where do these fibers end up? “They have been identified everywhere from aquatic life: in rivers, oceans, deep coastal sediment, and throughout the water column,” says Karba, “to on land where wastewater sludge has been applied, and, more recently, fibers have been identified in atmospheric deposition.” A lot more research needs to be done on this, she adds, “the wearing and tearing (or shedding) of a jacket as you move around your home needs to be more closely looked at.”

Then there is the issue of chemistry, says Beth Jensen, senior director of sustainable business innovation at the Outdoor Industry Association (OIA) as, “often clothing has a chemical coating, and when the garment sheds, the fibers still have the chemicals on them, which then make their way into waterways and marine life.” The microfibers are out there, but their impact on the health of organisms up and down the food chain in many cases is still unclear. As the industry drives research to better understand this and explore possible solutions,
“we also want to make sure that we are not replacing current fabrics and chemistries with regrettable substitutions,” she adds, especially ones that may be even worse for the environment.

Karba was part of a study at the University of California, Santa Barbarás (UCSB) Bren School, which looked at shedding based on the type of washing machine used and the age and quality of the garment washed. They found that the use of a top-load washing machine resulted in over 5 times as many fibers being released than a front-load machine and that older, lower-quality jackets shed more fibers as well.
Another study, led by Chelsea Rochman, examined the prevalence of fiber and plastic waste in a variety of fish species and bivalves bought commercially from markets in Indonesia and California, USA. In both sample locations, in the guts of the seafood, anthropogenic (manmade) waste was found. In 28% of the Indonesian fish, there were plastic fragments (60% of the waste), plastic foam (37% of the waste), plastic film (2% of the waste), monofilament (1% of the waste), and 0 microfibers. In the guts of 25% the US fish and 33% of the bivalves (Pacific oysters), there was anthropogenic material as well. The research team found textile fibers (80% of the waste), plastic film (10% of the waste), plastic foam (3.33% of the waste), and plastic fragments (3.33% of the waste).

All these research projects give further insight into the behavior of different types of textiles, and where fibers end up, but more studies are needed, says Jensen. The community of microfibers stakeholders, including the outdoor industry, is now collaborating to identify the knowledge gaps and prioritize the most efficient ways to fill them, as quickly as possible. The industry, “needs to better understand all of the different leakage points, where they are coming from and what role water treatment plants and other stakeholders can play,” Jensen says. She adds that we need to ask, “What are impacts at end of life on marine life and humans, and where does this issue truly fit with all the other supply chain issues?”
What is the Industry Doing?

The issue of microfibers is of great interest and concern to many outdoor brands and their supply chains. “This problem is potentially the textile equivalent of automobile tailgate emissions—and, because we know that fibers shed from fabrics, we now have to design the Prius of the fabric world,” says Karba, “and to do that, we need to better understand how to test fabrics in a standardized, rapid fashion.”

OIA has a Sustainability Working Group subgroup focused on microfibers that has created a resource library to map the landscape of organizations, researchers, and institutions that are looking at both impacts and possible solutions. As an industry group, they are “working with researchers to define what information the industry needs, and then from there, we hope we’ll be able to more effectively allocate resources to address this issue,” says Jensen.

To define and identify, the industry needs to quantify. “Do we as an industry need to figure out what a minimum plastic particle threshold is, and then design products based off of that?” muses Karba.

“Since the issue is so complex and requires so many members from different levels of the supply chain, can organizations put aside competitive attitudes and work together?” asks Karba’s colleague, Heather Shields, testing and standards engineer, Technical Knits, at Patagonia Inc. “Can people share ideas and methods that they create versus keeping them close to their chest?”

Shields is working with AATCC Committee RA100, Global Sustainability, to make recommendations as they develop a wash test method for microfibers released during home laundering. This is one of the big gaps in the industry—the ability to quantify and measure fiber shedding—according to Jensen. For this new test method, AATCC committee members...
are looking at using an accelerated laundering machine, which is currently used for AATCC Test Method 61, Colorfastness to Laundering: Accelerated. This machine can test up to 20 swatches at a time and the committee is currently exploring how to construct the test specimens and set up the wash settings in a way that best correlates to home laundering. Recreating studies with full washing machines is also something that people in the industry are looking at.

What is needed in the short term and long term is a two-pronged approach. First the industry needs to look at, “mitigation and cutting off that pollution vector,” for fabrics that shed microfibers, says Mallos. “How do we capture them and prevent them from entering into the environment?” He adds that, “It's not a silver bullet, but it's something we can do in the short term.” For the long term, Mallos says that, “We need to look at materials and how they are designed, and take a holistic approach to identify the perfect suite of solutions to maximize the reduction of shedding.”

Furthermore, new research being done needs to take into account the broader range of stakeholders and textile companies that are a major piece of the puzzle, says Mallos. “They need to come to the table and communicate with the leading researchers in this space in developing a list of priority research questions.”

“We need their input to inform and ensure that this research is not done in a vacuum and it is applicable for their processes,” adds Mallos. For the new AATCC test method being created, “We want this to be able to be tested at the mill level, allowing them to test the same material with different attributes,” says Shields.

Identifying a solution will require the continued dedication of stakeholders across the supply chain and them working together to understand the causes, do further research, and find solutions through discussions and collaboration.

**Educating Consumers**

One of the issues with raising awareness about microfibers, says Mallos, is that, “there is a massive pollution problem that you can't actually see,” not unlike air pollution. Part of the broader notion of educating the public is “highlighting some of the major sources such as clothing, tires, sheets, and other products that are unintentionally contributing to this.”

When the enormity of the issue is considered, it can seem like a gloom and doom scenario. However, “the important thing is to look at what could make an impact and be an interim solution,” says Mallos.

One item available for consumers to purchase is the Coraball, which is the brainchild of the Roasalia Project for a Clean Ocean and mimics the filtration capabilities of coral. When put into the washing machine, it traps fibers while still allowing water to flow through it. The fibers can then be removed from the ball. It doesn’t catch every fiber, but many households, each capturing a percentage of fibers, could make a big difference.

Patagonia will soon be selling the Guppy Friend bag (at cost), a filtration bag that synthetic clothes can be zipped into while in the washing machine or while hand washing. The bag catches fibers, preventing them from getting into the wastewater system. Patagonia has also invested in a waterless textile and apparel laundering company called the Tersus Solution. Tersus’ technology uses liquid carbon...
dioxide to clean clothing, and is essentially a closed loop washing machine that doesn’t dissipate fibers or the chemistry on them into wastewater.

Concerned consumers can also purchase and install a Wexco washing machine filter that captures fiber waste as well as dirt and other particles and prevents them from entering wastewater facilities and septic systems.

Part of the Solution

All of these experts and organizations are clear that they are not advocating for the elimination of synthetic fibers and are supportive of the attributes and functionality enabled by synthetics. In addition, “Some NGO’s will say just avoid synthetic fibers—but this is actually misleading, as often natural fibers are blended…or there are other issues associated with them, such as pesticide use, water use, or animal welfare issues. So, that approach is looking myopically at this issue,” remarks Jensen.

“All materials have impacts. We need to think about how can we keep [items of apparel] in use as long as possible, while avoiding these unintended consequences and waste streams,” says Jensen.

While many gaps remain between what is known and not known about microfiber shedding, the search for a solution—or several solutions—is underway. And it’s clear that everyone can be a part of that solution.

Kilara Le is a Raleigh, NC, USA-based writer and consultant, specializing in the apparel industry. www.linkedin.com/in/kilaralittle

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You may think that comfortable seats and plush carpets make up the majority of textiles in your car, but actually many of the textiles used in modern vehicles are invisible—concealed away under the hood, or in the console panels, hidden in plain sight.
Why Add Textiles?

Why are automotive manufacturers adding more textile components to vehicles? They need to reduce weight to improve fuel economy, reduce emissions, and to comply with stricter standards concerning recycling and the manufacturing carbon footprint. It also makes economic sense to be more efficient and sustainable. Conversely, greater use of technology in a vehicle can add to the build weight. As demand for more connectivity and smart tech increases, can manufacturers find weight savings and increase sustainability by using even more textiles?

Car as Mobile Computer

“I view the automobile an information processing engine that also transports individuals from point A to point B,” says Sundaresan Jayaraman, Kolon professor and director of the Kolon Center for Lifestyle Innovation at Georgia Institute of Technology’s School of Materials Science & Engineering. “The moment you make this paradigm shift, and view the car as an information processing engine (aka computer) and not just as a transporter, the opportunities for innovation are limitless. Also, textiles are an integral and significant component of today’s automobile. So, it is important to leverage that unique position and presence to contribute to the concept of the connected car.”

A Brief History of Car Comfort

It’s 1976, it’s the hottest summer on record, and I’m sitting on the back seat of my dad’s big red Ford—a small child sticking to the vinyl leatherette fabric. No seat belts, no head restraints, and certainly no airbags. Noise reduction consists of nylon carpeting—minimal to say the least.

Thankfully, automotive textiles have come a long way. These days, smart seat belts that tighten when you brake and airbags that fold down into the smallest side panel come as standard equipment in new cars. Then there are noise reducing, fully recyclable plush carpets and head-linings. Seats today have head restraints, heater elements, lumbar support, and pocketed coil springs. Add new technologies such as stain-resistant seat covers, and smart fabrics that monitor the driver’s health and temperature, and you have an interior that is comfortable, safe, and designed for the modern commute—or for when that ice-cream gets dropped by the grandchild.

The driving experience of the last few years has seen some dramatic changes, from the introduction of foam seats to the use of radar-activated pre-crash systems.

Beginning the Journey

The first cars used coach seats passed down from the horse-drawn carriage, made from horsehair, webbing, and springs. By the 1930s, some cars had inflatable cushions (that were prone to punctures). Panels were metal or wood, and often handcrafted.

It isn’t until the 1960s that foam rubber is widely used as seating, with plastic replacing wood. (Mirroring the new
Fashions appearing in the homes of baby boomers.) The industrial assembly lines of the 1970s saw expanded foam rubber as the most common filler for automobile seats, often with internal springs, and leather-look vinyls took the place of more expensive leather for sedans.

The 80s and early 90s saw cars and their interiors undergo a revolution. Sculpted seats, plush carpets, and velour headlinings suddenly became the norm. Lean manufacturing extolled efficiencies, with auto-factories assembling seats in line with the Japanese model of kaizen—a natural progression from the assembly line first instigated by Henry Ford. Seats, panels, and other components were delivered to the assembly lines “just in time” to be fitted into the vehicle. Laser cutting replaced dies for more efficient and precise fabric pattern cutting, robots were utilized in both durability testing and assembly (such as spot welding of seat frames), and modern safety features such as seat belts, airbags, and head restraints became standard.

By the 2000s, new regulations by federal governments (such as the EU) enforced recyclability and lower carbon emissions upon manufacturing. (For example, since 2015, EU quotas for the recycling of materials derived from scrapped vehicles are 95% recovery with at least 85% reused and/or recycled materials.)

Are We There Yet?

Now in the 2010s, increased awareness of sustainability and recycling targets drive the sales of hybrid fuel and electric cars, and vehicle interiors are changing again. This time, the revolution is with smart technology. Full integration is provided for personal devices, satellite navigation systems, cell phone chargers, and tablets. Radar can help the driver park the car, or trigger active safety devices in the event of a collision. Health monitoring seats synchronize with in-car systems, increasing ventilation automatically to keep the driver alert. And let’s not forget the continuing progress with completely autonomous, driverless vehicles. Manufacturers claim that you will no longer be the driver, just another passenger who can either relax into their smart seats for a massage, or continuing working in your portable office with full connectivity.

Automotive textiles are also changing. Natural composites of wood and flax make panels and consoles; coil springs and wool are inside executive seats; nanotechnology is used to keep seats clean and fresh; and seat belts not only think for themselves, but also are being re-engineered for better stretch and fit.

As I sit in my air-conditioned car, with contour-sculpted seats, synching my cell phone and checking my SatNav, I wonder what that little girl from the 1970s would have thought of the modern automotive experience. Even if we can’t know for sure if the future is bright—it’s certainly going to be connected.

Fabric as an Information Infrastructure

“The traditional view of textiles is that they protect and make individuals or surfaces look good,” Jayaraman notes. “My view is that a fabric is an information infrastructure that also protects and makes you look good. In other words, the yarns in the fabric can be used for transmitting information, say from sensors, or power, say from batteries. Moreover, the fabric itself can act as a sensor. This combination of a textile fabric being a sensor and/or a databus makes it a ‘meta-structure’ and can be deployed for multiple applications in the connected car. Advancements in conductive and optical fibers enhance the features of these fibers, thereby contributing to their increasing use in the automobile of the future.”

In terms of the driving experience, Jayaraman sees two main areas that will have the greatest impact—health and comfort, and driver safety. “In terms of the impact of smart textiles on the user, i.e., driver, smart textiles will enhance the experience for the driver in at least two ways,” Jayaraman says. “First, they will make the experience more comfortable; for instance, the ergonomics of seating can be enhanced depending on the user’s comfort level by measuring the pressure on the seat and back by the smart fabrics in the seats. The lighting of the interior panels can be enhanced through the optical fibers integrated into the structure. Smart textiles will also enhance the safety of the driver; for instance, sensors integrated into the car seat or the seat belt can monitor the driver’s weight, profile, and position, and accordingly control the deployment of the air-bag to minimize potential injuries to the driver from the deployment.”
weave, which they say will make seat belts more comfortable. In their “low-friction seatbelt,” the weave of the webbing changes from a regular weave to a variable herringbone. Nissan estimates improvement in flexibility by softening the sash portion to give a more comfortable feeling will result in a 20% reduction in tightness and a 10% reduction in the “pull force” required to slide the belt through the hoop. Nissan hopes this reduction in forces will reduce tightness during wear and encourage seat belt use.

**Airbags**

Radar systems and smart seat belts are examples of active safety systems—whereas standard seat belts and airbags are passive safety systems. All airbags must be both very strong and lightweight enough so as not to cause injury upon deployment. They are usually made from nylon 6,6 yarn in deniers of 420-840 (finer deniers of 235 are also used).

How does the nylon used in automotive textiles differ from other materials? “The nylon has similar properties to that used in some other applications,” Autoliv’s global textiles project team leader, Tom Hajkus, says. “However, the final specification is specific to airbag fabrics and is qualified individually for each product. The quality specifications and requirements are often stricter for airbag fabric use than for other uses.”
Recycling is a major factor in Autoliv’s manufacturing processes. “Recyclability is always considered and a significant amount of our waste and scrap is recycled. Our products are labeled to reflect the recyclability of our products after use,” Hajkus says. “For the nylon recycling, most of the scrap and waste occurs during the cutting process. Any recyclable material is sent to an external recycling company. We have several different technologies (combinations of construction, yarn, and coating types) and the recyclability depends on these.”

One innovation under development at Autoliv is in rear seat belt design. By manufacturing both airbags and seatbelts, they can provide integrated solutions and are currently developing the “bag-in-a-belt” rear seat belt. Here the webbing on the sash is part extra wide seatbelt, part airbag, which deploys in a collision. A gas generator forces several layers of webbing, held together by deliberately weak stitches, apart—giving a greater surface area to distribute load over the occupant’s ribcage.

**Head Restraints**

Pre-crash systems also feature in the latest head restraints. US car seat giant Adient (a spinoff of Johnson Controls) has developed a head restraint that uses “passive whiplash protection.” The “riACT” includes a pyrotechnic igniter to move the head restraint forward at 50 mm per second in the event of a crash. This coordinates with other pre-crash systems to minimize spinal injuries with adjustments to side wings and tilt made manually, or by built-in electric actuators connected to the seat control unit. “Pour-in-place” foams produce the head restraints with the mechanics and cover placed into a form and low-density foam poured in. Part of the substrate can use recycled PET.

“The systems which are in production are triggered by the vehicle sensors and deployed by a pyrotechnic igniter,” says Adient’s director of innovations for safety and comfort modules, Oliver Alber. “The function principle is that the igniter heats up a certain volume of air in a sealed volume which then expands and moves the head restraint towards the occupant’s head. The forward displacement of the head restraint is put into motion in 15-20 milliseconds, effectively minimizing injuries to the cervical spine.”

The **riACT** system has been in production since 2005. “While head restraints contribute to a safe and comfortable driving experience, weight and design are also major influencing factors,” says Alber. “We fulfill the highest expectations of automakers and drivers for these products and work continuously on optimizing these areas.” RiACT is currently in production in the BMW 5 and 7 series in the high-end seat versions (comfort seats). “This version is called riACT Gen 3,” says Alber. “We also have another version in pre-development which is called riACT Gen 4. The function principle is the same; however, it is slimmer than the Gen 3 model. This allows for better packaging conditions, especially for slim and sport seats with integrated headrest. Also, the deployment time is reduced to 10-15 milliseconds.” Alber says that the riAct Gen 4 would be coming on line in late 2018.

**The Supporting Cast**

Many of the components in a vehicle that are textiles, or have textiles as reinforcements, are all around you, taken for granted. If the seats and carpets are the glamorous leads of the automobile interior, then consoles and panels are the supporting cast. Armrests and consoles continue to evolve
into connectivity devices, with ports, cup holders, and cell-phone chargers. Decorative features such as stitching and high-end fabrics like leather are available as options, with manufacturers such as Adient creating modular designs with different customization, thus increasing the flexibility of the design.

**Panels**

Creating sustainability through increasing the use of natural fibers in the automotive manufacturing process has become very popular in recent years. Lineo of Belgium is producing a non-woven that uses pectin (the same substance that makes fruit jelly set) to bind together flax fibers, creating a composite designed to replace polyurethane and glass fiber compounds, used in side panels, trims, and rear seat panels. Flaxtape has a weight reduction of approximately 50% compared to traditional materials such as polyurethane, and is 100% recyclable.

Faurecia Automotive Seating equipped 2017’s Car of the Year, the Peugeot 3008, and also manufactures automotive panels and consoles. With their partners, Automotive Performance Materials, they are focusing on reducing CO₂ emissions during the manufacturing process by using bio-composites to replace traditional polyurethane foams. Their product, Naflane, uses 20% hemp fibers, in combination with polypropylene, to create a weight-saving and fully recyclable, injectable composite used in automotive interiors. Hemp is mostly organic in that it requires no fertilizer to grow and has a small carbon footprint. Its long fibers are durable and rot-proof, traditionally used for ship’s ropes. Head of Media Relations, Eric Fohlen-Weill, sees technology as the future.

“Comfort and connectivity will be essential tomorrow,” Fohlen-Weill says. “The automotive industry is undergoing a technological revolution in terms of connectivity and autonomous driving.”

**Back-Stage Textiles**

Finally, we have the back-stage textiles—those invisible vital components that keep the show going. Non-woven filters, knitted hoses, wheel liners, carpet backings, and flexible fuel tanks are always in the background, unseen. Not glamorous, but they are essential.

Arville, a family-owned company from the UK, specializes in supplying technical textiles worldwide to automotive manufacturers. Their fabrics reinforce mechanical rubber goods such as hoses and flexible fuel tanks. They also coat, waterproof, and seal fabrics ready for manufacturing uses.

Arville’s Head of Marketing, Andy Smith, says that cutting fabrics on the bias is important for reducing waste and costs for their customers. “We have special machinery [which] allows us to produce bias cut fabrics very efficiently,” he says. “Some textile reinforcements can offer great tensile strength, but because of their fiber type (e.g., aramids) and their woven construction, they have very low elongation in the warp/weft directions, which can limit how well they form into complicated shapes. Hose manufacturers can get around this by using the fabric on an angle (bias) but this can lead to extra waste. By offering fabric which is pre-cut on a bias at a specified angle, we can reduce their material waste and improve production efficiencies, with often significant cost-savings.”

Environmental concerns are especially important to Arville. “Arville is committed to running its business in a responsible, environmentally sound, and sustainable manner,” Smith says. “We recognize that our supply chain, processes, and products have both direct and indirect environmental impacts. We seek to identify these, and to find effective ways of eliminating or reducing them.”
Besides sustainability, innovation is also important to Arville. "We are continually innovating," Smith says. "At the moment, we are working on developing a fabric with a unique weave construction that behaves as a hybrid between a woven and knitted fabric, with low elongation in the warp direction and high elongation across the weft. The benefits to the hose market would be a high strength fabric with excellent formability for complicated shapes."

**What the Future Brings**

Jayaraman, who is involved in the creation of smart fabrics, summarizes his views on the driving experience. "The textiles in the car’s interior can serve as an effective platform for the integration of sensors and processors to significantly enhance the comfort and safety of the driver," he says. "When the data from these sensors are integrated into the automobile’s data system, which, in turn, are connected to other automobiles, the connected ecosystem will give new meaning to the driving experience."

Jayaraman sees smart tech and textiles combining to create multitasking car components. Fabrics can be integral parts of the web of connectivity within vehicles—sensing and activating systems autonomously. New bio-composites drawing from natural fibers, such as lignin, wool, and hemp, are enhancing the sustainability and recyclability of these components, and innovative technologies are cutting waste and reducing costs for manufacturers. Although hidden from view, these textiles benefit us all through enhanced safety features and added comfort. These benefits extend outside of our cars and into the wider environment. The increasing use of "invisible" textiles in our cars carry benefits that are clear for all to see.

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In recent years, the enormous popularity of athleisure (active wear worn as day-to-day clothing) has energized an otherwise sluggish apparel industry. The global growth is expected to continue, with sales forecast to reach US$350 billion by 2020 (up from only US$197 billion in 2007). Among the primary consumers who have propelled this trend are women who are leading more active lifestyles and wearing relaxed, gym-inspired clothing to work, school, and places beyond the yoga studio or tennis court. Plain and functional no longer, women’s sports clothing has been transformed into fashionable garments sold by everyone from retailers, to pop stars, to high-end designers. Wearing comfortable, stylish exercise clothes, both to exercise and to have lunch with friends, is becoming more commonplace for women of all ages.

It is therefore no surprise that major brands are actively expanding their female sports apparel lines, offering an almost limitless array of colorful compression leggings or brightly patterned sports bras. Sports bras, in particular, have undergone several transformations through the years. In 2002, sports bra sales accounted for approximately 6% of the US$4.5 billion bra market. By 2015, the bra market was worth about US$15 billion.
From Jogbra to Smart Bra

In the late 1970s—as more and more women participated in popular sports like jogging—Hinda Miller, a designer who was herself an enthusiastic runner, saw the difficulties that many women encountered. Physical damage due to “bouncing boobs” was an unhealthy norm for far too many female runners. Seeing an opportunity to change that, Miller, together with two friends, Polly Palmer-Smith and Lisa Lindahl, created the sports bra. Inspired by Lindahl’s husband’s jock strap (which he jokingly wore across his chest), the first sports bra, known as the Jogbra, was invented. This innovation altered the way female athletes trained.

For decades, with the exceptions of some tweaks in design, style, and color, the sports bra remained largely the same. However, this changed in 2006. A small US company called Textronics, now owned by adidas, introduced a sports bra that doubled as a heart rate monitor. Called the NuMetrex Heart Sensing Sports Bra, it was one of the earliest forays into the new category of “smart” sports bras. The then-revolutionary bra was the first to have heart rate monitoring technology knitted directly into the straps of the bra. The fabric adjusted to the wearer’s body movements while sensing her heart rate. A transmitter inside a pocket of the bra then sent the information to a compatible watch, phone, or cardio machine.

Soon, other brands developed their own smart sports bras. Lululemon and Sensoria started selling bras with heart rate monitors. Adidas also launched its own version of the garment. All three brands essentially added heart rate monitors to otherwise regular-looking sports bras. Until this year, so-called “smart bras” seemed limited to measuring only a single metric.

Game-Changing

In September 2016, a game-changing sports bra was launched by OM Signal, a tech wearables startup based in Montreal, Canada. OM Signal’s head of electronic textiles, Joanna Berzowska, said in a press release, “Our focus was to create a beautiful sports bra to enhance a woman’s body, respond to the unique strains of running, and accurately detect the body’s core signal...”

The OMbra is a clear fusion of fitness trackers and women’s sports apparel, designed to give women a better running experience through proper breast support, digital coaching (with its companion app OMRun), and accurate tracking of heart rate and breathing. The bra is constructed from a lightweight cloth that wicks moisture, combined with mesh paneling for breathability. The four-way stretchable fabric, made from a polyester-nylon-elastane blend, enables the bra to conform to the wearer’s natural body shape while in motion. The specially-developed textile also absorbs pressure, decreasing stress on the wearer’s back and shoulders.

Unlike most sports bras, the OMbra consists of two separate cups that fully support each breast; these cups were specially designed to constrain side-to-side, as well as front-to-back movement. The double-cup design also results in a more flattering shape, avoiding the “uni-boob” look that is created by many conventional sports bras. Fully-adjustable straps and hook-and-eye back closures allow the wearer to find the proper fit. The racerback form...
eliminates the problem of falling straps, and also reduces the impact of running on the shoulders, distributing it to other parts of the body. The bottom part of the bra has a reinforced textile undercup and a thick panel in which numerous tiny sensors are integrated. These sensors obtain data on heart rate and breathing directly from the wearer’s torso. On the bottom panel’s left side are five small pins, to which the user needs to connect a black box, called the OMbox. The OMbox contains an accelerometer that records the movement and steps of the wearer.

The biometric data collected from the bra is transferred via Bluetooth to the OMapp in the user’s smartphone. In addition to heart rate, breathing, movement, and certain running data, the bra also detects the wearer’s effort level, fatigue, and the number of calories burned. The information gathered from the body is then used by a running app to provide coaching tips to improve the wearer’s performance. Early reviews of the OMbra seem encouraging. It has been described as both “cute” and “comfortable.”

The Key is Comfort

A key factor that determines whether a sports bra is comfortable or not is the ability of the garment to adequately support the wearer’s breasts. Proper breast support alleviates problems commonly experienced by girls and women during physical activity. According to Jenny Burbage of the Department of Sport & Exercise Science at the University of Portsmouth, “The breast itself has very limited internal support, meaning that excessive breast motion can occur if the breast is not supported appropriately during sport and exercise. This is more of a problem for larger-breasted athletes. We have conducted some preliminary research in this area, trying to understand whether wearing poor breast support could be detrimental to an athlete.”

Burbage adds that a bra “needs to fit well and provide sufficient support for the activity being undertaken. A good sports bra will have a firm underband and lots of adjustability in the band and straps (to help achieve a good fit). Wide, padded shoulder straps can be advantageous, along with a high neckline and good lateral support.” Women need to put a lot of effort into finding the best style for their body—what works for one woman may not work for another. Burbage explains that this often means “trying lots on and jumping up and down in the changing room to ensure that it is supportive. For larger-breasted athletes, an encapsulation style (breasts are supported separately) has been shown to be more effective than a pure compression style bra (which just flattens the breasts to the chest wall).”

Beyond Smart Bras

Many sports bras are designed to improve women’s running experiences, but there is a long list of sports that would benefit from customized smart sports bra designs. The needs of a runner may be vastly different from those of a tennis player, or a basketball player, or a woman practicing judo. As Burbage notes, “More research is needed to find optimum support for a variety of activities.” Hopefully, companies will recognize these differentiated needs.

The smart revolution in athletic textiles goes far beyond sports bras. Indeed, the goal of smart textiles is largely to enhance the performance of anyone wearing the fabric. From an athletic performance standpoint, a smart fabric can monitor the wearer’s core body temperature and adjust as necessary—this may be important for monitoring the efforts of endurance athletes, like marathon runners, or reducing the risk of hypothermia for mountain climbers and other extreme athletes. Smart clothing can also reduce wind resistance and may also reduce dangers from various environmental hazards.

Some products incorporating smart fabrics and smart technology have already hit the market, whereas other products have experienced challenges—primarily because of high price points.
For example, the Finnish company, Myontec, attempted to raise private funding for innovative shorts that would measure muscle load and also identify possible biomechanical form weaknesses that could result in injuries. Unfortunately, Myontec failed to raise the funds to produce these shorts for the mass market.

Other companies have had more success. For example, Athos has successfully sold a pair of compression shorts with sensors built into the glutes and the thigh region. These sensors record a wide range of data that is then transmitted to the wearer via a smartphone app.

Smarter Fabrics, More Confident Athletes

The arrival of smarter sports bras ushers in a new wave of workout apparel that is not only more aesthetically appealing, but also increasingly responsive to women’s bodies. Hopefully, the availability of well-designed sportswear especially suited to the unique needs and preferences of girls and women will inspire more of them to be active and confident athletes.

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Introduction

Increasing concerns over the environment have lead the world to think eco-friendly. To accomplish eco-friendliness, sustainable development is being preferred by manufacturing plants around the globe. Many conventional processes are being banned by different countries and improvements are continuously being made to update manufacturing technology to a safer level for the benefit of the environment. The textile industry has been impacted by these improvements as well.

The most important process involved in eco-friendly textile manufacturing is chemical processing. Conventional methods of textile chemical processing include wet methods involving harmful chemicals, which after use, are disposed of into water, air, and/or soil. These practices directly affect the environment, and above all, human health.

Textile chemical processing includes desizing, scouring, bleaching, dyeing, and finishing of textiles by various means and methods. Major advancements in textile chemical processing are the use of biodegradable and eco-friendly colors or natural dyes, as well as the reduction and reuse of water. Auxiliary chemicals are now being replaced with more efficient and environmentally-friendly chemicals and enzymes, along with better disposal of chemical effluents and use of alternative eco-friendly methods. Pretreatment is an inevitable part of chemical processing, in which desizing, scouring, and bleaching are the most important from a manufacturing point of view, as the quality of further processing depends on them. This paper deals with eco-friendly advancements in textile pretreatments (Fig. 1).

Desizing

Desizing is the removal of warp size paste from woven fabric for better dyeability and further...
chemical processing. Enzymatic desizing of fabric was the most significant eco-friendly development in desizing, followed by ultrasonic and plasma energy-assisted desizing (Table I).

Table I. Summary of Advances in Desizing

<table>
<thead>
<tr>
<th>No.</th>
<th>Method</th>
<th>Reference(s)</th>
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<tbody>
<tr>
<td>1</td>
<td>Desizing with α-amylase</td>
<td>1–3</td>
</tr>
<tr>
<td>2</td>
<td>Use of ultrasonic energy</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>Alternatives for size chemicals</td>
<td>5, 6</td>
</tr>
<tr>
<td>4</td>
<td>One-step pre-treatment of denim</td>
<td>7</td>
</tr>
<tr>
<td>5</td>
<td>Wastewater management and disposal of size</td>
<td>8, 9</td>
</tr>
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Enzymatic desizing using α-amylase (from *Bacillus* sp. KR-8104) at acidic pH is advantageous in terms of reducing process times and desizing at lower temperatures. Use of an acidic pH enables simultaneous desizing with removal of inhibiting minerals. The enzymatic effect does not appear to be influenced by the use of EDTA. Therefore, resins as well as chelating agents can be used in the same bath, thus eliminating the use of CaCl₂ as an auxiliary, which otherwise could lead to a decrease in the enzyme concentration used in this process.¹ Similar research using xylanase from *Bacillus pumilus* carried out under neutral conditions results in the combined desizing and scouring of micro-polyester fabrics. Cotton fabric treated in the same manner does not achieve as good of a result compared to micro-polyester fabrics, although the whiteness factor is improved by the method.² The desizing efficiency and hydrolysis of starch with different α-amylases is reported as native cornstarch > starch acetate > starch phosphate > quaternary ammonium cationic starch, while introduction of carbon chains reduces enzyme efficiency to some extent.³

Use of ultrasonic energy also boosts process efficiency. This is done by combining ultrasonic with ongoing enzymatic action. The starch layer is believed to become uneven on ultrasound application, which allows maximum surface interaction of enzymes with starch and significantly increases the desizing efficiency. Increased ultrasonic power linearly improves desizing efficiency to 80% at 180 W rated power. Ultrasound assisted desizing also decreases the desizing time to half with an increase in efficiency of about 5%.⁴

Polyester or polyester cotton blends are usually sized with starch or PVA (polyvinyl alcohol). PVA is the most widely used, but it is not degradable in textile effluent treatment plants and poses environmental hazards. Keratin obtained from chicken feathers is a good alternative to PVA as keratin is easily degradable and costs less than PVA. Keratin can be desized using activated sludge.⁵ Cotton warp sizing using starch is the most important sizing process. Cotton sizing can be done with poly[(2-acryloyloxyethyl trimethyl ammonium chloride)-co-(acrylic acid)] branches grafted on the backbone of starch. The most interesting feature of the modified starch structure is improved adhesion on the substrate as well as better desizing efficiency—up to 90% when the grafted branches are only 46.8% of the size content.⁶

Pretreatment of denim fabric usually includes desizing, washing, enzyme treatment, additional washing, and softening. These processes combined consume a remarkable amount of energy and resources. To reduce the use of these valuable resources, these processes may be carried out in one step using cellulase, amylase, and laccase in combination for bio-desizing and bio-washing. This combined process also increases abrasion resistance in addition to reduced back staining, and results in significant color change when compared to processes using cellulase or laccase or both cellulose and laccase in combination.⁷

Filters used for industrial wastewater treatment are an expense that is not directly economically profitable for manufacturers. Used desizing liquor is mixed with wastewater from scouring and other wet processes before being sent to wastewater treatment. This resultant wastewater contains mainly NaOH, refining agent, dispersing agent, and the removed fabric size in combination with many other chemicals. This wastewater is difficult as well as costly to treat. When treatment filters are used excessively, their efficiency goes down, and they must be repeatedly cleaned. Ultrafiltration ceramic membranes used for wastewater treatment are easily cleaned with a mixed cleaning solution of NaOH and sodium dodecyl benzene sulfonate (SDBS).⁸

Another interesting study uses desizing wastewater for ethanol production. A mixed culture of *Bacillus subtilis* D and *Saccharomyces cerevisiae* TISTR 5160, in a ratio of 5:10 with shaking at 150 rpm at 37 °C yields 5.8 g/L ethanol after 48 h. Introduction of nitrogen sources increases the ethanol yield.⁹

### Scouring

Eco-friendly scouring processes are now available, with enzymatic methods leading the way (Table II).
Enzymatic scouring and bleaching can be done together in one bath by using enzymes and bleaching chemicals (e.g., hydrogen peroxide) produced by enzymes during glucose degradation in the bath. Pectinase is used for bio-scouring of cotton fabrics and provides an eco-friendly alternative to caustic soda and other chemicals used conventionally for scouring. Use of non-ionic detergents is compatible with pectinase scouring, with improved performance. Marine pectinase produced from *B. subtilis*, with the assistance of *Citrus limetta* peel substrate, improves scoured cotton whiteness. Pectinase or cellulase, in combination with peracetic acid, results in combined bio-scouring and bleaching of cotton. A new rhamnolipid bio-surfactant obtained from *Pseudomonas aeruginosa* bacteria is used for gentle scouring of cotton fabrics. The bio-surfactant combined with pectinase gives equivalent efficiency to similar treatments using other surfactants, is environmentally friendly, and is easily biodegradable.

Cutinase can also be used for scouring of cotton fabrics. It removes the cuticle layer of cotton fiber and does not affect the overall tensile strength of the fabric, with a nominal decrease of 2.7%. A study on the role of mechanical action on cotton fabric scouring revealed a novel scouring method at low temperatures of about 30 °C. Cutinase from *Fusarium solani pisi* degrades and removes cotton waxes at low temperatures in 10-15 min. With this method, the scouring temperature of 100 °C used for alkaline scouring can be replaced by scouring with a combination of cutinase and pectinase at 30 °C that is nearly as effective.

**Bleaching**

Bleaching whitens textiles by removing color and colored impurities. Advancements in bleaching include enzymatic bleaching, application of ultrasonics, and wastewater usability (Table III).

In enzymatic bleaching, different enzymes breakdown glucose to generate hydrogen peroxide, which is activated by bleaching at an optimal pH. In some cases, enzymes are used as a hydrogen peroxide stabilizer in the bath. Cellulase, when used as a hydrogen peroxide stabilizer, results in better bleaching and bio-polishing of the knitted cotton fabric in one step, while improving the cellulose crystalline structure. A comparative study on performance of enzymatic bleaching versus conventional bleaching shows that when knitted cotton was treated with glucose-oxidase, the resulting fabric has a 6% better whiteness index with negligible strength loss.

Ultrasonic energy can play an important role in enhancing bleaching performance. Use of ultrasonic energy results in cost effective and more efficient bleaching, with less energy use and chemical consumption. When ultrasonic energy is used along with glucose oxidase enzyme for bleaching, the whiteness index is the same as that obtained from conventional hydrogen peroxide bleaching. However, all seed fragments are removed from the sample and the COD (chemical oxygen demand) value becomes significantly less than that for conventional bleaching. Ozone treatment may also be used as an alternative to conventional hydrogen peroxide bleaching. Ultrasonic ozone bleaching is an efficient bleaching process and results in dramatically lower COD values.
An interesting study reuses the residual water obtained from washings after hydrogen peroxide bleaching. By treating the residual water with catalase enzyme immobilized on Al₂O₃ pellets and crosslinked with glutaraldehyde, this treated residual water can be reused for dyeing.²³

Chemical effluents are cytotoxic (toxic to cells) and mutagenic (triggers mutations on the DNA level) and are degraded easily after gamma irradiation in the presence of a small amount of hydrogen peroxide—a potential wastewater treatment for textile effluents.²⁴ In addition, gamma irradiation can also be used for bleaching. H₂O₂ bleaching assisted with gamma irradiation results in reduced water and energy consumption, yielding excellent water absorbency and satisfactory whiteness values for samples. The whiteness properties achieved through gamma irradiation are equivalent to conventionally scoured and bleached fabrics. The gamma irradiation process results in a small (15%) strength loss.²⁵

Conclusion

Consumers are demanding that textiles be sourced and manufactured in a more environmentally-friendly and sustainable manner. Research is focused on making the pretreatment process more efficient as well as more environmentally friendly. Alternative and renewable methods of pretreatment include the use of enzymes, ultrasound, and even CO₂ to replace chemicals, energy, and solvents. Industry will continue to adopt these and other more sustainable pretreatment alternatives in the future.

References


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Introduction

Most textile items are expected to maintain their properties over time, and thus, exhibit durability. Durability extends to mechanical integrity, color, and additional properties conferred by textile finishes. The durability of color is routinely measured in colorfastness tests, many of which are accelerated. Such accelerated testing of finish durability is less common, and durability to laundering is tested using multiple conventional laundering processes.

For example, some product specifications require textiles treated with a water-repellent finish to maintain the repellency through multiple launderings, such as the US Army Physical Fitness Uniform, specification GL/PD 13-04, which requires satisfactory water and oil repellency initially and after 100 laundering cycles. The development of a fabric to meet this specification can involve numerous product lots, each of which requires the full 100 launderings. Testing to meet such specifications thus requires much time, labor, water, and energy.

If colorfastness to laundering, in which the color loss in five launderings is assessed, were to be tested using conventional launderings, individual colors would have to be laundered separately five times, making the development of textile products complicated and costly. To avoid this, accelerated tests have long been used.

An AATCC test method to evaluate colorfastness using the Launder-Ometer was introduced in 1928. In 1950, the first version of AATCC Test Method (TM) 61 using the Launder-Ometer to test colorfastness was published. Since then, the method has been further developed and revised, leading to the current method. AATCC TM 61: Colorfastness to Laundering: Accelerated provides six tests that correspond to various conventional laundry conditions. In each case, the test will produce a color change approximating that obtained in five cycles of laundering. This correlation has been tested and confirmed over several changes in washing conditions and changes in detergent formulations.

This test method only correlates color loss in the test with that in actual laundering. Even though staining, via the inclusion of a white multifiber fabric, is assessed in the test, the method notes that the staining of the multifiber cannot be assumed to correlate with that found in conventional laundering. Furthermore, the test makes no mention of correlation between the effects obtained in the Launder-Ometer and realistic laundering conditions for any other textile property, and, as far as can be determined, none has been researched. Instances when such a correlation is assumed are common, however, and “one Launder-Ometer cycle equals five home launderings” has become something of an urban myth. Two recent examples involve the use of the Launder-Ometer to test the durability of textiles finished with a silver-based antimicrobial.

The present study sought to compare the effects of laundering, using a top-loading washing machine and accelerated Launder-Ometer testing, and thus determine if a combination of factors in an accelerated test could mimic the effects of that laundering on the durability of water- and oil-repellent finishes to multiple home launderings. In other words, does one Launder-Ometer cycle produce the equivalent to five home launderings in terms of finish durability? If it does, the potential benefits are large: an accelerated method to test finish durability would save both time and resources, especially during product development. If an accelerated (and small-scale) test were shown to approximate the effects of five launderings on the loss of a finish, it would allow 100-laundering durability testing in approximately 20 hours compared to over 100 hours in a top-loader washer and dryer.

While the earlier studies cited might simply assume a correlation with laundering in general, it should be noted that the present study sought to correlate accelerated laundering with very specific conditions of conventional laundering. If such a correlation were...
established, continued changes of conditions within conventional laundering (e.g., temperature, detergent type and amount, and machine parameters) would make it necessary to reestablish correlation.

The savings of water and energy can also be considered. A typical top-loading machine will use 68 liters (18 gallons) of water per cycle (i.e., 6800 liters for 100 launderings). Respective lots must be washed separately to avoid any contaminants from one lot to the next. Testing 20 fabrics would thus require 2000 laundering cycles, and 136,000 liters of water. In contrast, 20 samples can be washed at one time in a Launder-Ometer, using 150 mL of detergent solution per sample. Thus, 20 fabrics subjected to 20 Launder-Ometer cycles would use around 60 liters of water (i.e., 150 mL per canister, 20 canisters, and 20 cycles).3

Energy savings would also accrue. Heating 136,000 liters of water from 20 °C to 40 °C would require 11.8 MJ. Heating the 65-liter bath of the Launder-Ometer from 20 °C to 50 °C 20 times would use 161 kJ. The costs of drying, wastewater treatment, detergent, and labor would also be reduced.

Experimental

Overview

Part 1
Two lots of dyed nylon fabric (C6i and C6ii) were treated with a C6 fluorochemical durable water repellent (DWR) finish. Samples were washed 100 times in a top-loading washing machine, and the loss of repellency monitored at intervals. The same fabrics were subjected to 20 cycles of Launder-Ometer testing, with repellency measured at intervals. The correlation between top-loader and Launder-Ometer was assessed. Conditions of the Launder-Ometer testing were adjusted, and the 20 cycles repeated with the new conditions to achieve better correlation of repellency loss with real conventional launderings.

Part 2
One lot of dyed nylon fabric (C8i) was treated with a C8 fluorochemical DWR finish. Samples were washed 100 times in a top-loading washing machine, and the loss of repellency monitored at intervals. Samples of the same C8i fabric were subjected to 20 cycles of Launder-Ometer testing using the best Launder-Ometer conditions from part 1 to determine if the loss of repellency was the same as that of the two C6 fabrics, and/or the same as the 100 launderings. Launder-Ometer conditions were adjusted to see if better correlation could be obtained on C8i fabric.

Materials

The base material for all experiments was a woven 70-denier nylon fabric, dyed black. It was finished with different concentrations of a durable C8 or C6 fluorochemical oil- and water-repellent finish, with a blocked isocyanate added to increase durability. A detailed description of each fabric is listed in Table I. After application of finish, the lots were dried on a gas tenter frame at temperatures and speeds listed in Table I.

<table>
<thead>
<tr>
<th>Fabric</th>
<th>DWR (type)</th>
<th>Applied (%)</th>
<th>Extender (%)</th>
<th>Cure Temperature (°C)</th>
<th>Speed (m/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C6i</td>
<td>C6</td>
<td>10</td>
<td>*</td>
<td>175</td>
<td>27</td>
</tr>
<tr>
<td>C6ii</td>
<td>C6</td>
<td>11.75</td>
<td>0.75</td>
<td>175</td>
<td>27</td>
</tr>
<tr>
<td>C8i</td>
<td>C8</td>
<td>9</td>
<td>2.5</td>
<td>175</td>
<td>27</td>
</tr>
</tbody>
</table>

* Commercial formulation in which an extender is included

Procedure

Top-Loading Laundry

Each lot of finished fabric (C6i, C6ii, and C8i) was divided into two sets of 10 quarter-yard cuts. Each quarter-yard cut allowed for replications of water-and oil-repellent testing.

The 20 samples of each fabric were laundered separately 100 times in a top-loading Kenmore model 20442 washing machine conforming to Table II C of AATCC Monograph 6-20133 with 66 g of AATCC Standard Reference Detergent WOB using conditions derived from AATCC TM 135-2015: Dimensional Changes of Fabrics after Home Laundering (i.e., permanent press wash cycle at 40.5 ± 3 °C, a large size wash load, and permanent-press tumble dry at 68 ± 1 °C until dry). The test method allows a dryer temperature of wider range, but this temperature was more tightly controlled in the study. One set of samples of C8i fabric was dried at 63 °C before repellency testing, another set was dried at 68 °C. The wash load consisted of 68 L of water, the samples, and standard cotton ballast sufficient to make up a 1.8 kg load.

After every 10 launderings, samples were removed, dried, conditioned at 20 ± 1 °C and 65 ± 2% relative humidity (RH) for 4 h, and tested for water and oil repellency.
repellency using AATCC TM 22-2014: Water Repellency: Spray Test and AATCC TM 118-2013: Oil Repellency: Hydrocarbon Resistance Test, respectively. Each test was replicated 3 times with 3 experienced observers each time. Tested samples were replaced with ballast for succeeding wash cycles.

**Launder-Ometer Studies**

Repellency testing required larger samples (~200 × 200 mm) than are used in AATCC TM 61: Colorfastness to Laundering: Accelerated (50 × 150 mm or 50 × 100 mm). A preliminary study was run to determine if such a large sample could be treated evenly and consistently in the Launder-Ometer canisters.

A sample of the nylon woven fabric used in the main study was dyed with a dye of known poor colorfastness. Four 200 × 200 mm samples and four 50 × 100 mm samples of this fabric were subjected to AATCC TM 61-2A, with the assumption that an even loss of color would indicate even treatment within the Launder-Ometer. The tests were conducted both with (as required in the test) and without (mimicking the conditions to which finish durability might be tested) multifiber. Additionally, the samples without multifiber were subjected to 2 and 3 cycles of TM 61. After the washing cycles, the samples were air dried and conditioned. The samples were each inspected visually for evenness of the color loss, and the color change determined spectrophotometrically by determination of $L^*a^*b^*$ values and $\Delta E_{CIELab}$ using D 65/10° conditions.

Finished 200 × 200 mm samples of C6i and C6ii were then subjected to repeated cycles in the Launder-Ometer. Each testing round consisted of 20 cycles, with samples being tested for repellency after 1, 5, 10, 15, and 20 cycles.

While the Launder-Ometer reached its operating temperature, samples were placed in individual 3.5 × 8 in. canisters with the appropriate number of steel balls and amount of detergent solution. The canisters were then locked, placed into the Launder-Ometer and agitated for 45 min. At the end of the cycle, each canister was emptied into a beaker. Each sample was then rinsed three times in the beaker with deionized water at 40 ± 3 °C for 1 min each with occasional agitation. The samples were then dried in a tumble dryer at 68 °C until dry.

At cycles 1, 5, 10, 15, and 20 (approximating to, perhaps, 5, 25, 50, 75, and 100 home launderings), samples were removed, air dried, conditioned, and tested for repellency using AATCC TM 22 and AATCC TM 118. After comparing the repellency between the conventional launderings and the Launder-Ometer testing on C6i and C6ii, Launder-Ometer conditions were adjusted and the 20-cycle test sequence repeated.

The varied conditions to which fabrics C6i and C6ii were exposed are listed in Table II. Note that Round A uses the conditions of AATCC TM 61-2A.

In Part 2, the Launder-Ometer conditions showing the best correlation with conventional launderings of C6i and C6ii from Part 1 were applied to C8i finished fabric, its repellency after 1, 2, 5, 10, 15, and 20 Launder-Ometer cycles determined, and the results compared to the repellency of samples washed in a top-loading washing machine. As in Part 1, Launder-Ometer conditions (amount of detergent solution, number of steel balls, or temperature) were adjusted to improve correlation as the study progressed. To determine the effect of that alteration, the Launder-Ometer cycles and repellency tests were run after each change.

The varied conditions to which the C8i fabric were exposed to in the Launder-Ometer are listed in Table III.

**Results and Discussion**

**Level Treatment**

The changes in color of the of poor fastness specimens are given in Table IV. The change in color ($\Delta E_{CIELab}$) is reported with the unwashed sample set as the standard.
This preliminary study showed that the color change of the 50 × 100 mm samples was very similar to those of the 200 × 200 mm samples, and that the change was visually even. The loss in color over 1, 2, and 3 cycles was similar between the small and large samples. It was assumed that the Launder-Ometer would evenly treat the larger samples required in the experiment, and that size did not affect the color change.

Part 1

The changes in repellency ratings for the two C6 fabrics are shown in Table V. Both lots performed similarly, starting out with spray ratings of 100 (no wetting or sticking) and ending with spray ratings of 70 (partial wetting of the specimen face beyond the spray points). Both lots had an oil repellency rating of 6, which decreased to 5 by the end of the 100 cycles.

Table VI shows the effect of various numbers of Launder-Ometer cycles (using the conditions of TM 61-2A) on the repellency rating (Round A). In contrast to the samples washed 100 times in a top-loading washing machine, the samples subjected to 20 Launder-Ometer cycles had water repellency ratings of 80–95 (versus 70) and oil repellency unchanged from its initial value of 6 (versus 5). It appears that the conditions of TM 61-2A were not severe enough on this fabric to produce the effect of 100 home launderings in 20 cycles.

In Round B (Table VII), the conditions in the Launder-Ometer were modified to increase the volume of solution to provide the same liquor ratio as used for colorfastness testing in TM 61-2A. Once again, the reduction of repellency did not match that obtained in conventional laundering: indeed, these conditions appeared to have little effect on the finish at all.

In Round C (Table VIII), the number of balls was increased to maintain the same ball-fabric area ratio as used in AATCC TM 61. After 20 Launder-Ometer cycles, fabric C6i had a spray rating of 80 and fabric C6ii had a spray rating of 70.
The increase in temperature did not degrade the finish enough to change oil repellency ratings from 6 to 5. Additionally, the loss of water repellency was somewhat less than obtained in Round C.

Part 1 thus showed that changing Launder-Ometer conditions did affect the durability of repellency on this 70-denier nylon fabric. However, none of the conditions tested produced changes in water and oil repellency consistent with those obtained by home laundering in top-loader washing machines. Dramatically increasing the number of steel balls to 267 reduced the finish on one lot enough to reach home laundering levels for water-repellency, but did not change the oil-repellency rating. Finally, increasing the temperature of the detergent solution affected the water-repellency of one lot to a lesser degree than increasing the number of steel balls, but that loss was still less than the home laundering test results.

Part 2

The repellency of fabric C8i over 100 home launderings is given in Table X. Two different dryer temperatures were used to cover both minimum and maximum dryer temperatures of the range allowed in the test procedure and thus ensure that this lot would be satisfactory in use. The dryer temperature is known to affect repellency ratings, and these results suggest by how much.

Broadly, the repellency ratings found for C8i at either drying temperature were very similar to those found for fabrics C6i and C6ii (Table V). It was expected that the effect of Launder-Ometer treatment would be similar, and thus the Launder-Ometer conditions of Round D in Part 1 were applied over 20 cycles to fabric C8i as Round A’ (Table XI). Unexpectedly, both the water- and oil repellency ratings dropped after ten Launder-Ometer cycles. These same conditions were not severe enough on the C6 fabrics to produce the same loss of repellency as 100 launderings, but here seemed to be too severe.

Round B’ (Table XII) was based on making the test less severe by using fewer steel balls.
The reduction in agitation from fewer steel balls did little to change the effects observed: the loss of repellency was not very different, and much greater than found after conventional laundering.

A further attempt to make the test less severe was carried out in Round C’ (Table XIII) by reducing the temperature instead of reducing the number of balls. The water- and oil-repellency ratings in Round C’ declined even more quickly than they did in Rounds A’ and B’.

Round D’ (Table XIV) was initiated with lower temperature and fewer balls, essentially back to the starting point of Part 1 with conditions the same as in the TM 61-2A. The results from the Launder-Ometer and the results from the top-loading machine did not correlate. In the top-loading machine, the lots finished with a C6 DWR performed similarly to the samples finished with a C8 DWR. In the Launder-Ometer, the C6 fabrics had more durable repellency than in conventional launderings. In the Launder-Ometer, the C8 fabric finish was lost more quickly than in the conventional launderings.

**Conclusion**

Both Parts 1 and 2 showed that changing the conditions in the Launder-Ometer will affect the durability of oil- and water-repellency on the 70-denier nylon fabric tested. However, none of these conditions produced both water and oil test results consistent with multiple home launderings in a top-loading washing machine. Neither of the two C6-finished fabrics lost repellency in the Launder-Ometer to the same extent that they did in conventional launderings, despite increasing the severity of the test conditions. In contrast, the C8 finish on the same fabric suffered loss of repellency in the Launder-Ometer to a far greater extent than in conventional launderings, despite making the test conditions less severe.

None of the conditions tested produced both water- and oil-repellency results consistent with multiple home launderings in a top-loading washing machine. The results suggest that although this work did not achieve direct correlation of real conventional and

---

**Table X.**

Top-Loader Washing Machine Results for C8i

<table>
<thead>
<tr>
<th>Cycles</th>
<th>Water</th>
<th>Oil</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dried @ 63 °C</td>
<td>Dried @ 68 °C</td>
</tr>
<tr>
<td>Initial</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>10</td>
<td>95</td>
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</tr>
<tr>
<td>100</td>
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</tbody>
</table>

**Table XI.**

Round A’ Results in Launder-Ometer

<table>
<thead>
<tr>
<th># of Cycles</th>
<th>Water</th>
<th>Oil</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>100</td>
<td>100</td>
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<tr>
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<td>50</td>
<td>50</td>
</tr>
<tr>
<td>20</td>
<td>50</td>
<td>50</td>
</tr>
</tbody>
</table>

**Table XII.**

Round B’ Results in Launder-Ometer

<table>
<thead>
<tr>
<th># of Cycles</th>
<th>Water</th>
<th>Oil</th>
</tr>
</thead>
<tbody>
<tr>
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<td>100</td>
</tr>
<tr>
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<tr>
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</tbody>
</table>

**Table XIII.**

Round C’ Results in Launder-Ometer

<table>
<thead>
<tr>
<th># of Cycles</th>
<th>Water</th>
<th>Oil</th>
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</thead>
<tbody>
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<tr>
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</table>

**Table XIV.**

Round D’ Results in Launder-Ometer

<table>
<thead>
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<th># of Cycles</th>
<th>Water</th>
<th>Oil</th>
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</thead>
<tbody>
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<td>100</td>
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<td>15</td>
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<tr>
<td>20</td>
<td>50</td>
<td>50</td>
</tr>
</tbody>
</table>
accelerated laundering, it is feasible to adjust conditions to achieve that correlation for one finish on one fabric. However, that correlation would need to be re-established for any change of fabric or finish, and the goal of broad correlation does not seem realistic.

While an accelerated laundering test may suggest a convenient method for assessment of finish durability, any simple correlation with numbers of conventional home launderings cannot be assumed, and may vary greatly even with two very similar finishes.

References

Abstract

The purpose of this research was to determine the effect of firefighter’s self-contained breathing apparatus (SCBA) on heat loss through clothing ventilation openings in structural firefighter turnout suits. Passive and active ventilation openings were fabricated into structural turnout suits and tested with and without the SCBA to determine the effect on clothing ventilation. Turnout suits were evaluated under two test conditions on a sweating manikin to measure thermal and evaporative resistance. A predicted total heat loss (THL) value was calculated for each suit and compared to a control turnout without ventilation openings. A significant improvement in heat loss was measured when the SCBA harness, mask, and thermal hood were removed from the structural ensemble. Results showed the SCBA harness significantly decreased heat loss in firefighter turnouts.

Key Terms
Comfort, Firefighter, Protective Clothing, Turnout Suit, Ventilation

DOI: 10.14504/ajr.4.5.1
Cotton Dyeing with Sulfur Dyes using Alkaline Enzymes as Alternate Reducing Systems

By J. N. Chakraborty, National Institute of Technology, Jalandhar and Priyadarshi Jaruhar, Apparel Training and Development Centre, Ludhiana, India

Abstract

Sulfur dyes are water insoluble and require reduction as well as solubilization before application. These dyes are used for dyeing cotton with heavy shades, primarily because of good light and wash fastness at low cost. Sodium sulfide used for reduction is highly toxic, releasing sulfur products in drained out liquor, including hydrogen sulfide gas. Enzymes capable of reducing sulfur dyes were studied to replace sodium sulfide in dyebath formulations. It was found that a few enzymes viz. protease, pectinase, lipase, and catalase can effectively reduce all sulfur dyes. Dyebath potential, color strength (K/S), reduction bath stability, and colorfastness of dyeing were comparable among the reducing systems, thus demonstrating the feasibility of enzymatic cotton dyeing with sulfur dyes.

Key Terms
Color Strength, Enzymes, Reduction Potential, Sodium Sulfide, Sulfur Dyes

DOI: 10.14504/ajr.4.5.2

Effect of Silicone Softener Particle Size on the Colorfastness, Softness, and Tensile Strength of 100% Cotton Woven Fabrics

By Ebru Demirci, Sinem Guneşoğlu, Mehmet Topalbekiroğlu, and Cem Guneşoğlu, University of Gaziantep

Abstract

This work investigates the effect of various silicone-based softener particle sizes on woven cotton fabric properties. Twill- and plain-woven 100% cotton fabrics dyed with red and blue reactive dyes were used to observe how the softeners acted on different weave patterns and colors. Fabrics treated with macro-, micro-, and nano-emulsion softeners were assessed for softness, tensile strength, and colorfastness with respect to laundering, perspiration, and crocking. Macro-emulsion softeners gave softer cotton fabric than micro- and nano-softeners. Micro-emulsion softeners had the most favorable tensile properties. Micro- and nano-emulsion softeners imparted better washfastness and perspiration fastness. The effects of silicone softener particle size and fabric construction properties on the softness, fastness, and mechanical properties of the treated cotton fabric were studied.

Key Terms
Colorfastness, Cotton Fabric, Particle Size, Silicone Softener

DOI: 10.14504/ajr.4.5.3
Expanded Selective Bacterial Enumeration with the TEMPO Most Probable Number Technique for AATCC Test Method 100

By Maria Bernardini Piazza, Trevor Smith, Adam Liebowitz, Joseph Venezia, and Steven Arcidiacono, US Army Natick RD&E Center

Abstract
 Enumeration of bacteria is a large component in standard testing of antimicrobial textiles; however, there are multiple plating methods used that are tedious and labor intensive to perform. TEMPO is an instrument that automates much of the enumeration process using the most probable number (MPN) technique. Selective reagents for \textit{Staphylococcus aureus} (salt) and \textit{Pseudomonas aeruginosa} (cetrimide) were used to expand TEMPO capability. It was demonstrated that TEMPO had either the same or smaller variance than the traditional spread plating for cells in solution and on textiles tested using AATCC Test Method (TM) 100. TEMPO is a faster and more cost-effective method, and with expanded selective capabilities, can be used to improve enumeration efficiency.

Key Terms
Antimicrobial, Bacterial Enumeration, Most Probable Number, TEMPO

DOI: 10.14504/ajr.4.5.4

Detergent Matters

Standard detergent allows valid comparison of the test results from laboratory to laboratory. For more on the importance of using the right detergent, visit www.aatcc.org/test/washers.
Technical Center Visitors

Associate Professor Yingjiao Xu, associate department head and director of Graduate Programs for the Department of Textile and Apparel, Technology and Management at North Carolina State University (NCSU) visited AATCC in July with students from Southwest University, and Jiangnan University, both in China. The students ranged from high school seniors to freshmen, sophomores, juniors, and seniors, and some graduate students studying for their Masters and PhDs. In addition, a professor from Southwest University and a visiting scholar from Jiangnan University accompanied the students.

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- Submit answers and your contact information to media@aatcc.org
- Deadline for answers: September 30 for Question 309; October 31 for Question 310
- The drawing for the final Trivia Game Winner will be on November 14, 2017
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