TEXTILES FOR THE MILLENNIUM

Christine M. Ladische
Purdue Univ., W. Lafayette, IN 47907
Billie J. Collier
Univ. of Tennessee, Knoxville, TN 37996
Karen K. Leonas
University of Georgia, Athens, GA 30602
Gita N. Ramaswamy,
Kansas State Univ., Manhattan, KS 66506
Yanqiu Ren and Sara Douglas
Univ. of Illinois, Urbana, IL 61801
Kitty Dickerson
Univ. of Missouri, Columbia, MO 65211

New and Novel Technology for Coloring Textiles with Transition Metals-Billie J. Collier

A new technology for coloring fabrics with transition metals and metal complexes is borrowed from the field of immunology. Metal colloids, particularly gold colloids, with particle sizes ranging from 5-80 nm, have been used by immunologists to bond to anti-bodies and locate diseased sites in tissue. The colloids are formed by reacting a nucleating agent with a metal in solution to precipitate the metal.

In applying the technology to textiles, fabrics of silk and other fibers were treated with tannic acid (TA) to serve as a nucleating agent. The fabrics were then placed in solu-tions of gold, titanium, vanadium, zirconium, and other metal ions and heated to develop the color. The color depended on fiber, metal, pH, temperature, and particle size. A patent appli-cation has been filed by the inventor, William Todd, Professor of Veterinary Science at the LSU Agricultural Center. Following the initial discovery, an interdisciplinary team was assembled to further study the technology and determine the specific mechanisms of color formation. The team consisted of Nell Morris, Ioan Negulescu, Billie Collier, Melissa Day, and Madalina Romanoschi.

Particles formed from gold are zero valent gold because the metal complex initially formed with TA is unstable and the gold ions are added to the growing particle as gold met-als. The color is formed by light scattering from the particles, with the particular hue depending on the size of the particles. Larger particles give a pink to purple color on silk, while finer particles can color the fabric black. Unlike gold, titanium forms a stable complex with TA and therefore colors fabrics by light absorption. The color imparted by this complex was similar on acetate, cotton, silk, rayon, and wool, with the color depth being dependent on the weight percent of TA used. Micrographs of titanium-dyed silk showed that the color was consistent throughout the fibers.

In additional experiments, polypropy-lene fabrics were treated with radio frequency plasma to activate the surface of these nonab-sorbent fibers and enhance their affinity for TA. Both hydrazine and argon plasma treat-ments were used. Surface analyses showed that treated fabrics absorbed, and were colored by, titanium, whereas untreated fabrics did not.

This new technology for dyeing fabrics uses metals and metal complexes to color fab-rics, yielding colors that vary by fiber and treatment and are not the same as the parent metal. The metals are especially effective in dyeing silk, cotton, and rayon and produce metallic shades that reflect our high technology age.

Biomedical Textile Applications-Karen K. Leonas

The use and development of textiles and related polymeric materials in biomedical applications is an interesting area of study. These products fall within the category of bio-materials. As we move to the 21st century, the field of biomaterial sciences is ever growing. New technological advancements and material development provide the basis for visionary research in the field. There are numerous opportunities for textiles and related polymeric studies in the discipline of biomaterials science. Common applications of biomaterials include orthopedic hip and knee replacements, intra-ocular lens, dental implants, heart valves, contact lenses, vascular grafts, blood bags, catheters, surgical gowns and drapes, sutures, drug delivery devices, adhesion prevention, wound dressings, membranes, tendons, and ligaments. From this extensive list of applica-tions, it is apparent that no one material is suit-able for all biomaterial applications resulting in a large variety of materials being used. Some materials commonly used include metals, fab-rics, hydrogels, ceramics, glasses, ceramic-glasses, grafts, coatings, thin films, polymers, composites and others. Rarely are these used as simple materials, more commonly integrated into devices. Many synthetic textile fibers, such as polyethylene, polypropylene, poly-ester, nylon, and aramids, are used in a variety of applications. These textile products are used in all forms, including braids, hollow fibers, monofilaments, multifilament yarns, knits, and woven and nonwoven fabrics.

A number of characteristics are exam-ined when a material is considered for a biomedical application. These include suitable mechanical and physical properties, surface properties, toxicity, and the ethics surrounding the use of the product. Biomaterial science is interdisciplinary in nature and is sometimes re-ferred to as a field that represents scientific cultural diversity. The field brings together professionals from a wide variety of disciplines such as inventors, attorneys, veterinarians, sci-entists, educators, engineers, physicians, industrialists, regulators, and ethicists. The biomaterials scientist has an appreciation of materials science that may range from an in-depth understanding of materials theory and application to a general understanding of the properties of materials that might be demon-strated by the physician biomaterials scientist (Ratner, 1996).

Areas of future growth that are expected in biomaterials science include tissue engineering for regrowing and regenerating body parts, the development of scaffolding materials as support systems, small vein replacement, and stem cell research. (personal communication, J. Russell Parsons, November 1, 1999). Tissue engineering is a critical area of research as we enter the 21st century. This area involves the development of combinations of materials and biological compounds to regrow or regenerate body parts. Currently there is a tremendous amount of work in the area or organ development (especially the liver), synthetic bone grafts, and cartilage. A second area where tissue engineering is used, is where the biomaterials act as a scaffold. The scaffold is used to grow cells and tissue mate-rials . Textiles and porous polymeric materials are used exclusively as the scaffolding material.

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New Fibers and New Uses for Old Fibers- Gita N. Ramaswamy

There has been an increasing global demand for natural fibers, namely flax, indus-trial hemp and kenaf. Kenaf is being promoted by many states in the US. Industrial hemp has been legalised in Germany, Hungary, Aus-tralia, and Canada. Flax has been promoted in Great Britain by Flax UK and in the US by the US Flax Association.

Kenaf product development activities have resulted in grass mats, animal litter, spe-cialty paper, and textiles (Chen et al., 1995; De Guzman, 1982; and Ramaswamy et al, 1994, 1995a, 1995b). Hemp textile collections of high quality have been created in Germany (Karus & Leson, 1999). Canadian hemp is also being marketed as high resin composites for automobile interiors. Flax has always been the finest of cellulosic textiles. Flax processing can be done by mechanical hackling and scutching and/or enzymatic and chemical retting.

The increased demand for alternative fiber crops exists because it provides agricul-tural diversification for farmer; it can be grown with less fertilizer, pesticides; and water; for the paper industry, bast fibers are known to require less chemicals and energy and can be bleached easily with hydrogen peroxide, pro-ducing greater whiteness, thus avoiding the use of chlorine bleach; products are eco-friendly and satisfy many different niche markets; and bast fibers are good substitutes for wood and are fast growing crops.

Potential markets for bast fibers are growing rapidly. Filler for plastics (agri-plas-tics/high resin composites) may suffi-ciently pay for many of these crops (Global Hemp Archives, 1999). Flax and hemp textiles have a very stable though not very large mar-ket. Also, with German hemp the quality of these prod-ucts will definitely create newer and better markets.
Challenges for products and marketing still exist: fiber separation system; mechanical, bacterial, chemical, or enzymatic processing; market stability for the newer products; regard-ing fiber for

paper, will the pulp industry make the changes needed to process flax or kenaf or hemp? Can just specialty paper provide enough profits to make the crop profitable for farmers? A lot of work has been done on the process-ability of these high resin/agricultural materials in injection and extrusion molding. Are indus-tries at a point to make the commitment to using these agriplastics in their products? Finally, can bast fibers be high yield crops to satisfy the needs of world farmers.

To meet worldwide demands and com-petition, the textile complex must make adapta-tions. Can the textile complex afford to invest enormous resources to make all these changes for product markets which are not yet estab-lished? Should the world textile complex think on the lines of long-fiber or short-fiber spin-ning? Some of these decisions have already been made in Germany and the UK for hemp and flax. In Western Europe all arrangements are in place to make jeans out of ecologically grown hemp.

There are still strict regulations against growing industrial hemp in the US. Much of the future success of fiber crops depends on the yields and return to the farmers. Flax is still in the research stage in the US and it will be inter-esting to watch its progress. Flax and hemp are already being established in Aus-tralia, Ger-many, the United Kingdom, and Canada. Kenaf is also slowly being established in Portugal and Spain. The future for all fiber crops is promising.

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Continuity and Change in Textile Trade and Economics-Yanqiu Ren, Sara Douglas, and Kitty Dickerson

Rather than textile innovations, this paper examines the economy in which such innovations exist and the economic issues that can be expected to be encountered in the near future. Boundaries of traditional softgood chain linkages in the U.S. have become increasingly blurred in the past 25 years as the industry has aggressively restructured to meet the challenges of globalization. Notable changes are integration and alliance formation. Both forward and backward vertical integration have merged production stages as manufactur-ers acquire retail stores and vice versa. Hori-zontal acquisitions have resulted in unions of Galey and Lord and Swift Denim, VF and Bestform, and Warnaco and Calvin Klein jeans. In the midst of such major change, con-tinuity and strength has been maintained through the cooperative and close inter-sector industry relationships established in the past decade. Advanced technology and capital intensiveness provide opportunities for the U.S. manufactured fiber industry to be the leader in the world marketplace. Mill con-sumption of manufactured fibers rose in the first half of 1999. Natural fibers are more sensitive to factors such as production condi-tions, trade, and government subsidization; mill consumption of both cotton and wool fell during the same period.

Compared with the first half of 1998, apparel manufacturers managed to come out slightly ahead in the first half of 1999 with shipments and wholesale sales up. Moreover, in spite of the generally labor-intensive nature of this sector, computer technology continues to provide positive effects. For example, Levi Strauss is doing more and more "mass cus-tomizing" of some products, as well as enjoy-ing the benefits of the new 3D body scanning technology.

Both globalization and information technology also have restructured retailing. Numerous partnerships have been formed between retailers headquartered in different countries as well as between retailers and their suppliers. Consumer spending is up and pre-dictions are that it will stay up for the year. Consumers also seem to be moving with ease into the convenience of buying on-line. E-commerce has been enjoying rapid gains in popularity and is expected to cause far-reaching change.

After several months of moderate import growth, an August surge in textiles brought U.S. imports of textiles and apparel up in August 1999. NAFTA has kept Mexico and Canada top export partners of the U.S., as measured by value. Caribbean countries have moved onto the list more recently, largely with leverage from 9802 rules. Recently Mexico and China have been the leading U.S. textile and apparel importers. Proposed legislation that would liberalize trade rules with sub-Saharan African and Caribbean countries currently is stalled in Congress. If it should pass in 2000, trade with these countries can be expected to increase. China also has great potential for increasing its exports if its relationship with U.S. is stable in the long term.

U.S. textile trade will be affected sig-nificantly by two events in the near future. The first is the Multifiber Agreement, which is scheduled to be phased out completely by 2005. The lack of regular progression in the U.S. phase-out schedule disadvantages other countries and ultimately will disadvantage the U.S. textile sector as well. The second is whether or not China will be granted WTO membership. Although concerns exist in both the U.S. and China, in the long run it is expected that membership will bring benefits to both countries.