



# *Institute of Textile Technology*

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**September 10, 2004**

## **CALL FOR PROPOSALS**

Proposals are solicited from industrial research institutes, nonprofit organizations, and faculty members of senior colleges and universities for grants under the ITT/NCSU Textile and Materials Research Consortium's Fiscal Year 2005-2006 Program. **The deadline for submitting proposals is November 1, 2004** (proposals must be post-marked or delivered by November 1, 2004). No exceptions will be made to this deadline.

Total available funds are approximately \$400,000. This includes funds for any ITT Fellows that may participate in MS Thesis Research at North Carolina State University. A complete application/instruction package for the grant program is available at the ITT website: <http://www.itt.edu/>. Please follow instructions closely. The maximum award is \$30,000. The anticipated starting date for projects is no earlier than March 1, 2005. Projects funded must be completed by May 1, 2006, except for the final researcher report that will be due July 1, 2006. Investigators may apply for renewal during the next call for proposals, but such requests will be considered totally separate from this grant cycle. Applications for renewal grants will be evaluated in the same manner as a proposal for new projects.

Proposals for the ITT/NCSU program should be addressed to:  
TAC Chairman  
ITT/NCSU Textile and Materials Research Consortium  
Box 8301  
NCSU College of Textiles  
Raleigh, NC 27695

Inquiries or questions can be made to Dr. Henry Boyter Jr. at 919-513-7704 or [henryb@itt.edu](mailto:henryb@itt.edu). Applications may also be delivered to the ITT offices at 2418 College of Textiles, North Carolina State University campus prior to 5:00 pm on the closing date.

# INSTRUCTIONS TO APPLICANTS FOR RESEARCH GRANTS

## GENERAL REQUIREMENTS

Proposals are solicited from industrial research institutes, nonprofit organizations, and faculty members of senior colleges and universities for grants under the Technical Advisory Committee (TAC) of the ITT/NCSU Textile and Materials Research Consortium's (hereafter called the Consortium) Fiscal Year 2005-2006 Program. The deadline for submitting proposals is November 1, 2004 (proposals must be post-marked or delivered by November 1, 2004). No exceptions will be made to this deadline. The anticipated start date for projects is no earlier than March 1, 2005.

The purpose of the Consortium's program is to encourage applied textile research that can be adopted by manufacturers with a goal that the results from the research be capable of implementation in textile facilities within a six-month period. Research is encouraged in the field of emerging technologies where the research application is longer term, but even in this area, a timely goal for textile application should be maintained. A list of priority research topics identified by the Consortium Technical Advisory Committee is given in [Exhibit 5](#). However, proposals on any applied textile topic that falls within the Institute's mission will be considered.

Criteria that will be used to judge proposals are:

- the scientific quality of the proposed work,
- the need for the research in the textile industry,
- the probability that useful results can be obtained in one grant cycle,
- the potential for continued support from other funding sources,
- the cost of the proposed work,
- participation of ITT Student Fellows at NCSU to fulfill NCSU theses requirements.

Special consideration will be given to proposals that satisfy the above criteria that include a priority topic (outlined in [Exhibit 5](#)). Attention will also be given to past performance on grants funded through the Consortium. Requests for funds should not exceed \$30,000. Capital equipment (>\$3000) cannot generally be obtained through this grant process. Exceptions can be made, but must first be approved in writing prior to proposal submission and approved capital equipment can never exceed 50% of the proposal budget. For all proposals from NCSU faculty, a line item for one ITT Student Fellow should be added to the budget at \$15000, but this should not be included in the total for the budget and will not be considered in the \$30000 maximum award.

For all proposals funded, the PI must submit a minimum of four reports to the Technical Advisory Committee of the ITT/NCSU Textile and Materials Research Consortium. These presentations are:

Milestone	Presenter	Presentation Area	Timeframe
TAC Spring Meeting 2005	PI	Brief Summary of Proposed Research (10-15 minutes)	May 2005
TAC Fall Meeting 2005	PI or Student	Detailed Review of Proposed Research and Results to Date	October 2005
TAC Spring Meeting 2006	PI or Student	Detailed Report of Results	May 2006
Final Report	PI	Final Written Report	July 1, 2006

It is expected that for funding involving an ITT Student Fellow, the student will make the indicated presentations. Detailed Presentations are normally 20-30 minutes, but can be made longer if there is time in the meeting program and the PI requests the time in advance. The final written report is separate from any student thesis. The Principal Investigator will determine the format for the written report, but are encouraged to use a recognized engineering or physical science style or journal guide.

Principal Investigators under this grant program agree that no results will be reported to anyone other than the Consortium until after the submission of the final report to the Consortium or written approval of the President of ITT. The PI is also encouraged to submit the research for publication in a refereed journal at the completion of the grant cycle. However, proprietary or patentable research results will be governed as stated in the ITT/NCSU Textile and Materials Research Consortium Agreement and By-Laws.

## RESEARCH PROPOSALS

The first page of each proposal should be a fully executed research cover form. ([Exhibit 1](#)). Each proposal is to consist of four sections. The synopsis consists of 7 elements and is not to exceed one page. The project description consists of 8 elements and is not to exceed 10 single spaced-pages – typed in 12 point Times New Roman font. This page limit includes the list of references but does not include resumes. Other important information consists of 4 elements and is not to exceed 1 page. The Budget is to be placed at the end of the proposal. DO NOT NUMBER ELEMENTS WITHIN SECTIONS. A checklist is included at the end of these instructions for your convenience.

**Synopsis:** (Please use the standard format as seen in [Exhibit 2](#) —1-page limit)

1. Title. A concise, descriptive, textile-related title.
2. Research Area Number. A list of the research areas is attached. ([Exhibit 5](#)) If a proposal is being submitted that is not based on these research areas, use NA for the number.
3. Keywords. List descriptor words, separated by commas.
4. Name, title, organization, email address, facsimile number, and phone number of the principal investigator.

5. Name, title, organization, email address, facsimile number, and phone number of other important investigators.
6. Name, organization, email address, facsimile number, and phone number of Research Dean, University Point of Contact, or equivalent for the Principal Investigator.
7. Abstract. Provide a concise description of the problem, methods, and objectives.

**Project Description:** Start a new page. (10-page limit excluding resumes)

1. Title. Use the same title as in synopsis.
2. Statement of the Problem(s) to be addressed by the project, including explanation of the need for research (two paragraphs maximum).
3. Statement of Results, Benefits and/or Information expected to be gained by use of the grant during the performance period (two paragraphs maximum).
4. Nature, Scope, and Objectives of Research including a timeline of activities (See [Exhibit 3](#) for sample timeline).
5. Methods, Procedures, and Facilities. Provide sufficient information to determine if the technical approach will satisfy the objectives.
6. Related Research. Show by literature and communication citations the similarities and dissimilarities of this proposed project to completed or ongoing research on the same topic. This must include an in-depth search of the literature of pertinent references.
8. Investigator(s) Qualifications. Include resume of the principal investigator and other critical members of the research team. No resume is to exceed 2 pages or list more than 15 pertinent publications. Resumes are not included in the 10-page limit.
9. Other important Information: Start a new page. (1-page limit)
10. Submittal of Proposal to Other Agencies. The application must disclose any other agencies to which this or a similar proposal has been or is anticipated being submitted for funding, including the anticipated date(s) of initiation. Consortium funds are not available for commingling with other funding sources.

**Budget:** Start a new page.

PLACE AT THE END OF THE PROPOSAL. Budget justification must be included as Attachment A. The proposed budget must include the amount proposed from each line item (Financial Plan form is attached as [Exhibit 6](#) and is available as an MS Excel file at [www.itt.edu/](http://www.itt.edu/)). Please note that the Consortium does not pay or collect indirect costs. Applicant must submit detailed budget justification to explain computations, salary rates, etc. to allow proper evaluation of the costs proposed. PROPOSALS NOT CONTAINING BUDGET JUSTIFICATION WILL BE RETURNED TO P.I. WITHOUT CONSIDERATION FOR FUNDING. If the proposal is for continuation of work funded in a previous grant cycle, include the budget for each grant cycle.

- (a) Salaries and Wages. Include individuals or personnel categories of salary and wages, estimated hours or percent of time and rate of compensation proposed for each person or category. Overtime and/or premium pay are not allowed. If the rate of pay shown is higher than the current rate of pay include an explanation of amounts included for projected increases.

- (b) Fringe Benefits/Labor Overhead. Proposed rates/amounts in conformance with applicant's institution accounting policy. Explain what costs are covered in this category and the basis of rate computations. Indicate whether rates are used for proposal purposes only or whether they are also fixed or provisional rates for billing purposes. Proposals from NCSU faculty and staff should not include costs in this category. These costs are covered in a negotiated overhead rate for the consortium.
- (c) Supplies and Expendable Equipment. Indicate amounts estimated for laboratory, computing, and field supplies separately. Funding is not allowable for office supplies. Provide detail on any specific item or other subcategory that represents a significant portion of the proposed amount (\$500 or more).
- (d) Equipment. Itemize any proposed permanent equipment acquisitions and show the estimated cost of each item. Include only items that are of a type not chargeable to an indirect cost pool. Computer purchases are not allowed. If fabrication of equipment is proposed, list parts and materials required for each and show costs separately from the other items. Capital equipment (>\$3000) cannot generally be obtained through this grant process. Exceptions can be made, but must first be approved in writing prior to proposal submission and approved capital equipment can never exceed 50% of the proposal budget.
- (e) Subcontractors or Consultants. Identify the specific project tasks or problems for which such service would be used. List the contemplated subcontractors (including consultants), the estimated amount of time required, and the quoted rate per day or hour.
- (f) Travel. Briefly specify travel requirements for field work and for presenting project related information to the TAC committee at the three required meetings. Itemize estimated travel costs to show the number of trips required, destinations and miles to be traveled, the number of people traveling and per diem rates, cost of transportation, and miscellaneous expenses for each trip. Calculations of other special transportation costs (such as charges for use of contractor-owned vehicles or vehicle rental costs) should also be shown. It can be assumed that presentations will be made at the NCSU College of Textiles.
- (g) Other Direct Costs. Itemize different types of costs not included elsewhere, such as shipping, equipment use charges, or outside testing lab costs. Where clarification is needed, provide breakdowns showing how the cost was estimated.
- (h) Publication Costs. Do not include reproduction/printing costs for the final written report or meeting presentations other than the copies supplied to the Consortium. If the report is published by the Consortium as part of its numbered report series, these costs will be covered from sources outside the project budget. Only electronic submissions are required with the exception of the final written report (2 unbound copies and in color if applicable).

**Number of copies:** One electronic copy of the proposal on CD is required (in MS Word format and budget in MS Excel format). In addition, two paper copies of the complete proposal are required. DO NOT STAPLE THESE PROPOSALS. You may use paper clips, rubber bands or binder clips. One copy must bear the original signatures of the investigator(s), applicable Department Head or College Dean, and all other officials of the submitting institution who are required to sign proposals to off-campus agencies. ([Exhibit 1](#)) A checklist for submittals is given in [Exhibit 4](#).

### **INTELLECTUAL PROPERTY (IP)**

Intellectual property (IP) will be handled on a case-by-case basis with the research institute, nonprofit organization, college, or university involved and the ITT/NCSU Textile and Materials Research Consortium. No funding will be awarded if an IP agreement has not been finalized. IP agreements will not be made with individuals. Researchers should consult with their Research Head for further information on IP agreements. Any research involving ITT or NCSU researchers will be governed by the ITT/NCSU Textile and Materials Research Consortium agreement in place on the date the funding is awarded.

### **PAST PERFORMANCE**

While the Consortium recognizes that circumstances, such as graduate student schedules, beyond the PI's immediate control can adversely affect the schedule of research, nonetheless, the Consortium is constrained by administrative rules and funding requirements to adhere to project schedules, unless adjustments are mutually agreed to beforehand. Thus, timeliness of researcher performance on past projects funded through the Consortium must be a factor in proposal selection. As a consequence, any researcher who is late in an ongoing or past study funded through the Consortium without an approved no-cost extension may not be eligible to be a named participant in any proposal for this funding cycle. If you have any questions about eligibility for this funding cycle, please contact Dr. Henry Boyter Jr. at ITT.

# EXHIBIT 1

A Proposal to the  
Technical Advisory Committee of the

ITT/NCSU Textile and Materials Research Consortium

For Research entitled

(Title)

Covering the period from March 1, 2005 to July 1, 2006

Requested Support in the amount of \$ \_\_\_\_\_

SUBMITTED BY

\_\_\_\_\_  
(Name, Title and Department of Principal Investigator)

\_\_\_\_\_  
(Name and Title of Department Official)

\_\_\_\_\_  
(Name)  
Vice Chancellor for Research (or equivalent)  
(Name of University)

Date Submitted \_\_\_\_\_

## EXHIBIT 2

### Sample Format for Synopsis Portion of Research Proposal

#### RESEARCH PROPOSAL

(1) Title \_\_\_\_\_

(2) Proposal Number \_\_\_\_\_

(3) Keyword \_\_\_\_\_

(4) Principal Investigator(s), academic rank, university, address, phone, facsimile, email: \_\_\_\_\_

(5) Other Investigator(s), academic rank, university, address, phone, facsimile, email: \_\_\_\_\_

(6) Research Dean or University Point of Contact \_\_\_\_\_

(7) Abstract:



## EXHIBIT 4

FISCAL YEAR March 2005 – July 2006

### APPLICATION CHECK LIST

- Cover letter
- Signed Title Page ([Exhibit 1](#))
- Proposal package complete with all 4 sections included.
- Synopsis (1-page limit) ([Exhibit 2](#))
- Project Description (10-page limit excluding resumes)
- Other important information (1-page limit)
- Budget Plan included at end of proposal ([Exhibit 6](#)).
- Budget justification included as Attachment A.
- One electronic copy submitted on CD of the proposal in MS Word format and budget pages in MS Excel format.
- Three paper copies prepared for submission and secured by binder clips or rubber bands (no staples).

**NOTE:** All text must be in 12 point Times New Roman font.

# EXHIBIT 5

## MASTER LIST OF TOPICS

### 2005-2006 Funding Cycle

#### TITLES

[DYEING, FINISHING, ENERGY, AND ENVIRONMENT](#)  
[EMERGING TECHNOLOGIES](#)  
[GREIGE](#)  
[ECONOMIC COMPETITIVENESS](#)

#### ABSTRACTS

[DYEING, FINISHING, ENERGY, AND ENVIRONMENT](#)  
[EMERGING TECHNOLOGIES](#)  
[GREIGE](#)  
[ECONOMIC COMPETITIVENESS](#)

**Note: Project numbers ending in P are considered priority topics for funding.**

The Technical Advisory Committee (TAC) of the ITT/NCSU Textile and Materials Research Consortium has established a set of priorities for Consortium supported research for the Fiscal Year 2005-2006. The Committee selected these topics with aid from the Greige, DFEE (Dyeing, Finishing, Energy, Environmental), Emerging Technology, and Economic Competitiveness Subcommittees. In evaluating proposals, priority will be given to proposals that address these topics. However, all proposals will be considered, even concerning a topic not listed.

**DYEING, FINISHING, ENERGY, AND ENVIRONMENT ([Return to Index](#))**

[W1P](#) To Investigate Alternatives To Fluorocarbon Systems For Water/Oil Repellency + Soil Release Systems

[W2P](#) Investigation Of Methods To Improve Retention Of Water And Stain Resistance For Fluorocarbon-Based Finishes

[W3P](#) Ultraviolet (UV) Curing Processes for Textile Coloration

[W4](#) One Step Process of DP Finishing and Reactive Dyeing on Cellulose Fabrics

[W5P](#) Durable Aroma Finishing on Textiles through Low Temperature Curing Processes

[W6P](#) Dyeing & Finishing Plant Water And Energy Model For Determining Best Practices For Recovery And Reuse

[W7](#) Evaluation of the Use of Pre-reductive, Biological, and Post-Oxidative Treatments as an Optimal Wastewater Color Removal Technique

[W8](#) Removal And Treatment Of Microcapsules In Textile Waste Systems

[W9](#) Organic Tin Compounds In Textile Facilities

[W10P](#) Evaluation of Mill Energy Sources

[W11P](#) White Paper on Energy BMPs

[W12](#) Treatment of Nanoparticle-containing Wastewater

[W13P](#) Evaluation of PBDE Substitutes

[W14](#) Heavy Metal Levels in Imported Garments

[W15](#) Application of Finishes on Spacer Fabrics

**EMERGING TECHNOLOGIES ([Return to Index](#))**

[E1](#) One Step Textile Digit Printing with UV curing Technology

[E2](#) De-Bottlenecking The Electrospinning Process Using Oscillating Magnetic Fields

[E3](#) Dyeing Behavior Of Melt Spun Acrylic Fiber (Amlon)

[E4](#) Development Of Dyeing Technology For Spandex (Lycra®) Fibers

[E5P](#) Photo-Catalytic Self-Sterilizing Fabric

[E6](#) Wastewater Color Removal Using Ionic Liquids

[E7](#) Stealth of Yarn Tagging Technologies

[E8P](#) Ionic Liquids as Functional Yarn Sizes

[E9P](#) The Use of Quaternary Ammonium Compounds (QAC) Dendrimers to Improve Hygiene, Safety, and Healthcare of Antimicrobial Textiles

[E10](#) The Olfactory Properties of Textiles. Development and Validation of Objective Measurements with Human Sensory Panel and Electronic Nose

[E11](#) Controlled-Release Of Value-Added Compounds From Textile Fibers Via Nanoencapsulation

[E12P](#) Development of Textile Materials for Solid Polymer Fuel Cell

[E13](#) Improvement of Heat Insulation of Non-woven Materials

**GREIGE ([Return to Index](#))**

[G1P](#) Improving Product and Process Quality with Data Mining

[G2](#) Seamless Knitting Technology

[G3](#) Spacer Fabrics

[G4](#) Double-faced Fabrics

[G5](#) From Fabric To Finished Garment In 45 Seconds

[G6P](#) Rotor Spinning– The Effect of Yarn Count on Production Potential

[G7](#) Vortex Spinning – The Influence of Yarn Hairiness on Fabric Abrasion and Hand

[G8P](#) Yarn Benchmarking: Possible Machinery Manufacturer Financial Aide

[G9P](#) Vortex Spinning: Possible Machinery Manufacturer Financial Aide

[G10P](#) Slasher Waste: Possible Machinery Manufacturer Financial Aide

**ECONOMIC COMPETITIVENESS ([Return to Index](#))**

[EC1](#) Business Continuity Planning Strategy for Apparel Industry

[EC2](#) Design for Manufacturability in Textiles

[EC3P](#) Niche Market Strategies

[EC4P](#) Lead Times and Supply Chain Dynamics

[EC5](#) Analysis Of Joint Americas/Non-Americas Supply-Chain Sourcing Strategies

[EC6](#) Do Textile Mergers Work?

[EC7P](#) Optimum Plant Size in a Mass-Customization Environment

[EC8](#) Quality Products in the Textile and Apparel Industry

## ABSTRACTS

### DYEING, FINISHING, ENERGY, AND ENVIRONMENT ([Return to Index](#))

#### **W1P Investigation of Alternatives To Fluorocarbon Systems For Water/Oil Repellency + Soil Release Systems**

Fluorocarbon systems are currently the predominant technology for water/oil repellency and soil release. This project seeks to develop alternatives to these systems that do not use fluorocarbons or regulatory-controlled components.

[Return to Titles](#)

#### **W2P Investigation Of Methods To Improve Retention Of Water And Stain Resistance For Fluorocarbon-Based Finishes**

Water/Stain resistance fluorocarbon finishes are known to lose some oil and water resistance during extended use. The loss in activity can be due to reconfiguration of the fluorocarbon structure or due to surface reconfiguration effects. In both cases, heat treatments can often restore activity, indicating that the loss in effectiveness is reversible. This project seeks to characterize why activity is lost in specific applications and to develop methods to retain the activity for longer periods.

[Return to Titles](#)

#### **W3P Ultraviolet (UV) Curing Processes for Textile Coloration**

This is the second year of research in this project. The advantages of the UV curing process are energy savings, smaller equipment, fast curing and less air pollution. However, the shade depth and crockfastness of UV cured fabrics are not as good as that of conventional methods. The research will study the fundamental effects of photoinitiators, UV light sources, curing conditions, textile materials, and pigment chemical structures on properties of colored textiles, and improve the shade depth as well as the crockfastness.

[Return to Titles](#)

#### **W4 One Step Process of DP Finishing and Reactive Dyeing on Cellulose Fabrics**

This project is to develop a combined dyeing and finishing process for reactive dyeing of cotton with DP finishing. Various reactive dyes will be investigated with DMDHEU finishing. The aim of this research is to develop a suitable process for pad dyeing cellulose fabric. With the process, cotton can be dyed with low salt levels; high reactive fixation rate; high colorfastness to laundering, to crocking, and to light; good durable press property; less production time; and less wastewater.

[Return to Titles](#)

#### **W5P Durable Aroma Finishing on Textiles through Low Temperature Curing Processes**

High temperature thermal curing of encapsulated aroma finishes can cause aroma loss from the fabric. UV curing technology can quickly fix fragrant capsules on textiles at low temperature, which can not only prolong the aroma effect on textile, but also reduce the air pollution from the mill. The finishing process will be developed in this research.

[Return to Titles](#)

#### **W6P Dyeing & Finishing Plant Water And Energy Model For Determining Best Practices For Recovery And Reuse**

This project will develop a model for water and energy to maximize recovery and reuse addressing new technologies in light of increasing costs and stricter government regulations.

[Return to Titles](#)

#### **W7 Evaluation of the Use of Pre-reductive, Biological, and Post-Oxidative Treatments as an Optimal Wastewater Color Removal Technique**

Many techniques have been explored for the maximum removal of color from textile wastewater systems. Because of the diversity of materials present in textile wastewater streams, no single economical method can meet the requirements for color removal. Recent literature has explored combining oxidative techniques (O<sub>3</sub>, UV, and peroxide) as a post treatment with good success, but still there are systems that resist this type of treatment. It is proposed to explore the use of two diverse techniques that cannot be combined in a single stage.

[Return to Titles](#)

### **W8 Removal And Treatment Of Microcapsules In Textile Waste Systems**

The use of microcapsules as delivery agents on textiles for scents and comfort agents such as aloe is being used in a variety of applications. Currently, there is no literature on the fate of these microcapsules when entering waste streams at the textile facility. It is proposed to study the fate of such microcapsules in wastewater streams that would be typically treated by biological processes followed by either coagulation or oxidative treatments. Waste streams from both cotton dominant and synthetic dominant dyeing and finishing facilities would be evaluated by adding microcapsules to wastewater streams from facilities where no microcapsules are currently being used. If available, wastewater already containing microcapsules will be evaluated.

[Return to Titles](#)

### **W9 Organic Tin Compounds In Textile Facilities**

Recently, USEPA has implemented a water quality standard for the organic tin compounds (specifically tributyltin) that will result in wastewater permit limits at part per billion levels if applicable to the facility. Those facilities that use tributyltin, tributyltin oxide, or other precursors may be affected, but other sources of tin compounds in textiles have not been evaluated. Such sources could include preservatives in production chemicals, clean process water, and catalysts used for producing dyes and finishes. No current literature has been found discussing the presence of such compounds on cotton and synthetic yarn sources. This project will confidentially evaluate both waste streams and production sources from ITT Members for the presence of tributyltin.

[Return to Titles](#)

### **W10P Evaluation of Mill Energy Sources**

This project will review the major sources of energy consumption and the associated costs at current ITT Member textile facilities. The evaluation will include all forms of energy from raw materials to production and transportation. A whitepaper will be prepared on the findings.

[Return to Titles](#)

### **W11P White Paper on Energy BMPs**

This project will develop a whitepaper for energy Best Management Practices (BMPs) at textile facilities based on the expertise of ITT and the dozens of energy audits completed in the last ten years.

[Return to Titles](#)

### **W12 Treatment Of Nanoparticle-Containing Wastewater**

The research on nanoparticles and their use in textiles is expanding with many potential applications. Currently, there is no literature on the fate of these nanoparticles when entering waste streams at a textile facility. It is proposed to study the fate of such nanoparticles in wastewater streams that would be typically treated by biological processes followed by either coagulation or oxidative treatments. Waste streams from both cotton dominant and synthetic dominant dyeing and finishing facilities would be evaluated by adding nanoparticles to wastewater streams. In addition, the amount of nanoparticle loss from textile processes will be evaluated through coordination with research groups studying nanoparticle application processes.

[Return to Titles](#)

### **W13P Evaluation of PBDE Substitutes**

In this project, the current market for substitutes of PBDE flame retardants will be evaluated and potential substitutes will be evaluated in the ITT Laboratories for functionality versus PBDE fabrics and the lifetime of the substitute on fabric.

[Return to Titles](#)

### **W14 Heavy Metal Levels in Imported Garments**

In this project, garments will be obtained from national store chains where the origin of the item is in the Eastern Hemisphere. The garments will be tested for a standard list of Heavy Metals and compared to fabrics of similar construction. A direct comparison of the environmental impact of such garments as received and after single standard washing cycles will be examined.

[Return to Titles](#)

**W15 Application of Finishes on Spacer Fabrics**

Spacer Fabrics are an emerging product that can add functionality to fabrics over a single fabric layer. Little work has been completed on finding finishes, either currently used or unique, that will maintain the functionality of the spacer fabrics. This project will examine the changes in properties of spacer fabrics with applied finish, focusing on moisture and air permeability. (See Greige Topics for an additional Spacer Fabric project)

[Return to Titles](#)

**W16 Washing Efficiency on Jet Dye Machines**

Because it can be such a large part of the total dye cycle, this project aims at reviewing the current efficiency of Jet Dye Machine wash cycles and testing strategies for improving the process from time, removal, and environmental standpoints.

[Return to Titles](#)

**EMERGING TECHNOLOGIES** ([Return to Index](#))**E1 One Step Textile Digit Printing with UV curing Technology**

The aim of project is to build a printing process, by which printing on textiles is as simple as printing on paper. It will have no pretreatment and no after-treatment. The research is to develop UV curable dye base inks and to investigate the printing and curing processes on an ink jet printer attached UV curing system.

[Return to Titles](#)

**E2 De-Bottlenecking The Electrospinning Process Using Oscillating Magnetic Fields**

Recent trends in the textile industry show an increasing interest in smaller fibers for specialty and value-added products. However, the commercial production of fibers with features in the nanometer scale remains an elusive dream. Electrospinning is recognized as the most viable technique to produce single nanofibers. While the production of nanofibers via the electrospinning of polymer solutions has been amply reported in the scientific literature, commercial applications of this process have been scarce in the textile industry. The proposed work should allow the commercial production of nanofibers at higher polymer concentrations.

[Return to Titles](#)

**E3 Dyeing Behavior Of Melt Spun Acrylic Fiber And Development Of Market Value**

This project will focus on studying the dyeing behavior of melt spun acrylic fibers (Amlon fibers), evaluating the characteristics of the fiber polymer structure related to textile wet processing, and giving feedback for polymerization improvement.

[Return to Titles](#)

**E4 Development Of Dyeing Technology For Spandex (Lycra®) Fibers**

Spandex fibers are usually left undyed in stretch fabric. When it is necessary, coloring of spandex fibers is limited to a small number of dyes and restrained conditions in order to ensure acceptable colorfastness and retain good physical properties of the fiber. This project will investigate the colorfastness of the spandex fiber/fabric coloring through dye self-crosslinking mechanisms and the effect of dyeing conditions on the fiber physical properties.

[Return to Titles](#)

### **E5P Photo-Catalytic Self-Sterilizing Fabric**

This project will explore the dye-sensitizing effect on the photo-catalytic activity of TiO<sub>2</sub> nanoparticle treated fabric for antimicrobial activity. The dye-sensitizing effect on TiO<sub>2</sub> nanoparticles has previously been verified in a solar cell for energy generation.

[Return to Titles](#)

### **E6 Wastewater Color Removal Using Ionic Liquids**

Because of the diversity of materials present in textile wastewater streams, no current single economical method can meet the requirements for color removal. It has been previously shown that a non-miscible ionic liquid can cause the removal of a dye from a water layer and return the color to the water layer by changing pH. This project will explore the use of ionic liquids for color removal and concentration of color for both laboratory textile wastewater streams and actual waste streams from ITT members. The ionic liquids chosen will be used singly and in tandem. Tandem solutions may allow the removal of multiple dye types that currently may require separate treatment steps. The ionic liquid solutions will be tested to see if the process can be reversed by pH change to give concentrated solutions that could be treated by conventional methods.

[Return to Titles](#)

### **E7 Stealth of Yarn Tagging Technologies**

Current technologies are being evaluated for the tagging of yarns for identifying the origin of the yarns for business and custom applications. For this project ITT will collaborate with an ITT Member evaluating such technology or a commercial collaborator to study the true stealth of the yarns through typical textile processes.

[Return to Titles](#)

### **E8P Ionic Liquids as Functional Yarn Sizes**

Ionic liquids (ILs) have been shown to coat yarns and have been tested as sizing agents. Unlike current sizes used in textiles, ILs have the ability to either eliminate processes or add value to the yarns in processes. This project will examine the properties of sized yarns in further downstream processes. This will include dyeing of the yarns without initial removal of the sizing agent, using the ionic liquid size as the dyeing media, and the application of water resistant sizes that remain on the yarn through the dyeing processes.

[Return to Titles](#)

### **E9P The Use of Innovative Chemical Systems to Improve Hygiene, Safety and Healthcare of Antimicrobial Textiles**

It is well recognised that limiting the spread of bacteria and other pathogens on textiles has many significant advantages for the healthcare, safety and quality of life of the ultimate consumer. In addition to controlling infection in the event of injury or within a healthcare setting, the use of bacteriostatic (limiting migration) and biocide (killing) agents can add protection for healthcare workers, emergency responders and military personnel. They can also reduce the incidence of malodors associated with sportswear, socks and intimate apparel, and reduce mildew formation and fungal growth on exterior furnishings, tents, awnings and transportation covers. Research on this topic should address innovative chemical systems.

[Return to Titles](#)

### **E10 The Olfactory Properties of Textiles. Development and Validation of Objective Measurements**

The successful sale of dyed and printed fabrics into the apparel, home furnishing and household textile markets requires that two specific sensory characteristics be met, namely, color and hand. And because of the importance of these two key properties, product development departments, procurement officers, marketing and sales agents as well as quality control operations during dyeing and finishing rely on standard test methods and procedures to ensure that the delivered fabric's color and hand fall within the tolerance of the desired specification. An emerging technology that will soon impact many downstream markets is the addition of fragrance or odor to textiles. This means that we need to be able to measure a third sensory characteristic. Since the attributes of these odor characteristics have not been established, and they cannot be measured by valid, reliable and objective test methods, it is difficult, if not impossible, to make claims about the initial quality of the fragrance as well as its longevity over many wear and laundering cycles. Research on this topic should address innovative ways to measure this parameter.

[Return to Titles](#)

### **E11 Controlled-Release Of Value-Added Compounds From Textile Fibers Via Nanoencapsulation**

Interest in the use of textile fibers as vehicles for the controlled release of value-added compounds such as insecticides, dyes, and drugs has increased recently. However, the lack of control during the uptake and desorption of these compounds remains the main obstacle in this field. Innovative research in controlled-release systems is requested.

[Return to Titles](#)

### **E12 Development of Textile Materials for Solid Polymer Fuel Cell**

This project intends to develop a textile material to be used as the anode and the cathode in solid polymer fuel cells (SPFC) with lower cost and higher performance. The new material is required as porous, diffusible to chemicals, electronic and heat conductive, mechanically strong, and chemically stable. Properties of PAN non-woven fabrics will be investigated after carbonization and nanotechnology treatment.

[Return to Titles](#)

### **E13 Improvement of Heat Insulation of Non-woven Materials**

This study will focus on developing an advanced lamination approach for thermoplastic nonwoven fabrics for improved heat insulation through maximizing the amount of air entrapped and duration of air space between non-woven layers. Different laminating technique will be explored from both physical and chemical standpoints.

[Return to Titles](#)

**GREIGE** ([Return to Index](#))

### **G1P Improving Product and Process Quality with Data Mining**

In modern cotton spinning mills a vast amount of data is available from routine online and offline testing and monitoring equipment. The proposed research will determine whether better use can be made of this data to improve both process and product quality. An additional objective is to determine which data can be considered to be useful (in terms of controlling or predicting quality) and which items of data are superfluous (and thus their collection and storage can be discontinued). The methodology of data mining can then be applied to additional textile operations.

[Return to Titles](#)

### **G2 Seamless Knitting Technology**

Seamless and fully fashioned garment knitting has come to the forefront through the technology advances made by machinery manufacturers such as Santoni, Shima Seiki, and Stoll. Seamless knitting technology is capable of creating different types of knitted constructions in various shapes and sizes of integrated tubes. Research potential of three dimensional and shaped knitting technologies, including further advancements, new product development, and marketing strategies has not been fully realized. Specifically, research could examine a) new opportunities for the technology b) design parameters, including gauge, yarn, pattern, performance, and three dimensional printing and finish, and c) new attitudes in promoting and merchandising these products at retail. The results could be applied to many existing and new products such as military gear, space clothing, footwear, clothing for special needs, and other three dimensional seamless products in automotive components, medical textiles and contract seating.

[Return to Titles](#)

### **G3 Spacer Fabrics**

Spacer fabrics have been produced on double needle bar warp knitting equipment for many years finding applications in footwear and automobile upholstery et cetera. Now there is also an increasing interest in producing such fabrics on dial and cylinder machines. With their increasing use in the medical field (for examples support pads for people who have to remain immobilized in bed for long periods of time), this would be an opportune time to investigate this technology.

[Return to Titles](#)

#### **G4 Double-faced Fabrics**

Double-faced fabrics are similar to spacer fabrics produced on dial and cylinder machines however the difference is that in double-faced fabrics the two layers of fabric are touching one another and are not separated by the "spacing distance" inherent in conventional spacer fabrics. A slightly different form of double-faced fabric can also be formed on a single jersey fabric basis when "plaited" fabrics are produced (one common form of plaited fabric is where cotton yarn is plaited with Spandex - but other yarn combinations are possible and common). The research area proposed is related to "comfort fabric" product applications where moisture is wicked from the body and one side of the fabric to the other (one good example of such a product is hosiery made from polypropylene yarns which do not absorb moisture but merely wick or transport it to the external surface for subsequent evaporation).

[Return to Titles](#)

#### **G5 From Fabric To Finished Garment In Less Time**

One step innovations for producing garments would save companies money on labor and utilities. Innovative ideas are sought for this topic.

[Return to Titles](#)

#### **G6P Rotor Spinning– The Effect of Yarn Count on Production Potential**

Rotor spinning is a well established spinning process with significant adoption in the USA. During its evolution the technology has undergone several stepwise changes that have resulted in major improvements in potential processing speeds (potential yarn twisting speeds increasing from 30,000/min. to 150,000/min.). Unfortunately the maximum speed is rarely achieved in practice and this is particularly true when processing synthetic fibers and coarser count yarns. The impact of yarn count on maximum processing speed is significant since the potential twisting rate is seldom achieved as the yarns become coarser. A systematic study of the influence of count on yarn quality and processibility is worthwhile.

[Return to Titles](#)

### **G7 Vortex Spinning – The Influence of Yarn Hairiness on Fabric Abrasion and Hand**

While vortex spinning has found some acceptance in Europe and Asia (and more recently Australia) the US continues to dominate the investment in this technology. The obvious advantage of this system is a very high spinning speed, when compared to other technologies, coupled with an acceptable yarn and fabric quality. Additional benefits are that the vortex yarn resembles ring-spun yarn in some attributes, but has a distinct advantage of less pilling propensity, due to the presence of wrapper fibers which minimize yarn hairiness. This latter structural feature also carries a penalty, which is that surface hairs may be advantageous when considering fabric hand. This topic is to carry out a well defined parametric study of the factors influencing hairiness and to assess the subsequent impact on knitted fabric performance and aesthetics.

[Return to Titles](#)

### **G8P Yarn Benchmarking: Possible Machinery Manufacturer Financial Aide**

An update on yarn quality benchmarking with a MQC type database needed. The ITT membership has a need for an updated MQC type yarn resource that would include international data to accurately depict where they stand on yarn quality. The project would also need to evaluate new equipment to detail what quality gains can be realized by improved technology. This project would also include some work and reference to how yarn quality relates to fabric quality and downstream processing.

[Return to Titles](#)

### **G9P Vortex Spinning: Possible Machinery Manufacturer Financial Aide**

A focus on vortex capabilities with core spun yarns and new markets would be evaluated in one or more projects. Also, research on “how to” process vortex downstream is desired by our members. This project will be done in partnership with Murata.

[Return to Titles](#)

**G10P Slasher Waste: Possible Machinery Manufacturer Financial Aide**

The inherent waste generated when starting up the slashing operation needs to be addressed. This category of waste has increased in recent times due to the smaller lots typically running in our membership. The plan would be to work with slasher experts and vendors to develop or investigate new ways to “thread” slashers to reduce waste. Additional investigation would look at new controls for the slashing process as well to improve function, cost, and quality.

[Return to Titles](#)

## **ECONOMIC COMPETITIVENESS ([Return to Index](#))**

### **EC1 Business Continuity Planning Strategy for Apparel Industry**

The purposes of this research are to a) conduct an analysis of the business disruptions in the U.S. apparel industry, b) determine the business continuity planning strategies currently in place, and c) develop a managerial model for developing business continuity plans useful for conducting future business in volatile global market environments. As a result of this proposed research, companies will be able to 1) identify the risks of operating in a global supply chain, 2) evaluate the impact of disruptions, and 3) develop business continuity plans to minimize the financial risks.

[Return to Titles](#)

### **EC2 Design for Manufacturability in Textiles**

The goal of this project is to enhance the interface between design and manufacturing by developing a model for implementing design for manufacturability (DFM) in textiles. DFM concepts have been used in the metal working and electronics industries. The model will address implementing the concepts of DFM. Outcome of this research will be a conceptual framework that integrates product development backwards with fabric construction and manufacturing technology. It is proposed that the framework will allow for prioritized recommendations of yarn and fabric construction properties.

[Return to Titles](#)

### **EC3P Niche Market Strategies**

Niche products provide economic competitiveness opportunities for the U.S. textile industry: higher margins, a "movement" away from the commodity business (which competes predominantly on price), and an "import resistant" approach to the global marketplace (short-term with the niche product; long-term with the "niche strategy".) This research will be an investigation into the economic, political, environmental, and technological factors surrounding the establishment of specialized markets, also known as niche markets -- resulting in a business strategy model for textile niche products and markets. The business strategy model, developed in this study, can be used by ITT member companies as a guide in developing niche textile products and markets.

[Return to Titles](#)

## **EC4P Lead Times and Supply Chain Dynamics**

Two phrases provide potential opportunities for the U.S. textile industry:

*"Speed is more important than price"*

*"Speed allows you to avoid markdowns."*

Given that the "home" of the U.S. textile industry is in the world's largest consumer market (U.S.), unique opportunities should exist for the U.S. textile industry for speed (due to close proximity) and service (reduced markdowns). This research will be an investigation of the lead times for sourcing textile and apparel products (ITT member companies can provide priority of products/sectors), the "tolerance levels" for markdowns", and the identification of competitive strategies for U.S. textile producers . The results of this study will provide strategies that can be used by ITT member companies as a guide in developing relationships with U.S. retailers.

[Return to Titles](#)

## **EC5 Analysis Of Joint Americas/Non-Americas Supply-Chain Sourcing Strategies**

Currently, retail groups often source large amounts of goods from non-Americas locations owing to only superior pricing. However, there is a significant lag between order request and arrival when moving materials from eastern nations to the United States as compared with domestic suppliers or even suppliers in the Caribbean region. Since current forecasting methods are unable to predict demand to a high accuracy level far in advance. The primary objective of this project is to study the benefits of dual-source supply chain sourcing strategies that attempt to combine the economic advantages of non-Americas sourcing and local sourcing to obtain optimum supply chain configurations. The goal of this project is to develop understanding of these types of configurations such that U.S. textile manufacturers can capitalize on replenishment-market business opportunities as far-eastern cost pressures continue to intensify.

[Return to Titles](#)

## **EC6 Do Textile Mergers Work?**

This proposal seeks to review textile and apparel mergers over the past 10 to 20 years, analyze the stated objectives for the mergers, and investigate if those stated (or unstated) objectives have been met. Emphasis lies on the evaluation of productivity, market share, direction of merger (vertical or horizontal), if available market value (for public companies), changes in cost structure, SWAT Analysis pre- and post-merger. Critical evaluation of mergers as a tool to improve competitiveness of a company; key issues to consider for mergers, and final outcomes should be evaluated.

[Return to Titles](#)

**EC7P Optimum Plant Size in a Mass-Customization Environment**

This proposal seeks to evaluate optimum plant sizes for companies active in the mass customization environment. Traditionally optimum plant sizes were determined by economies of scale and issues of manageability. In an environment where markets require economies of scope and economies of scale (flexibility and cost), optimum plant size considerations are likely to change. A critical review of optimum plant size considerations; guidelines regarding plant size and related issues in a mass-customization environment should result from this work.

[Return to Titles](#)

**EC8 Quality Products in the Textile and Apparel Industry**

Textile manufacturers we have certain ideas of what constitutes good or acceptable quality, and we may even express these requirements in textile technology terms. However, in marketing textile and apparel products, consumers may associate high quality with different product characteristics, and for producers it is critical to match perceived and required qualities of a product with technological qualities. This research proposes to investigate consumer relevant quality issues and relate them to textile manufacturing.

[Return to Titles](#)

