DEPARTMENT PROFILE

UNDERGRADUATE PROGRAMS

• Bioprocess Engineering (BS)
• Paper Engineering (BS)
• Paper Science (BS)
• Bioprocess Science (Minor)
• Computer and Information Technology (Minor)
• Management (Minor)
• Paper Science (Minor)

GRADUATE PROGRAMS

• Bioprocessing (Advanced Certificate)
• Paper and Bioprocess Engineering (MPS, MS, PhD)
  o Bioprocess Engineering
  o Paper Engineering
  o Biomaterial Engineering
• Sustainable Engineering Management (MPS)
  o Bioprocess Engineering
  o Paper Engineering

SPRING 2011 STATISTICS

Undergraduate Students: 70
  %Female / % Male 21%/79%
  % International 6%
  Mean Cumulative GPA 2.84

Bioprocess Engineering 44
Paper Engineering 26
Paper Science 0

Graduate Students: 35
  % Female / % Male 46%/54%
  % International 57%
  Mean Cumulative GPA 3.69

PhD 25
MS 6
MPS 1
Certificate 3

Faculty:
  Full-Time 9
  Part-Time 3
# TABLE OF CONTENTS

- Introduction ............................................................................... 3
- Undergraduate Programs ............................................................ 4
  - Bachelor of Science .............................................................. 4
  - Undergraduate Program Enrollment .................................... 6
- Graduate Programs .................................................................... 8
  - Advanced Graduate Certificate .......................................... 8
  - Master of Professional Studies ........................................... 8
  - Master of Science / Doctor of Philosophy ......................... 9
  - Graduate Program Enrollment ............................................ 9
- Graduates 2010-2011 .................................................................. 11
- Syracuse Pulp and Paper Foundation ..................................... 13
- Joachim Endowment ................................................................ 15
- International Opportunities ..................................................... 17
- Research Activities .................................................................. 19
- Empire State Paper Research Institute (ESPRI) .................... 21
- Faculty and Staff ..................................................................... 23

Photos throughout the report show Walters Hall and its educational and research equipment.
View of Walters Hall showing the green roof of the pilot plant.

Molten-carbonate fuel cell located behind Walters Hall. The biofuel tanks are in the background.
Another year has passed and the next group of graduates from our department has walked across the stage. With twelve 2010-2011 graduates, this year’s class was about evenly split between Paper Engineering students and Bioprocess Engineering students. This results from our continued strengthening enrollment in the department with the Fall 2010 incoming class also evenly split between Paper Engineering and the new Bioprocess Engineering programs.

Our Paper Engineering graduates continue to have success in finding employment after graduation and still top all programs at SUNY-ESF in terms of starting salary. The bioprocess engineering students have also been interviewing and job hunting with some success. In my exit interviews with students, some are considering job offers, one is planning on going to medical school, and others intend to seek permanent employment after taking some time off.

This year we also graduated our first dual-degree student through our program with the Beijing University of Chemical Technology (BUCT) in China. These students complete their senior year at SUNY-ESF and receive degrees from both universities. Ms Tiantian Hui joined her classmates at the graduation ceremony and plans to continue her education in the Department of Biomedical and Chemical Engineering at Syracuse University after a brief visit home to China. The dual degree program continues to be popular with an expected four students joining the PBE department for the 2011-2012 academic year.

Our other international program with the University of Munich in Germany also continues. Through the efforts of Dr Klaus Doelle, a steady stream of German students come to SUNY-ESF to study and Mr Ryan Reed, a Paper Engineering student, is completely an 11-month combined semester abroad and internship. We expect our ability to offer integrated international programs within the department will only enhance enrollment in our programs.

We celebrated the 50th anniversary of the Syracuse Pulp and Paper Foundation (SPPF) this year. In 1960, representatives from the pulp and paper industry came together to form SPPF in order to encourage students to student paper engineering at SUNY-ESF. Since that time, many students have benefited from the scholarships that are offered to all students in the paper engineering and paper science programs. This momentous occasion was marked with a number of events including the Beater Rats’ Ball at Drumlins, a golf outing, and the inaugural 3K paper run held on the SUNY-ESF campus and the adjacent Oakwood Cemetery. Generations of graduates came together for this celebration.

With the support of the Joachim Endowment through SPPF, twenty-four students were awarded their Green Belt after going through Six Sigma training held on the SUNY-ESF campus. Mr Brad Arthur with the Joachim Fellows, Ms Beth Arthur and Ms Prajakta Dongre, offered the training over the course of three months in the spring semester. The training was part of the mission of the endowment provided by Herman Joachim to enhance the management training opportunities for students in the Department of Paper and Bioprocess Engineering. Based on the success of this program, we are hoping to continue to offer the Green Belt training on an annual basis and perhaps extend the offering to Black Belt training.

We are looking forward to another exciting year at SUNY-ESF. I always look forward to hearing from alumni so please keep in touch and stop by to visit if you are in the area.

Gary M. Scott
Chair, Department of Paper and Bioprocess Engineering
Director, Division of Engineering
UNDERGRADUATE PROGRAMS

BACHELOR OF SCIENCE

The undergraduate programs in the PBE Department provide a broad base of study to prepare men and women for professional positions in the pulp, paper, and bioproduct industries. This industry is the fifth largest in the nation—the largest based on renewable resources—and is very strong internationally. The College of Environmental Science and Forestry (SUNY-ESF) pioneered instruction for the pulp, paper, and allied industries in 1920 with the formation of a Paper Science and Engineering Department, which has maintained a singularly high position in this area of professional education. This program has a long-standing reputation for preparing graduates for rewarding positions as research chemists, process engineers, technical service representatives, managers, and many others. Graduates have advanced to positions of leadership in research, management, technical operations, and sales in the pulp and paper industry as well as such allied industries as heavy equipment manufacture, process chemicals, and other supply industries. Recent revolutionary research in the Department is exploring the production of chemicals, fuels, and other products traditionally made from nonrenewable, petroleum resources.

The curricula consist of several categories of courses. The general education component, which is required of all ESF students, broadens the students’ perspectives on global and societal issues, an important component of any education. Students also take a number of courses in math and the basic sciences—chemistry, physics, and biology—to provide the background for the courses that prepare students for engineering practice. The engineering courses cover a variety of topics that are traditional for a chemical engineering program, supplemented with courses specific to their particular programs.

Bioprocess Engineering

The bioprocess engineering program prepares students for careers as engineers in biological and chemical process-related fields, filling positions that are typically filled by chemical engineers following additional training. As we begin the 21st century, growth and development worldwide will need to be done in a sustainable manner that looks to the long-term survival of humanity and ecosystems as we know them today. The bioprocess engineering program educates engineers versed in the traditional chemical engineering fields with a focus on developing products and energy from sustainable sources in as sustainable manner, especially from wood and other lignocellulosic materials rather than non-renewable sources, such as fossil fuels.

Program educational objectives are broad statements that describe the career and professional accomplishments that the Bioprocess Engineering program is preparing the graduates to achieve. We expect graduates:

1. To achieve rewarding careers in bioprocess engineering and related fields after graduation.

2. To demonstrate advancement in their careers through increasing professional responsibility and continued life-long learning.

To achieve these objectives, students study a broad base of topics in the fundamentals of engineering focused on the chemical and biological processing of raw materials from sustainable sources. Emphasis in this program is on using renewable biomass resources to replace petroleum in energy and industrial product applications. Examples of such technology include the production of ethanol, acetic acid, butanol, lactic acid, polymers, and other chemicals that have traditionally been produced from fossil fuels such as oil, coal, and natural gas.

Students gain valuable experience through a capstone-design experience in which they work on significant problems in the design and implementation of new technologies. In addition, a summer internship is required
of all students during which they gain valuable skills and experience in terms of technical knowledge and professional development. Both of these experiences serve to integrate the knowledge gained in their coursework with real-world work experiences commonly seen in their first positions after graduation.

The bioprocess engineering program will be proposed for accreditation as a chemical engineering program through Engineering Accreditation Commission/Accreditation Board for Engineering and Technology (EAC/ABET) in 2012.

**Paper Engineering**

The paper engineering program is a chemical engineering-based curriculum designed to provide greater depth in fiber and paper processing for students preparing for an engineering career in the pulp, paper, and allied industry. The pulp and paper industry is at the forefront of the renewable resources industry. It represents the first industry that uses biomass in large quantities to produce commodity and specialized products. Graduates are well prepared to move into assignments in the engineering field and advance quickly to positions of responsibility in the analysis and design of processes and equipment.

Program educational objectives are broad statements that describe the career and professional accomplishments that the Paper Engineering program is preparing the graduates to achieve. We expect graduates:

1. To achieve rewarding careers in paper engineering and related fields after graduation.
2. To demonstrate advancement in their careers through increasing professional responsibility and continued life-long learning.

Courses present the principles of chemical engineering with the specific content and examples selected especially for the pulp and paper industry. Courses include study in the basic sciences — chemistry, mathematics, physics, computer science — as well as engineering topics such as statics and dynamics, mechanics, thermodynamics, transport phenomena, electricity, and design.

Students in the program gain valuable experience through a capstone design experience in which they work on significant problems in the design and implementation of new technologies, typically in conjunction with a local recycled-paper mill. In addition, a summer internship is required of all students in which they gain valuable skills and experience in terms of technical knowledge and professional development. Both of these experiences serve to integrate the knowledge gained in their coursework with real-world work experiences commonly seen in their first positions after graduation.

The paper engineering program has undergone significant changes over the last year. Effective with the incoming class for Fall 2011, the total number of credits needed for graduation is 130. This is down from the previous year’s total of 136, and well down from the 151 credits where the program was over 10 years ago. With this reduction in total credits, the program is now on par with chemical engineering programs throughout the state. In addition, students have the option of taking various electives during their junior and senior year, which is a significant change in the curriculum. Students will now be able to better tailor their program to their interests and career needs.

The paper engineering program is accredited by the Engineering Accreditation Commission/Accreditation Board for Engineering and Technology (EAC/ABET).

**Paper Science**

The paper science program allows those students who are more science-focused to prepare for careers in the pulp, paper, and allied industries. Students graduating from this program are well-suited for employment in many different facets of the industry, the allied chemical industry, as well as in applications of chemistry and
biology. This program prepares the student for careers in the technical, managerial, or technical representative areas that extend in many directions.

Program educational objectives are broad statements that describe the career and professional accomplishments that the Paper Science program is preparing the graduates to achieve. We expect graduates:

1. To achieve rewarding careers in paper science and related fields after graduation.

2. To demonstrate achievement in their careers through increasing professional responsibility and continued life-long learning.

The program consists mainly of chemistry, some engineering courses, and specialized courses relating to the manufacture and use of pulp and paper products. The student may choose to complete one of several options in order to specialize in a subject area of interest, with some options requiring the completion of a college minor.

UNDERGRADUATE PROGRAM ENROLLMENT

Over the past several years, we have seen a significant increase in the enrollment in our undergraduate programs in the PBE Department (Figure 1). While the total enrollment in the paper engineering program has remained essentially steady, the majority of the growth in the department has been through the bioprocess engineering program since its creation in 2006. Our total enrollment has grown from under 40 in 2005 to 70 in 2011. This reverses the declining trend in students that was seen prior to 2005. The visibility of the new program in bioprocess engineering not only brought students into that program, but also stabilized the enrollment in the paper engineering program over the past several years. In addition, there have been a number of students transfer from bioprocess engineering to paper engineering early in their careers at SUNY-ESF after they learned about the opportunities and scholarships in the paper engineering program.

The paper science program has shown a steady decrease in enrollment since 2004. This continues a trend that started with the EAC/ABET accreditation of the paper engineering program in 2002. In the years

Figure 1. Spring enrollment within the PBE Department by Degree program.
immediately after the accreditation, new student enrollment shifted significantly from paper science to paper engineering, indicating the value placed on program accreditation by students. Currently, the paper engineering program is accredited with the bioprocess engineering program to be proposed for accreditation during the next general review in 2012.

The number of graduates from programs in the PBE Department has varied considerably since the first students were graduated in 1923 (the program started in 1920) from a high of 41 in 1981 to a low of 1 in 1945 and 1946 (Figure 2). The last 10 years has seen an average of 10 graduates per year (Figure 3). The 2010-2011 academic year provided our first graduates of the bioprocess engineering program, which was started in 2006. We expect a steady increase in the number of graduates over the next several years as the enrollment in the department increases and the bioprocess engineering program continues to grow.

**Figure 2.** Number of BS graduates in the PBE department since the program was started in 1920.

**Figure 3.** Number of BS graduates by program of study since 2002 in the PBE Department.
ADVANCED GRADUATE CERTIFICATE

The Certificate Program takes advantage of unique local expertise and resources in bioprocess engineering. Students who complete the certificate support the development and manufacture of products produced through bioprocesses, such as those produced in the pharmaceutical, fermentation, and biorefinery industries. The purpose of the certificate program is to provide:

- Graduate education in bioprocessing that leads to a documented level of competency for practice;
- A structured and documented course of study at the graduate level; and
- A means for students to improve their competitive position in the employment marketplace.

Applicants must hold a bachelor's degree from an accredited institution in engineering, science or a related area. The student must have the required prerequisite background in topics that are fundamental to bioprocessing from previous coursework or professional experience. The curriculum consists of five technical courses including a capstone professional experience/synthesis course that will provide participants with a variety of skills supporting the technical aspects of the program. The capstone course will challenge students to use the skills they learned throughout the program and apply those skills to relevant business settings.

MASTER OF PROFESSIONAL STUDIES

The programs in the Master of Professional Studies (MPS) degree offered by the PBE Department provide an education in the physical sciences and chemical engineering, with specific emphasis on those aspects that relate to the sustainable manufacture of pulp, paper, and other products from wood and other lignocellulosic materials. This includes the chemistry, anatomy, and components of wood; the conversion of wood to pulp, paper, and other products; the chemistry and physics of paper and paper formation; and the industrial utilization of biological processes and sustainable raw materials. The MPS programs are particularly well suited for students who have a BS degree in another field and wish to extend their technical knowledge or have worked in the industry and wish to return for an advanced degree. The MPS degree offers students the opportunity to get a Masters degree without the significant research component of the MS degree.

Bioprocess Engineering

The MPS program in bioprocess engineering encompasses both the use of renewable and sustainable resources (e.g., wood) for the production of chemicals, advanced materials, fuel, and energy, as well as the use of bioprocessing technology to produce such products. Such bioproducts extend to the production of energy from renewable resources including the use of gasification, co-firing of byproducts, anaerobic digestion, solar, and the production of ethanol and other biofuels.

Paper Science and Engineering

The MPS program in paper science and engineering deals with the processes involved in the manufacture of pulp and paper. Two options are available in the program. The first, process and environmental systems engineering, is more engineering focused and encompasses process development, design, operation, and optimization of manufacturing methods and equipment. The second, pulp and paper technology, is more science and technology focused and deals with the processes, chemistry, and products used in the industry.

Sustainable Engineering Management

The sustainable engineering management program is certified by the Council of Graduate Schools as a Professional Science Master's (PSM) program, which allows students to pursue advanced technical training in engineering while also developing skills in the areas of business, management, and other professional skills.
As such, the curriculum consists of coursework in the chosen engineering discipline together with “plus” coursework which can include business, management, policy, law, and other professional areas. More information about PSM programs can be found at www.sciencemasters.com and www.cgsnet.org. Students can pursue options in Bioprocess Engineering or Paper Engineering.

**MASTER OF SCIENCE / DOCTOR OF PHILOSOPHY**

The department participates in graduate education leading to the master of science (MS), and doctor of philosophy (PhD) degrees in paper and bioprocess engineering. Three options are available within this program:

- Paper Science and Engineering (PSE)
- Bioprocess Engineering (BPE)
- Biomaterials Engineering (BME)

The program allows students to investigate a diverse range of topics in the area of pulp and paper design, process and product development, and manufacturing, as well as the production of chemicals, energy, and other products from sustainable raw material sources using both chemical and biological methods. The overall objective of the option is to educate students at MS, and PhD level in the development of new processes and products that can be produced in an ecologically sound and sustainable manner.

Many research projects are carried out under the auspices of one of the premier research institutes of the world, the Empire State Paper Research Institute (ESPRI), a renowned organization supported jointly by ESF and the Empire State Paper Research Associates, an international consortium of leading industrial companies. ESPRI’s research activities aim to generate new information regarding the fundamentals, science, engineering and technology of the production of products and chemicals, especially paper, from renewable resources such as wood in an ecologically sound manner. Recent work has been directed to fundamental investigations of pulping, bleaching, co-products from wood, additives, paper recycling, effluent disposal, the papermaking process, the properties of paper, reactions of wood components during mechanical and chemical treatments, novel wood component separation techniques, new biotechnologically-based pulping methods, process modeling paradigms, the structure of wood and wood fibers, evaporation, fluid dynamics, heat transfer, and chemical recovery. Pilot scale equipment in Walters Hall is often used as an integral part of these research programs.

**GRADUATE PROGRAM ENROLLMENT**

Our graduate enrollment has remained steady over the last five years, averaging about 37 students (Figure 4). However, the mix of students in the programs has changed considerably. While the certificate program has decreased, the number of PhD students has increased to be over 70% of all graduate students in the PBE department. This shows the strong emphasis on research within the department. With the new MPS programs starting, especially the MPS in Sustainable Engineering Management, we are expecting a significant increase in the MPS student population in the coming years. Up until now, the MPS program has not been a significant portion of the graduate programs. Over the past five years, we have graduated 1.6 PhD and 2.8 MS students per year. The details of these graduates are summarized in the next section.
Membrane nanofiltration system to separate the sugars from the acetic acid in the wood hydrolyzate.

Figure 4. Spring graduate enrollment in the PBE Department by degree program.
Students graduating from our BS programs in bioprocess engineering, paper engineering, and paper science continue to have success in obtaining positions within the industry. The average starting salaries continue to be the highest of all programs at SUNY-ESF and are averaging over $65,000 per year. These starting salaries are comparable to graduates nationwide from chemical engineering programs. This paper industry continues to experience a shortage of engineers and is expected to need to hire about 300 new engineers per year. By comparison, the various institutions that have programs in paper engineering programs (or chemical engineering programs with a paper focus) can only provide about half of those needed engineers. Because of this, many companies will also be looking to other engineering disciplines for their needed engineers. This bodes very well for our bioprocess engineering graduates, which will also have many opportunities in the paper industry. The paper science minor in conjunction with the bioprocess engineering major could be a very strong combination for a future career. Additionally, the BS programs are preparing students for further studies: Of this year’s graduating class, three are planning on graduate school and one student is planning on attending medical school.

Listed below are the graduates from all of the PBE Department degree programs. For BS graduates, their placement is given. Six of the twelve students have accepted positions with paper and related companies, with another student with a pending offer. The thesis/dissertation topic is given for those students graduating with the MS and PhD degrees.

### BACHELOR OF SCIENCE

<table>
<thead>
<tr>
<th>Name</th>
<th>Program</th>
<th>Placement</th>
</tr>
</thead>
<tbody>
<tr>
<td>DiMarco, Daniel Philip</td>
<td>Paper Engineering</td>
<td>International Paper, Riegelwood, NC</td>
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<tr>
<td>Forte, Thomas Turner</td>
<td>Paper Engineering</td>
<td>Clearwater Paper, Gouverneur, NY</td>
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<tr>
<td>Gaffney, Peter Andrew</td>
<td>Paper Engineering</td>
<td>Ashland, Atlanta, GA</td>
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<tr>
<td>Konte, Nathan Walter</td>
<td>Paper Engineering</td>
<td>Norampac, Niagara Falls, NY</td>
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<tr>
<td>Planter, Corey Robert</td>
<td>Paper Engineering</td>
<td>Bureau Veritas, Buffalo, NY</td>
</tr>
<tr>
<td>Hui, Tiantian</td>
<td>Bioprocess Engineering</td>
<td>Graduate School Syracuse University</td>
</tr>
<tr>
<td>Hull, Timothy Sellers</td>
<td>Bioprocess Engineering</td>
<td>Graduate School SUNY-Buffalo</td>
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<tr>
<td>Naro, Emiko H</td>
<td>Bioprocess Engineering</td>
<td>Medical School</td>
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<tr>
<td>Pietra, Mario Charles</td>
<td>Bioprocess Engineering</td>
<td>Deciding between offers</td>
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<tr>
<td>Platt, Melvin Clarence</td>
<td>Bioprocess Engineering</td>
<td>Domtar, Kingsport, TN</td>
</tr>
<tr>
<td>Story, Mark David</td>
<td>Bioprocess Engineering</td>
<td>Graduate School</td>
</tr>
<tr>
<td>Whitman, Dennis Francis</td>
<td>Bioprocess Engineering</td>
<td>MWV (offer) Lanett, AL</td>
</tr>
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</table>
ADVANCED CERTIFICATE IN BIOPROCESSING

Dhillon, Harbhajan Singh  
Dunay, Andrew  
Malerba, James Vincent  
McConnell, Ryan Thomas  
Orzell, John J.

MASTER OF PROFESSIONAL STUDIES

Tsui, Winnie

MASTER OF SCIENCE/DOCTOR OF PHILOSOPHY

<table>
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<tr>
<th>Name</th>
<th>Degree</th>
<th>Major Professor</th>
<th>Thesis/Dissertation Title</th>
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<tbody>
<tr>
<td>Lavrykova, Nataliya</td>
<td>MS</td>
<td>Ramarao</td>
<td>Permeability and Compressibility Characteristics of Pulps</td>
</tr>
<tr>
<td>Duarte, Gustavo</td>
<td>PhD</td>
<td>Ramarao</td>
<td>Hot water pre-extraction of hardwoods: impact of processing on extract and pulp properties</td>
</tr>
<tr>
<td>Kanungo, Dipankar</td>
<td>PhD</td>
<td>Francis</td>
<td>Investigation of alkaline condensation reactions between monomeric and dimeric phenols related to lignin</td>
</tr>
</tbody>
</table>

Computer laboratory in Walters Hall for student use (Walters 209A).
The Syracuse Pulp and Paper Foundation (SPPF) is a not-for-profit organization created in 1960 by representatives of the pulp and paper industry to provide scholarships for students to study paper engineering and paper science at SUNY-ESF. Over the past 50 years, SPPF scholarships have supported numerous students in the pursuit of their educational programs. Many of these graduates are now leaders, both technical and managerial, in the industry. The goals of SPFF go beyond just providing scholarships and include:

- To attract highly talented young people as students in the Paper and Bioprocess Engineering curriculum.
- To provide scholarship support for students.
- To assist the college in its education programs.
- To further fundamental and applied research of importance to the pulp, paper, and allied industries.
- To provide a means of liaison and communication between the College and the pulp, paper, and allied industries.

Over the past academic year, SPPF has provided $110,890 in scholarships to 30 students, funded primarily through the $4 million endowment dedicated to this purpose. Students studying paper engineering and paper science are eligible for up to $20,000 in scholarships awarded over four years. Additional scholarships are available for students that also complete the management minor at SUNY-ESF. Students studying bioprocess engineering in the department are eligible for up to $4,000 in scholarships for working towards the paper science minor.
In addition to the financial support in the form of scholarships, SPPF supports students in numerous other ways. Being the primary contact between companies, students, and the PBE department, SPPF coordinates the internship and permanent placement activities for students in the department. Over the past year, 10 companies were on campus and others contacted the SPPF office with interest to hire students. Despite the sluggish economy, our students have been very successful in securing both internships and permanent placements (see page 11). SPPF also coordinates a number of networking opportunities to bring together students with industrial representatives. During the semiannual meetings of SPPF in Syracuse over the past year, students met with company representatives during informal dinners, tours, and other activities.

In Fall 2010, SPPF celebrated 50 years of supporting the educational programs of students in the PBE department with a weekend of events including a golf outing, the 1st annual 3K paper run, and a “Beater Rats Ball.” It is only through the support of the alumni, friends, and corporate sponsors that SPPF will be able to continue its work in providing scholarships to highly qualified students to student paper engineering and paper science and maintain the supply of graduates that are technically trained and ready to work in the industry. Corporate and alumni members provide the operational support for SPPF so that the endowment proceeds can be dedicated directly to student scholarship support. In addition, members benefit through access and discounts on research programs within the department, interaction with faculty, staff, and students in PBE, and through interactions with their peers at the semiannual meetings.

The Syracuse Pulp and Paper Foundation also plays a key role in our educational programs in the department. The SPPF Curriculum Committee serves as the advisory committee for our undergraduate programs and is instrumental in the assessment and improvement of our ABET-accredited and other programs. Their feedback and semi-annual committee meetings assure that the programs are producing the graduates needed by the industry.
The Herman Louis Joachim Endowment was established in the early nineties to provide management education and support for students in the department of Paper and Bioproduct Engineering. Dr. Joachim recognized the need to teach management basics to young engineers, and created the Endowment to assure that PBE graduates are capable managers. The endowment, currently valued at about $4 million, provides a funding base for student activities and scholarships related to management training. Over the past year, the key activities supported by the Joachim Endowment are described below.

**Tappi Student Summit:**
A number of undergraduate students were able to attend the TAPPI student summit in Kingsport, Tennessee in January. At the summit, students were able to interact with industry leaders and obtain information on employment opportunities and the state of the industry. Topics covered during the summit included:

- “Effective Networking
- The Annual Engineering Challenge
- Job recruitment interviews with hiring companies
- Job transition and getting the right job
- Domtar mill tour

The students found this to be an invaluable experience in developing their professional skills and networking with other students and members of industry. We expect support for this activity to continue into the future.

**Joachim Fellow Support:**
The Joachim Endowment was used to sponsor two fellowships for graduate students in PBE. The 2009-10 Fellows were Beth Arthur and Prajakta Dongre. The Joachim Fellows engaged in a number of activities during the course of the year including providing seminars to students in the department as well as engaging in outside training. The Joachim fellows were instrumental in developing and implementing the Six Sigma training program and the development of the professional engineering skills courses described more completely below. In the upcoming year, the three Joachim Fellows will be instrumental in implementing the programs supported by the Joachim Endowment.
Six Sigma Training:
Twenty-four undergraduate and graduate students received their Six Sigma Green Belt after attending several seminars and working on a semester-long project that illustrated the principles of Six Sigma. Six Sigma is a management method that improves processes by identifying and removing the causes of defects and process variability. Many of the undergraduate students applied the techniques in conjunction with their senior product/process design class, PSE 468 (Papemaking Processes). In the course, they learned how to work through a defined series of steps that also had a basis in the statistical analysis of the resulting data.

Green Belt certification is the first step in the complete Six Sigma certification process and many employers require their process engineers to get this training soon after starting work. By providing the training to the students at the university, they enter the workforce one more step ahead of their peers from other universities. The next step in the certification process is the Black Belt. Based on the success of the program this year, we are planning on holding a Black Belt training session in conjunction with another Green Belt session in the upcoming academic year.

Educational Program Development:
Beginning in Fall 2011, the PBE Department will offer the course GNE 330 (Professional Engineering Skills) to all students. GNE 330 will be taught in a seminar format including seminars and workshops given by faculty, students, and guest speakers. The topics covered will vary from year-to-year, but will generally repeat over a three-year cycle. In this way, all students will encounter most of the topics during their undergraduate education starting with the sophomore year. Students starting in Fall 2011 and after will be required to take the seminar each semester from their sophomore to senior years.

The Engineering Accreditation Commission of ABET (EAC/ABET) specifies in Criterion 3 that engineering programs must have documented student outcomes that prepare graduates to attain the program educational objectives specified by the particular program. The design of engineering courses typically focus on the technical skills primarily and the professional skills secondarily. The purpose of this seminar course is to enhance the instruction of the professional skills in areas such as teamwork, ethics, communication, management, professional development, and contemporary society.
INTERNATIONAL OPPORTUNITIES

The PBE Department coordinates a number of international programs for students in PBE and more generally for students at SUNY-ESF. The purpose of these programs is to enhance the educational experience of students at SUNY-ESF and our cooperating institutions through cultural and educational exchanges. The outline below identifies the types of programs that are offered, the current programs in place, and the plans for expanded programs in the future.

Types of Programs
1. Single international-based course.
   - Targeted students: SUNY-ESF undergraduates/graduates
   - Course instructors: SUNY-ESF and/or international
   - Funding: Tuition, SUNY-ESF, PBE
   - Resources: Instructor travel expenses, instructor stipends

2. Dual-degree program. International students transfer to ESF for their senior year and complete an existing program at ESF. The student receives a BS degree from ESF and their home institution.
   - Targeted students: International undergraduates/graduates
   - Course instructors: SUNY-ESF (as part of regular course offering)
   - Funding: Tuition
   - Resources: None additional for instruction. May be costs to interview/validate students for program

3. Exchange program. Students exchange between ESF and international institution. Each student pays tuition to their own institution. The funds are used to host the guest students. A parity should be maintained in the number of students, credit hours, etc.
   - Targeted students: International undergraduates, SUNY-ESF undergraduates
   - Course instructors: SUNY-ESF (as part of regular course offering)
   - Funding: Tuition
   - Resources: None additional for instruction. May be costs to interview/validate students for program

4. Semester abroad. A designated semester is targeted with appropriate courses and integrated into the existing program(s).
   - Targeted students: PBE undergraduates
   - Course instructors: International institution instructors
   - Funding: Tuition
   - Resources: None

5. Semester/Internship abroad. A designated semester is targeted with appropriate courses and integrated into the existing program(s). The student also works an internship in the host country.
   - Targeted students: PBE undergraduates
   - Course instructors: International institution instructors
   - Funding: Tuition
   - Resources: None

Current Programs
1. BPE 230 (The China Experience). The course is offered in even years during the Maymester. It is offered to all students at SUNY-ESF and satisfies a general education requirement.
   - Coordinator: Dr Shijie Liu
2. Darmstadt semester abroad. Students take a semester of courses at the international institution and works at an internship at a German company. The total time in country is approximately 11 months.
   Coordinator: Dr Klaus Doelle

3. Sichuan exchange program. Students from Sichuan University began in the Fall 2010.
   Coordinator: Dr Shijie Liu

4. Beijing University of Chemical Technology dual degree program. This program began in Fall 2010 in Bioprocess Engineering.
   Coordinator: Dr Shijie Liu

Proposed Programs
1. Sichuan University summer program. A selection of courses will be offered in English to offset the exchange program. The program will be open to all SUNY-ESF and will primarily satisfy general education requirements.
   Coordinator: Dr Shijie Liu

2. India semester abroad. Students will take a semester of courses that is integrated into an existing program. The program will be open to students in the Paper Engineering and Bioprocess Engineering.
   Coordinator: Dr Bandaru Ramarao and /or Dr Siddharth Chatterjee

Students and Dr. Scott at the base of the Great Wall of China (2008).
RESEARCH ACTIVITIES

The PBE Department continues to have a strong research program through support from external research grants, the ESPRI program, and individual company funding. The research interests of the individual faculty members in the department are detailed in the Faculty and Staff section of this report (page 23ff) and include not only the traditional area of pulp and paper research, but over the past 10 years has expended into the bioprocess engineering areas including the production of biofuels and biodegradable plastics. Research expenditures have been over $1 million/year for the past five years, peaking at $1.7 million during the 2009-10 fiscal year (Figure 5. Research expenditures for the PBE department Figure 5). Approximately two-thirds of the funding is from federal sources such as DOE and the USDA, while another quarter is from industrial sources (Figure 6). About 10% of the funding is state-based funding. Key research projects in the department include:

- Value-Added Non-Carbohydrate Products form Hardwoods/Sugar Maple in the ESF Biorefinery
- Hot Water Extraction and Analysis and Separation of Extracted Sugars and Chemicals from Woody Biomass
- Environmentally Benign PHA Production from Hot-Water Wood Extracts
- COE in Watershed Applications & Technology-Biomass Gasification Project
- New Manufacturing Method for Paper Filler and Fiber Material
- The Biorefinery in New York - Bio Butanol from Biomass
- Conversion of Dairy and Biodiesel Waste Products to Omega-3 Fatty Acids and Lipids for Biodiesel Production Using Mixotrophic Algae
- The Use of Microporous Ceramic Composite Membrane Technology in the Improvement of Biofuels & Bioproducts Production
- Biodegradable Plastics from Renewable Sources for Manufacturing Medical Products in CNY
- Investigation of Depolymerization and Condensation Reactions of Lignin
- Butanol Production From Wood Extract Sugars
- Assessing the Forest Biorefinery Value-Prior-to-Pulping Business Concept
- Professional Science Masters Initiative at SUNY
- Electron Beam & X-Ray Irradiation of Lignocellulosic Biomass - Synergies w/Biodelignification & Hemicellulose Removal in Reducing Recalcitrance

400-L fermenter in the pilot plant in Walters Hall.
Figure 5. Research expenditures for the PBE department

Figure 6. Sources of research funding in the PBE department.
During this year, the projects conducted by ESPRI researchers included new and advanced technologies for pulp bleaching, the characterization of the dewatering of pulp suspensions, the spreading of ink droplets on paper surfaces, studies of the stiffness of paper and separation processes for biorefineries.

Two semi-annual reports for the Empire State Paper Research Associates were published (ESPRI Report Nos. 132 and 133). Eight manuscripts detailing past research were submitted to various refereed journals and contributions to books were prepared. Four publications appeared in journals and several publications appeared in refereed and unrefereed conference proceedings.

**Pulping & Bleaching**
In devising new technologies for bleaching, results on high pH D-stage bleaching with O2 were reported for four different chemical pulps (both softwood and hardwood).

**Papermaking**
The purpose of refining is to increase the strength and other performance properties of paper without sacrificing important properties such as bulk, stiffness and opacity. We conducted a simulation study of the effect of refining on paper sheets to specify the contribution of each type of refining action on the elastic modulus and stiffness of paper sheets, both of which are critical properties of interest. We considered the effects of each of these parameters on drainage resistance and wet pressing on the sheet development and sheet stiffness.

PCCs tend to flocculate and increase diameter by nearly 3 to 4 times over time scales of 10 – 40 min. PCC can be flocculated by a variety of polyelectrolyte retention aids such as polyacrylamides and nonionic polymers such as PEO. Native flocculation of PCC can also occur and result in agglomerates which impart different properties to the paper sheet. We investigated the agglomeration of PCC in aqueous suspension when the particle zeta potentials are sufficiently small. We found that the addition of anionic dispersants could stabilize the suspension by increasing the magnitude of the anionic surface charges. These suspensions could be induced to flocculate by adding simple electrolytes by traditional DLVO theory.

Papermaking pulps were characterized using permeability and compressibility in a more efficient and convenient way than has been possible hitherto. The specific surface area and specific volume of a set of different HW and SW pulps refined to different levels was measured quickly and reliably. The data seem to be reproducible with good precision and agree with expected values for simple pulps. Modification of this apparatus for highly refined pulp fines is underway presently.

**Biorefinery Separations**
Lignocellulosic hydrolyzates produced by hydrothermal treatment of wood chips contain hemicellulose sugars, acetic acid and significant quantities of colloidal material. These particles are mostly composed of lignin and its derivatives, which have a wide range of particle size distribution. Separation of these colloidal materials is necessary to improve fermentability of sugars into biofuels and other bioproducts. Flocculation of wood hydrolyzates prior to microfiltration improves their filterability. In this paper we investigated the separation of sugar maple wood extracts at bench and pilot scales (of 1000 kg) by a non-ionic polymer Polyethylene Oxide (PEO).
KRK 12-inch refiner in the Walters Hall Pilot Plant.

Pulping and Bleaching Laboratory in Walters Hall (Walters 103)
FACULTY AND STAFF

The PBE Department has nine full-time faculty members that engage in undergraduate and graduate teaching as well as developing a research program to various degrees. The faculty members has over 130 combined years of experience at SUNY-ESF ranging from over 30 years to faculty members hired within the last five years. The faculty also has a wide range of backgrounds including chemical, paper, and mechanical engineering, chemistry, forestry and forest management, and computer science, among others. This background brings a broad perspective to the educational programs in the PBE Department. In addition, three part-time faculty members also engage in teaching at the undergraduate and graduate levels and bring specialized expertise to the programs. Several staff members also support the educational programs in the department, particularly with regards to the maintenance and operation of the pilot plant facilities and the various educational laboratories. The faculty and staff active during the 2010-2011 academic year are listed below and the following pages detail the expertise and accomplishments of the various faculty and staff members.

State-Supported PBE Department Personnel

Professors:
- Dr. Thomas E. Amidon
- Dr. John C. Fieschko
- Dr. Yuan-Zong Lai
- Dr. Bandaru Ramarao
- Dr. Gary M. Scott

Associate Professors:
- Dr. Siddharth Chatterjee
- Dr. Shijie Liu

Assistant Professors:
- Dr. Biljana Bujanovic
- Dr. Klaus Doelle

Research Associate
- Dr. Raymond C. Francis

Instructional Support Staff:
- Mr. William Burry
- Mr. Raymond Appleby
- Dr. Shigotoshi Omori

Department Secretary:
- Ms. Lynn Mickinkle

Visiting, Emeritus, and Adjunct Faculty
- Dr. Wayne Amato
- Dr. Jose Iribarne
- Dr. Leland Schroeder

Research Foundation Supported PBE Department Personnel

Research Support Staff
- Mr. Alton Brown
- Ms. Kate Gratien
- Mr. Sergiy Lavrykov
- Ms. Jennifer Putnam

Syracuse Pulp and Paper Foundation Staff
- Ms. Linda A. Fagan
- Ms. Deborah Dewitt

Post-Doctoral Associates
- Dr. Samar Bose
- Dr. Asif Hasan
- Dr. Kaili Nie
- Dr. Zhijie Sun
- Dr. Ren Hao
RESEARCH AREAS

- Biorefinery
- Fiber properties
- Paper properties
- Pulping and bleaching
- De-inking

COURSES TAUGHT

- PSE 456, Management in the Paper Industry

PUBLICATIONS


SUMMARY

Dr. Amidon has completed work for the Value Prior to Pulping Consortium and provided written results and analysis for three components. The sugars extracted from wood with Hot Water Extraction were processed in the ESF Pilot Plant were successfully converted to ethanol at NREL, FPL, and Purdue U and to butanol by Cobalt Biofuels. The final report has been submitted to DOE and it shows that the ESF produced sugars are fermentable with a range of organisms and systems and that the implementation at hardwood pulp mills can be profitable. Large DOE projects have been completed at ESF, except for the final reports, on ethanol production and butanol production. The ESPRA board has agreed to be the funding mechanism for the Biorefinery Research Institute which will facilitate the start up. Dr. Amidon contributed to 4 significant grant proposals with 2 as PI. Presentation of research results have been made in the US, China, Portugal, and Spain. A cohort of Advanced Certificate students is being completed, bringing the total to over 60.

*Hot-water extraction reactor with the membrane filtration equipment in the background.*
RESEARCH AREAS

- Bioprocess engineering
- Fermentation processes
- Industrial biotechnology

COURSES TAUGHT

- BPE 300, Introduction to Industrial Bioprocessing
- BPE 481, Bioprocess Engineering Design

CNY BIOTECHNOLOGY CONFERENCE

Developed, organized and chaired the 3rd Annual CNY Biotechnology Conference. Over 30 companies and academic institutions will participate, and as of 5/20/11, more than 125 people are registered so far for the June 2-3, 2011 event. Significant sponsorship is allowing complimentary registration for numerous students and faculty from ESF, Upstate Medical University and Syracuse University. There is also a student poster session with more than 20 posters submitted so far, many from ESF. The event fosters communication between industry and academia and helps raise awareness of biotechnology in CNY including at SUNY ESF.

CNY BIOTECHNOLOGY RESEARCH CENTER

Applications are being accepted now for Central New York's newest biotech incubator—the CNY BRC. Dedicated to helping biotech and biomedical for-profit companies become successful and commercialize their products, the CNY BRC will open its doors in Spring 2012. Located in Syracuse, NY, this highly-specialized incubator draws on the bio-research strengths of two founding universities and a region rich in education and entrepreneurial spirit.

VISION: The CNYBRC strives to be a globally recognized nexus for accelerating biological and medical products to market.

MISSION: To support university-industry partnerships that discover, develop and deploy innovative products for the biological and medical marketplaces. The CNYBRC will provide growth-oriented companies essential business acceleration services and access to industry-specific development resources.

For more information: http://www.upstate.edu/biocenter/
SUMMARY

My most significant activities and accomplishments during this reporting period were to educate students to the best of my ability on real world applications of bioprocessing and biotechnology and advance the development of the Central New York Biotechnology Research Center (CNY BRC). BPE 300 was developed to provide students with exposure to various bioprocess industries and how to quantitatively solve problems typically encountered by a bioprocess engineer. BPE 481 was developed to provide students experience working in teams on laboratory projects and translating the results of those projects into process designs. The development of the CNY BRC was furthered by starting to recruit tenant companies for the building, organizing a major regional biotechnology symposium and the writing of research grants to try to raise additional funds.

Next year I plan to improve both BPE 300 and BPE 481 lectures using additional material, write research grants as the opportunities arise and organize and chair the 4th annual Central New York biotechnology research symposium.

Artist’s rendering of Central New York Biotechnology Research Center in Syracuse, NY.
RESEARCH AREAS

- Chemistry of wood
- Pulping
- Bleaching
- Bioproduct development

COURSES TAUGHT

- PSE 550, Principles of Pulping and Bleaching

PUBLICATIONS


Walters Hall Lobby showing plaques commemorating SPPF Scholarships.
SUMMARY

My professional activities related to the enhancements of College’s and Department’s visibilities are:


2. Invited to write and completed a chapter entitled "Wood and Wood Products” to be included in the Kent and Riegel's Handbook of industrial Chemistry and Biotechnology.

3. Invited to visit and give presentations this June at:
   - Dalian Polytechnic University, China
   - Nanjing Forestry University, China

4. Invited to chair a technical sessions and to give two papers at the 16th International Symposium on Wood, Fibre, and Pulping Chemistry (ISWFPC)”, Tienjing, China, June 8-10, 2011.

5. Invited to give a keynote presentation at an international conference to be held July 8-10, 2011 in Taiwan.

For the coming academic year, I hope be able to submit at least one research proposal and to receive some funding to strengthen my research activity. Also, I would explore the feasibility of writing or editing a wood-chemistry related book.
**RESEARCH AREAS**

- Fluid particle separations
- Colloidal and surface phenomena
- Transport of moisture in paper
- de-inking
- digital image processing

**COURSES TAUGHT**

- BPE 310, Colloid and Interface Science
- BPE 420, Bioseparations
- PSE 371, Fluid Mechanics
- PSE 467, Papermaking Wet End Chemistry

**PUBLICATIONS**


Yasarla, L. R., Ramarao, B. V. ‘Separation and purification of lignocellulosic wood hydrolyzates by polymer induced flocculation and crossflow microfiltration.’ World Biotechnology Conference, Hyderabad India, March 2011.

Yasarla, L. R., Ramarao, B. V. ‘Polymer induced flocculation of wood hydrolyzates.’ AIChe Annual Meeting, Salt Lake City UT, November 2010.

Duarte, G. V., Ramarao, B. V. ‘Flocculation of wood hydrolyzates.’ AIChe Annual Meeting, Salt Lake City UT, November 2010.
SUMMARY

I worked with the Empire State Paper Research Associates, as part of my duties to ESPRI, and stabilized the membership. I have been successful in getting the ESPRA grant renewed at or close to past annual level. This has placed ESPRA on a stable operating basis for the future. The primary reason for this accomplishment is the close alignment and successful conduct of the research projects funded by ESPRA over the past year. The results provided by these projects have been extremely valuable to the members. Some of the member companies met the research personnel multiple times during this year to apply the results in their specific situations. Several new projects have been initiated as a result of these collaborations. Significant among them are the ones supported by Domtar, Specialty Minerals, International Paper and Newpage Corporation.

My publication on ‘A review of separation technologies in biorefineries’ with colleagues from the University of Minnesota is the sixth most cited paper in Separation and Purification Technology Journal. This journal is one of the most prestigious ones in its field (Impact Factor 2.89). This publication was also the most downloaded paper for the past 3 years. The book on Granular Filtration of Aerosols and Hydrosols continues to be a leading research monograph in Environmental Process Engineering. It has over 320 citations in a short span since publication (2nd Edition, 2007). My H-index has increased to 12, a good measure comparable with other leading researchers and academics in paper and process engineering.

I was invited to review PhD theses for National University of Singapore and the University of South Eastern Finland, Kuopio, Finland. I also served as a reviewer/referee for a number of academic researchers and faculty members at leading universities in the world. I have been asked to review manuscripts and papers from a number of leading journals. One PhD and one MS student has graduated this year. Dr. G. V. Duarte defended his PhD dissertation titled 'Hot water pre-extraction of hardwoods'. He is currently a research engineer with a European agency and is investigating applications of the biorefinery concepts. Ms. Nataliya Lavrykova completed her MS in May and defended her thesis titled 'Permeability and Compressibility Characteristics of Pulps'. Both of these theses, and in particular, Ms. Lavrykova's thesis generated interest from ESPRA members.

I continued to serve as the director for the Forest and Plant Bioproducts Division of the American Institute of Chemical Engineers during the past year. I was also responsible for the programming of the division at the 2010 Annual Meeting in Salt Lake City, UT. My programs were highlighted significantly at the annual meeting as part of the 1st International Conference on Energy: Sustaining Supplies. I also chaired two sessions at this meeting and presented 4 papers. I also served as the vice-chair for Tappi's Fluid Mechanics Committee. In this role, I organized the Fluid Mechanics Sessions for this year's PaperCon 2011 in Cincinnati OH (Northern Kentucky). I am one of the organizers of the 2011 TAPPI International Conference on Nanotechnology for Renewable Materials, Arlington VA, June 6-8. I am chairing a session on Nanotechnology for Renewable Nanomaterials: Surface Modification and Functionalization besides co-presenting a poster.

I am chair of the PBE department’s graduate studies and research committee. As part of this committee, I set up and implemented policies to admit new graduate students, assign their teaching and research advisors, teaching fellow activities, maintain and update the graduate handbook and generally manage the graduate program. The principal method of action in the graduate committee is to arrive at consensus on assignments of teaching assistantships, fellowships, admissions and research advisors. All decisions are made by the committee at its regular meetings during the academic year. I led the departmental ad-hoc committee for by-laws during the past year. I also was part of the college wide committee on drafting college wide policies for appointments, tenure and promotions. I represented the department in this activity and was able to convey our department's viewpoints to be reflected in the college document. I also led the departmental APT committee for revisions of our current document for updating.

I intend to submit proposals to various funding agencies including the NSF and US DoE in collaboration with colleagues at Syracuse University, ESF, U Minnesota and GA Tech.
RESEARCH AREAS

- Biotechnology for the pulp, paper, bioprocess, and related industries
- Biopulping and biomechanical pulping
- Bioprocess Engineering
- Papermachine operations
- Recycling
- Process modeling

COURSES TAUGHT

- BPE 132, Orientation Seminar: BPE
- PSE 132, Orientation Seminar: PSE
- GNE 160, Computing Methods for Engineers and Physical Scientists
- PSE 370, Principles of Mass and Energy Balances
- PSE 797, Paper Science and Engineering Seminar

PUBLICATIONS


SUMMARY

I am currently completing my fourth year as chair of the Department of Paper and Bioprocess Engineering during which we have seen enrollment growth at the undergraduate level, primarily due to the bioprocess engineering program. My recruitment efforts include presentations given at high schools and science fairs entitled “Chemistry, Physics, and Engineering: The Secrets of Money” which incorporates chemistry and engineering demonstrations with a recruiting message for the department. These presentations have been successful in bringing the message of the department to high school students as well as more generally encouraging students to consider engineering as a career choice in their college educations.

My research concentrates on the use of biotechnology for the pulp and paper industry including using white-rot fungi as a pulping pretreatment, the extraction of hemicellulose from wood for ethanol production, the use of ligninolytic enzymes for bleaching, and the economic analyses of these developing processes. My other research projects concentrate on the use of simulation for the dynamic modeling of pulp and paper processes. This work includes the development of software for the purpose of performing engineering calculations.

I currently teach a number of foundation courses for the programs in the PBE Department as well as for the Environmental Science program. PSE 370 (Principles of Mass and Energy Balances) is the first engineering course taken by students in our program and introduces them to the concepts and methods of doing engineering calculations. The orientation seminars (PSE 132 and BPE 132) serve to introduce students to the programs within the department and the student services available at the college. Computing Methods for Engineers and Physical Scientists (GNE 160, formerly APM 153) introduces the computational tools of the engineer. The format of the course changed considerably this year, with the addition of a laboratory component to the course. The change seemed to have a positive effect on the performance of students in the course.

I continue to serve on the Board of Directors of the Technical Association of the Pulp and Paper Industry (TAPPI) as well as continuing as a Program Evaluator for the Engineering Accreditation Commission of ABET (EAC/ABET). During the past year, I was the program evaluator for an engineering program at a major U.S. university.
Siddharth Chatterjee
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Paper and Bioprocess Engineering

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B. Tech. (1982), Indian Institute of Technology, Chemical Engineering
M.S. (1985), Rensselaer Polytechnic Institute, Chemical Engineering
Ph.D. (1987), Rensselaer Polytechnic Institute, Chemical Engineering

RESEARCH AREAS

• Alternative energy
• Pollution abatement
• Separation processes
• Water conservation

COURSES TAUGHT

• APM 485, Differential Equations for Engineers and Scientists
• BPE 304, Summer Internship in Bioprocess Engineering
• PSE 304, Mill Experience
• PSE 480, Engineering Design Economics
• PSE 481, Engineering Design

Valley beaters in the handsheet laboratory (Walters 103).
SUMMARY

My major effort in AY 2010-2011 has been concentrated on teaching or co-teaching PSE 481, ERE 441/691, PSE 498, PSE 480/PSE 680, APM 485, and BPE 481. I was also responsible for PSE 304/305 and BPE 304. Some of these courses like ERE 441, PSE 480 and APM 485 have seen increased student enrollment. The process simulation tools WinGEMS and SuperPro Designer were incorporated into PSE 480/PSE 680 and BPE 481. I have also taught short courses on thermodynamics, thermodynamics and heat transfer, air quality, and advanced air quality as part of the FE/PE Exam Review Course program offered by SUNY-ESF Outreach. I was a guest lecturer to the Society of Environmental Engineers at Syracuse University, and to students in ESC 132 and ERE 503. I advised several undergraduate Paper Engineering and Environmental Science students on curricular matters and served on the thesis defense committees of two graduate students during the course of the academic year. I have served on the Undergraduate Education Committee and Safety Committee of the Department and was a member of Study Group 2 (Governance and Administration) in the ESF Self-Study team for reaccreditation by the Middle States Commission on higher education. My research work during this academic year has focused on the use of the surface-renewal concept to describe gas absorption with chemical reaction in a packed column and cross-flow membrane filtration.

My plans and expectations for the upcoming academic year are: (1) Continue with teaching, outreach and advising activities. (2) Write manuscripts on the production of biodiesel from tall oil model compounds and tall oil, and submerged packed bed biological reactor for wastewater treatment. (3) Continue work in the areas of gas absorption with chemical reaction and cross-flow membrane filtration, and prepare manuscripts in these areas. (4) Revise class notes of some of my courses. (5) Collaborate with NREL in the area of xylan hydrolysis and mass transfer.
RESEARCH AREAS

- Bioprocess kinetics
- Reaction engineering
- Fermentation
- Bioprocess systems engineering
- Biorefinery
- Pulping

COURSES TAUGHT

- BPE 230, China Experience (3)
- BPE 336, Transport Phenomena Laboratory
- BPE 421, Bioprocess Kinetics and Systems Engineering
- BPE 440, Bioprocess and Systems Laboratory
- BPE 438, Introduction to Biorefinery Processes
- BPE 621, Bioreaction Engineering

PUBLICATIONS


**SUMMARY**

During the 2010 academic year, I have enjoyed full teaching load in educating our undergraduate students, notable service and professional activities, and successful research activities. I have continued to enjoy backing the highly publicized ESF biorefinery research claim with research results. Here are some of the evidences:

1). I taught 4 full courses, 1 co-taught with Dr. Gary M. Scott, 1 single-credit lab course that partly use my research lab resources, and supervised 4 undergraduate student research studies. In addition, I supervised 7 graduate students.
2). I have been serving as the undergraduate curriculum coordinator.
3). I have published 10 refereed articles, of which 2 are co-authored with another faculty member (Dr. Thomas E. Amidon) at ESF. In addition, I have published 2 non-referred articles and presented 4 conference presentations.
4). I have held 7 active research projects with external funding totaling $3,116,222, of which I am the PI for 4 projects totaling $324,597.
5). I have written 3 other research proposals that were not funded.
6). I have been serving as the Executive Editor for the Journal of Biobased Materials and BioEnergy.
7). I served as guest editor for 1 Special Issue on Journal of Biotechnology Advances, 28(5), September/October, 2010
8). I have served as Session chairs in international conferences: ICBT 2010 and AIChE annual conference.
9). I have been coordinating with ESF exchange programs with China, and dual degree program in Bioprocess Engineering.
10). I have coordinated the revision of BS in bioprocess engineering and BS in paper engineering programs.

In the upcoming 2011 academic year, I am planning to stay actively engaged in teaching and advising students; carrying out service, professional, successful research activities; and raising the profile of SUNY ESF by publication and external activities. I will be making an effort to maintain and expand the biorefinery research activities within the Department of Paper and Bioprocess Engineering at ESF. I will be reaching out more to advance research and professional development. I will be taking an active lead in ABET self studies for the Bioprocess Engineering program.
RESEARCH AREAS

- Wood chemistry
- Lignin/structure and reactivity
- Pulping and Bleaching

COURSES TAUGHT

- BPE 335, Transport Phenomena
- PSE 465, Paper Properties
- PSE 466, Paper Coating and Converting
- ERE 596, Discover Lignocellulosics I: Chemistry
- ERE 496, Introduction to Lignocellulosics

PUBLICATIONS


Goundalkar, M., Bujanovic, B. and Amidon, T. (2010):”Lignin in hot-water extraction of hardwoods,” ESPRA Research Report Number 133, ESPRI, SUNY-ESF: Ch.4.31-46.
SUMMARY

Teaching: In this reporting period, I have been teaching science and engineering courses which belong to both undergraduate (Paper Properties, Coating and Converting, Transport Phenomena and Introduction to Lignocellulosics) and graduate curricula (Paper Properties and Discover Lignocellulosics I: Chemistry, Research in Paper Science Engineering, and Doctoral Thesis Research) at our Department. The Introduction to Lignocellulosics course was introduced for the first time in the fall of 2010 as an experimental course and was taught in cooperation with Dr. Francis and Dr. Lai. This spring, the PSE223 Introduction to Lignocellulosics has been accepted by ESF COI as an undergraduate course.

Research: My research group has continued working in the following areas: 1. characterization and evaluation of the potential use; production of adhesives and antioxidizing agents, of non-carbohydrate material dissolved during HWE; 2. development of disassembling methods for wood; 3. use of PLA, a designed biorefinery product in paper reinforcement. Grant proposal activity: In the summer of 2010, I submitted two proposals as a PI: NSF Early Career “CAREER: Development of a sequential disassembling of wood for the production of chemicals, and materials, and energy,” ($420,344); an invited proposal based on the letter of intent: USDA-NIFA-AFRI-2010 “Valorization of Lignin, Lignin Degradation Products, and Extractives within a Biorefinery Based on HWE of Northeastern Hardwood Biomass” ($991,902) (neither funded). In the fall of 2010, as a co-PI, I submitted McIntire-Stennis letter of intent which was approved for the submission of the full proposal (“Novel green adhesives from the ESF Biorefinery”) ($53,497; not funded). I was a part of an industrial-academic group (Andritz, ABS, Cobalt, INL, NCSU, SUNY-ESF) in which I represented SUNY-ESF. This group submitted a pre-application for Biomass Research and Development Initiative (BRDI) “Flexible Lignocellulosics based Production System and Processes for Biofuel and Bio-products” (TPC $18,150,000) in summer of 2010 (letter of intent; not invited). I submitted a proposal in the area of “Formaldehyde-free resin/binder/adhesive technology” to Nine Sigma. I also submitted two seed grant proposals; 1. PI (“Enzymatic polymerization of phenolic compounds from hot-water extract of hardwoods”); 2. co-PI (“Lignin-based green adhesives from the ESF biorefinery”) (each $8,000; neither funded). This spring, I have been a member of an ESF team which submitted a proposal to DE-FOA-0000337: “Integrated process improvements for biochemical conversion of biomass sugars” (TPC: $9,829,021) (PI: Dr. Amidon). I contributed to an ESF letter of intent to BRDI (5/27/2011) (“Integrated Production and Utilization of Willow Biomass and Forest Hardwoods for Biofuel and Bioproduct Production in Biorefineries”) (PI Dr. Stipanovic) (TPC $7,931,998).

Outreach activities: Representing our College at Conferences: oral presentations: TAPPI PEERS October 2010; 241st ACS Anaheim, March 2011 (invited oral presentation); PaperCon 2011 May 2011; 16th ISWFPC, a prestigious conference in the area of wood, fiber, and pulping chemistry (Tianjin, P.R. China, June 2011); poster presentations: 240th ACS Boston August 2010. My research group has been invited to present our results at the 242nd ACS (Denver, Colorado) in August of 2011. Representing our College in science and engineering literature: 1. along with Dr. Amidon and M. Goundalkar, I have been a co-author of the chapter “Biorefinery with Water” in “The Role of Green Chemistry in Biomass Processing and Conversion” book (John Wiley & Sons; submitted); 2. I have been invited to write a chapter on PAPER for the new edition of Encyclopedia of Science and Technology (McGraw Hill).

Service: I have been a member of Graduate and Undergraduate Committees at our Department and a member of APT and By-laws subcommittees. I have been a Recruitment Committee Chair for two years now and in this capacity, I have been coordinating several recruitment events at SUNY-ESF and other institutions. I have been a major professor to two PhD students and a co-major professor to three students. I have been serving in steering committees for several students at our Department. I have been providing a peer-review service for several journals, e.g. BioResources, J. Biobased Materials and Bioenergy, and Industrial & Engineering Chemistry Research.
RESEARCH AREAS

- Papermaking and related processes
- Paper fillers
- Paper recycling
- Constructed wetlands
- Water treatment systems
- Bioenergy

COURSES TAUGHT

- PSE 300, Introduction to Papermaking
- PSE 468, Papermaking Processes
- ENS 797, Environmental Science Seminar
- PSE 498, Research Problem
- BPE 498, Research Problem

PUBLICATIONS


SUMMARY

In academic year 2011/2011 I have started self funded research projects to compensate for the economic downturn in the paper industry and to attract industry funding. A first result is a student fellowship through the SUNY-ESF College Foundation from a company called Lhoist, the world largest lime supplier. The graduate student working on this project started May 15th. I also have been successful in obtaining funding to support my research efforts. I received a DOE Grant of $298,000 which supported 3 graduate students this year. I also was successful in getting funding for my research project with the Village of Minoa. The Village received $307,000 in funding from the New York Environmental Facility Corporation from a grant I have written with my colleague David Johnson. The grant will fund modification of existing wetlands, anaerobic fermentation and composting system.

The summer, fall and spring semester continued with work on my Department of Energy grant as well as my research projects in bleaching and gasification as well as sustainable bioenergy and cleanwater research at the Village of Minoa, implementing a outreach component with the East Syracuse Minoa (ESM) School District for K-12 high school students. This fall and spring semester I had 5 ESM high school students working on the projects. In addition I am planning to expand the outreach activities in the area of papermaking for the 2011/2012 academic year.

In the past academic year I have been directly involved in acquiring funding for research. I have written a total of 27 grant proposals, 17 as principal project investigator, 7 for international student funding through the German exchange agency DAAD, and 3 as part of a consortium. 7 of the applications are still pending. Total funding was $25,972,339, with a funding request of $20,088,397.

The total funding grant request in detail is as follow:

- pre-applications $21,898,002, with a funding request of $17,482,483, pre-applications pending $13,153,179 with a funding request of $10,491,882,
- grant application $4,074,337 with a funding request of $2,605,914
- grant proposals pending $2,320,613 with a funding request of $1,226,260
- funded applications $579,500 including DOE grant of 248,000

I was appointed as undergraduate and graduate curriculum group participant in the Division of Environmental Science in the area of Renewable Energy, Environmental and community Land Planning, Environmental Systems & Risk Management, and Water & Wetland Resource Studies.

I am also involved actively in committees, both at the department and College and SUNY-Level. My primary involvement has been in the area of undergraduate education, recruiting and maintenance committees at the department level. At the college level I was involved in Faculty Governance, as Chair of COI and member of the Academic Standards Committee. At the SUNY-Level I have the privilege to represent SUNY-ESF as Senator at the SUNY-Senator meetings.

It is my hope that this brief summary demonstrates my high level of achievements in the past academic year. Plans for the 2011/2012 academic year are (i) acquire funding for research, (ii) improving the PSE200 Introduction to Papermaking, PSE468/668 Papermaking Processes based on student review, (iii) start assembling new paper program courses PSE 552 Fiber Materials Recycling and Processes and PSE 437/637 Equipment Troubleshooting & Maintenance. (iv) design a exchange program with the University of Munich for grad and undergraduate students that is part of the PBE curriculum, (v) work on the Paper Engineering program ABET accreditation that will come up in summer of 2012, (vi) implement and improve my outreach activities with the ESM School District and, (vii) implement a paper program outreach component at the Institute of Technology at Syracuse Central, Levy School.
RESEARCH AREAS

- Wood chemistry
- Pulping and bleaching
- Biobased materials

COURSES TAUGHT

- BPE 441, Biomass Energy
- PSE 436, Pulp and Paper Unit Operations

PUBLICATIONS


15 kW photovoltaic array on the pilot plant roof of Walters Hall.
SUMMARY

The significant activities and accomplishments of Dr. Raymond C. Francis in 2010-2011 were primarily related to research activities and graduate student stewardship. Dr. Dipankar Kanungo graduated with a PhD in December 2010 and co-authored three refereed publications with another one imminent (next issue of the J. Wood Chem. & Technol.). Mr. Attiogbe has two refereed publications with two others already granted final acceptance while Ms. Alves already has three and data for at least three more.

Dr. Francis was invited to give a special lecture at the recent International Colloquim on Eucalyptus Pulp (ICEP) in Porto Seguro, Brazil with all of his expenses including miscellaneous expenditures paid by the Conference organizers. His submission to the 16th International Symposium of Wood, Fiber, and Pulping Chemistry (ISWFPC) in Tianjin, China (June 8th – 10th) was granted early acceptance for oral presentation. At the ICEP, the Evonik division of Degussa Corp. gave a presentation on the D/Pm bleaching technology that they are developing. Construction of a pilot plant for M (molybdate) recovery is reported to be almost completed. At the conference, Degussa referred to the basic principle behind the technology as the Francis process.

Procurement of research funding will be one of Dr. Francis’ top priorities in 2011-2012 and a $200,000 pre-proposal was submitted to USDA on June 1, 2011. Dr. Francis is PI with co-PIs from Utah State, Iowa State and the Northern Research Station of the US Forest Service.
William Burry
Instructional Support Specialist
Paper and Bioprocess Engineering

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B.S. (1974), SUNY-ESF, Forest Biology
M.A.T. (1999), SUNY-Cortland, Science Teaching

RESEARCH AREAS

• Particle surface energetics
• Ambient air monitoring data analysis
• Hazardous waste site remediation
• National energy supply processes

COURSES TAUGHT

• PSE 201, The Art and Early History of Papermaking
• PSE 302, Pulp and Paper Laboratory Skills
• PSE 351, Pulping and Bleaching Laboratory Skills

PUBLICATIONS


Papermaking demonstration for Ed Smith 1st graders.
SUMMARY

My instructional and research activities both supported and advanced the college’s and department’s mission during this past academic year. My undergraduate research is not funded by grants and as such falls below the traditional radar screen. Because of the non-traditional nature of this research, I must be proactive in advancing novel ways of utilizing our natural and engineered renewable resources into pulp and paper production as an integral part of classroom instruction or more precisely into laboratory and pilot plant instruction. All this requires collaboration among multiple instructors and courses for which I lead students in my courses preparing the material for papermaking in subsequent coursework. A New Technology Disclosure for a Willow Paper Product (May 2010) made by our students from the College’s Tully Campus shrub willow and a presentation at the PTS Papier Symposium 2010 (September) in Munich, Germany were fruits of previous student research. A paper product made from invasive common reed material was investigated during this 2010-11 academic year. The particular reed material chosen was from the test bed cells of the Minoa Municipal Wastewater Treatment Facility – a research study in itself. Fruits of this student research may take longer to ripen since paper made from reed is certainly not novel. However, the scope of this research is novel with far-reaching potential for making use of this aggressive specie either in its’ invasive ‘natural’ environment or in its’ engineered water treatment environment.

The potential to take student research on reed material one giant step further exists within BPE. I will begin this coming academic year to collaborate with additional instructors and their coursework to investigate the potential for undergraduate student research in a hot water extraction of reed for recovery of useable biochemicals prior to my course work where students would prepare the resulting cellulosic reed material for papermaking.
Wayne S. Amato, P.E.

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Paper and Bioprocess Engineering

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B.S., Ch.E. (1963), New Jersey Institute of Technology, Chemical Engineering
M.S. (1965), SUNY-Buffalo, Chemical Engineering
Ph.D. (1970), Syracuse University, Chemical Engineering

RESEARCH AREAS

- Process control
- Thermodynamics
- Heat transfer
- Gas absorption
- Rheology/mechanics of materials
- Applied mathematics

COURSES TAUGHT

- PSE 477, Process Control
- PSE 361, Engineering Thermodynamics

SUMMARY

During the 2010 – 2011 academic year, I taught Process Control and Engineering Thermodynamics. I maintained my professional engineering registration by completing 36 professional development hours. I gave a lecture to new students on Engineering Ethics. I participated in and updated ABET materials for upcoming accreditation activities.
#1 Papermachine in the pilot plant in Walters Hall.

Paper recycling equipment in the pilot plant in Walters Hall.
RESEARCH AREAS

- Carbohydrate chemistry
- Pulping chemistry

COURSES TAUGHT

- PSE 350, Pulping and Bleaching Processes

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Paper and Bioprocess Engineering

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A.B. (1960), Ripon College, Chemistry

Flotation deinking cell in the Walters Hall pilot plant.
### OTHER FACULTY AND STAFF

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**Christopher T. Nomura**
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- Ph.D., Pennsylvania State University

**Jose Iribarne**
- Ph.D., SUNY College of Environmental Science and Forestry (Paper Science and Engineering)
- Teaching: Engineering design

**William Holtzman**
- B.S., Pennsylvania State University
- M.S., Ph.D., Institute of Paper Chemistry

**Fermentation laboratory in Walters Hall (Walters 204).**
View of Walters Hall and the Robin Hood Oak and the new parking lot.

Papermaking demonstrations at the New York State Fair.
View of paper artwork throughout Walters Hall.