DIRECTOR’S MESSAGE

Hello from Washington University in St. Louis! The Environmental Engineering Science Program is off to a great re-start! I joined my new colleagues in August 2000 and we have embarked on several new initiatives.

• The Jens Professorship Installation Ceremony and the “Environmental Challenges and Responses” Symposium, organized by the Alumni of the Program was held in October on the campus of Washington University. The Symposium was presided by Prof. Otis Sproul, Dean Emeritus, Univ of New Hampshire, and the keynote lecture was given by Dr. Subhas Sikdar, Director of the Sustainable Technology Division, USEPA. Presentations and Panel Discussions by Alumni were followed by an outlining of the highlights of the Program by the Faculty.

• The existing Program Curricula was reorganized to address the future needs of the discipline. The Undergraduate Minor in Environmental Engineering Science was designed with a set of well connected and integrated courses. We have initiated a Summer UG Environmental Research Internship Program. The M.S. and D.Sc. Programs were also streamlined - and details are available on our website - www.env.wustl.edu/envdeg.htm

• Establishment of several named scholarships to support graduate student education. See page 3 for details.

• An Industrial Partners Group has been set up, see back cover for details. Features include opportunities for collaborative research, graduate student internships, and an Annual Open House on Campus wherein highlights of research activities for the past year will be presented.

• A weekly Friday Seminar Series in the Fall and Spring Semesters has been initiated with presentations by invited speakers and our graduate students.

• To obtain critical mass in the focal areas of the Program, a National search is on for two faculty members.

• A collaborative program with major support from the Boeing Foundation involving Boeing, Delft University and Washington University is being finalized.

We are very pleased with the support of and feedback received from the Alumni. We are proud of all your achievements, and would like you to be an integral part of our Program as we move ahead in the years to come. I personally invite you to visit our Campus, and will be glad to show you around. Due to the generosity of the Edgerly family, and the initiative taken by Dr. Ryckman, we have been able to obtain copies of all Alumni Theses, which will soon be displayed in the Library in our Conference Room. I hope you enjoy the first edition of EnviroNews, and please look out for upcoming Newsletters. It has been an exciting first six months, and I look forward to working with my colleagues and you all in the years ahead to make this a top ranked Environmental Engineering Program.

~ Pratim Biswas

DEAN’S MESSAGE

In 1995, the School of Engineering and Applied Science put together a strategic plan to guide the School into the 21st Century. Known as Project 21, the plan states, “Our vision as a school is to provide international leadership in key selected areas of engineering education and research. We will build and enhance a few world-class programs by focusing resources on quality engineering education and on innovative and important research in four key areas.”

I am pleased to say that environmental engineering science is one of four areas identified to establish the School as a world leader in engineering education. I am personally pleased to see the revitalization of this program and the promise it brings to addressing some of the critical environmental issues of our time through education of students and research.

I am proud to have Dr. Pratim Biswas as the director of our Environmental Engineering Science Program. Dr. Biswas has a proven record of leadership, vision, scholarship activities and professional involvement. I believe that under his direction, Washington University will once again become an international leader in this field.

~ Chris Byrnes
The Environmental Engineering Science Program, Washington University in St. Louis invites nominations and applications for two junior level faculty positions with tenure track appointments in Chemical and/or Civil Engineering. Details on areas of research and teaching, and the advertisement for the positions can be viewed at www.env.wustl.edu.
The Environmental Engineering Science Program at Washington University provides an integrated engineering and scientific education for individuals focusing on the improvement and management of the quality of the environment. The Program is interdisciplinary and is supported by three Departments: Chemical, Civil and Mechanical Engineering. The interdisciplinary structure enables the incorporation of several engineering specialties along with science, regulatory, law and management aspects of this challenging field. The three major focal areas of the program are:

- **Aerosols and Air Quality**
  This specialty focuses on the fundamental mechanisms that control the physics and chemistry of air quality. The emphasis is on specialized study in aerosol science and engineering, ambient air quality encompassing atmospheric chemistry, combustion processes and air pollution control.

- **Water Quality**
  This specialty focuses on the fundamentals, design and operation of the physical, chemical and biological processes used in the treatment of water and wastewater, industrial and hazardous waste. The group also focuses on the transport of contaminants in the subsurface.

- **Sustainable Technology**
  This specialty focuses on the development of new environmental technologies and environmentally benign processing methodologies. The emphasis is on an understanding of processes at the atomistic or molecular scale. This group also focuses on the legal and policy aspects of new and existing environmental technologies.

### DEGREE PROGRAMS

#### Undergraduate Minor in Environmental Engineering Science

The Minor is available to any student receiving any of the Bachelor of Science degrees offered by the School of Engineering & Applied Science, or the environmental studies degree offered by the College of Arts and Sciences.

#### M.S. in Environmental Engineering Science

- 15 units of core classes
- 9 units in a specialty area (Aerosols and Air Quality; Water Quality or Sustainable Technology)
- 3 units in Environmental non-specialty area
- 6 units of Thesis

#### D.Sc. in Environmental Engineering Science

(Requirements after the B.S. Degree)

- 36 units of course work (27 in Env areas, 9 in non-major area)
- 36 hours of research
- Qualifying Examination (based on Env MS Core Classes & Specialty Area) taken in May (first year)
- Proposal Defense (by end of 2nd year)
- Thesis Defense (when done)

### Scholarships

The Environmental Engineering Science Program at Washington University has several named scholarships that are awarded to meritorious incoming students.

#### Scholarship Donors

- Charles A. Buescher Jr. Scholarship
- The Envirsan Scholarship
- Charles and Marlene Buescher Endowed Scholarship
- The Edgerley Scholarship
- Cecil Lue-Hing Scholarship
- Henry and Marjorie Reitz Scholarship
- The Schwartz Scholarship
- Suburban Suns Carting Scholarship

#### Year 2000 Recipients

- Zhengkai Li
- Chul Han Kim
- Megan Yu
- Robert Downer
- Sun Zhen
- Garima Bhatia
- Pramod Kulkarni
- Yanhui Yang

In addition, the Program has several Research Assistantships that are available for the students to work on their Thesis research. Applicants can use an online application form at [www.env.wustl.edu/online.htm](http://www.env.wustl.edu/online.htm).

Megan Yu, receiving the Charles and Marlene Buescher Endowed Scholarship, at the October 2000 Scholarship Awards Dinner.
In 1997, the U.S. Environmental Protection Agency (EPA) promulgated a National Ambient Air Quality Standard for airborne fine particles (PM-2.5). In addition to implementing a nationwide monitoring network to determine compliance with this standard, EPA is also funding several large-scale studies to shed more light on the nature and sources of fine particles. The St. Louis metropolitan area soon will know more about the physical and chemical characteristics of its airborne particulate matter thanks to a $3.5 million grant from the EPA. Jay R. Turner, Associate Professor of Chemical Engineering and Civil Engineering and director of Washington University’s Air Quality Laboratory, is principal investigator of the project, which will monitor fine particulate matter air pollution at one core site and two satellite sites in metropolitan St. Louis.

Other University researchers involved in the project, all veteran air pollution researchers, are Edward S. Macias, atmospheric chemist and Executive Vice Chancellor and Dean of Arts & Sciences; Bret Schichtel, formerly a Research Associate with the School of Engineering’s Center for Air Pollution Impact and Trend Analysis (CAPITA); and Warren White, Research Associate in Chemistry and a CAPITA researcher. Collaborating institutions include the University of Minnesota, University of Wisconsin, University of Maryland, Harvard School of Public Health, and the Desert Research Institute of the University of Nevada.

The project began in January 2000 and runs through December 2003. Commencing in April 2001, researchers will make sustained measurements of numerous aerosol physical and chemical properties with time resolution ranging from a few seconds to days, depending on the measurement type. The final two years of the project will be devoted to chemical characterization of certain collected samples, data analysis and reporting on results.

Particulate air pollution measurements - the focus of the St. Louis “Supersite” - will be integrated with three large health effects programs. The purposes of these separately funded studies include investigating relationships between different pollutants and human illnesses ranging from cardiovascular disease to pulmonary illnesses; investigating the relative toxicity of the different particle types; and identifying susceptible populations.

“The study is designed to support a range of data needs,” Turner said. “For example, the scientific community will benefit from such a detailed study of air pollutant levels, personal exposure and health ramifications. This will help EPA set appropriate air quality standards.

“There also are immense benefits for the Midwest in general and the St. Louis region in particular,” Turner added, “as we will have a better grasp of our particulate matter air pollutant burdens and their impacts on human health.”

Sampling instruments of various types will allow researchers to detect and monitor numerous particle properties, including their size, mass and chemical composition. “The particles that we’ll capture contain significant information regarding their nature and origin, but the information is often a very noisy signal,” Turner said. “We have very sophisticated equipment to sort the information out.

“In conjunction with similar programs to be implemented in New York City, Baltimore, Pittsburgh, Houston, Los Angeles and Fresno, California, we hope to arm the scientific community with an enhanced understanding of particulate matter air pollution sources, transport and effects.”
Anaerobic Bioremediation of Floating Vegetable Oil Spills

Brian A. Wrenn, Zhengkai Li, Robert Downer, and Demian Wincele

Vegetable oils and animal fats are among the most common organic materials that are accidentally released into the environment in the United States. Like spills of petroleum products, vegetable oil spills result from shipping accidents (e.g., barges and rail cars), pipeline breaks, and failure of storage tanks. Some of these accidents can result in releases of large volumes of these materials to surface waters, including rivers, lakes, and harbors. Although vegetable oils are not as acutely toxic as many petroleum products, uncontrolled releases can result in significant environmental damage due to oiling of aquatic birds and mammals and rapid depletion of dissolved oxygen (especially in fully or partially enclosed freshwater bodies). Although they are usually considered to be readily biodegradable, chemical oxidation of vegetable oils can lead to the formation of varnish- or gum-like coatings on oiled surfaces that can persist in the environment for years after a spill. For these and other reasons, there is a great deal of interest in understanding the behavior of vegetable oils in freshwater environments following large uncontrolled releases and in developing rapid, inexpensive response alternatives that can be implemented by facilities that store, use, or transport large quantities of these materials.

Our research, which is attempting to determine whether clay-oil flocculation can be used to convert floating vegetable oil to a form that will settle out (i.e., during growth of oil-mineral aggregates). Each of these factors was set at two levels—high and low—in each of eight experimental treatments, and each treatment was replicated four times. The results, showing the effect of each factor and the interactions between factors are shown in Figure 1.

Sedimentation of floating vegetable oil was investigated using a fractional factorial experimental design to determine which of four factors were most important to the sedimentation of floating oil.

- First, to demonstrate that floating vegetable oil can be converted to a negatively buoyant form by interaction with clay or other natural particles, and second, to show that vegetable oil is biodegradable under anaerobic conditions in freshwater sediments.

Sedimentation of floating vegetable oil was investigated using a fractional factorial experimental design to determine which of four factors were most important to the sedimentation of floating oil. The four factors that were investigated included (1) addition of a coagulant (ferric chloride), (2) addition of clay, (3) the mixing energy during dispersion (i.e., the initial contact between the oil and clay), and (4) flocculation mixing energy (i.e., during growth of oil-mineral aggregates). Each of these factors was set at two levels—high and low—in each of eight experimental treatments, and each treatment was replicated four times. The results, showing the effect of each factor and the interactions between factors are shown in Figure 1. The only treatments that were statistically significant were clay, the presence of which increased the amount of oil transferred to the sediments, and the dispersion mixing energy, high levels of which decreased the amount of oil transferred to the sediments. A significant negative interaction between two treatment factors was also observed. Unfortunately, this experimental design does not allow us to distinguish interactions between clay and dispersion mixing energy from interactions between coagulant and flocculation mixing energy. We interpret these results to indicate that the initial contact between dry clay and oil is critical to the formation of negatively buoyant aggregates and that wetting of the clay by contact with water reduces its ability form these aggregates. These interactions between oil, water, and clay are currently being subjected to a more detailed investigation.

**Figure 1:** Effects of coagulant (FeCl	extsubscript{3}), clay, and dispersion and flocculation mixing energy on the amount of floating vegetable oil that was transferred to the sediments in a series of jar tests. Only effects that are greater in absolute value than the 95% confidence interval are statistically significant. The effects of interacting factors (e.g., Fe/clay indicates a potential interaction between coagulant and clay) are shown by the three categories furthest to the right. Only the interaction between clay and dispersion mixing energy (or between coagulant and flocculation mixing energy—the experimental design is incapable of distinguishing between these two types of interactions) is statistically significant.
a message from otis sproul

Approximately two years ago, Dean Chris Byrnes spoke with me about the School’s plan to re-establish the Environmental Engineering program as one of the premier programs in the country. At that time, Dean Byrnes asked me to form a committee of Envirsan graduates to consider a response to a critical need in the environmental engineering program - financial support for graduate students. I thank Charles Buescher Jr, MS 61; Ellen Lee, DSc 69; Cecil Lue-Hing, DSc 66; Gerry Schwartz, MS 62 and Jack Stein, MS 69 for agreeing to serve on the committee.

The committee reacted positively to the Dean’s request and established a goal of $1 million to endow fellowship support for graduate students. As a graduate of the environmental engineering program, you are a valuable resource. During upcoming months, you will be visited or contacted by a fellow graduate to discuss the revitalized program and how you can be of help. We will obviously need the assistance of many beyond the committee for this work. I appreciate your consideration and willingness to be involved in this effort when you are approached.

Given the added value in our lives from our Washington University education, and the clear need in the environmental engineering program, the committee felt their fellow graduates would each do their share to meet the $1,000,000 goal. I appreciate your willingness to participate in this effort and feel confident you will find it rewarding to work together again to build an even stronger program. I will keep you posted as the campaign moves along. Your ideas and thoughts are always welcome.

If you are an Alumnus of the Environmental Engineering Science Program, please make a copy of this page, fill out the appropriate information and fax to (314) 935-5464 or mail to:
Washington University in St. Louis
One Brookings Drive
Campus Box 1180
St. Louis, MO 63130

This form is also available on-line at www.env.wustl.edu.

Name: ____________________________________________
Address: _______________________________________
City: __________ State: __________ Zip: _________
Phone: _________________________________________
Fax: ___________________________________________
E-mail: _______________________________________

Year of Graduation: __________ Degree: ___________


Dr. M. Marjamaki, Dr. Keskinen, Dr. Pui, D. Y. H., Dr. Chen, Da-Ren, Dr. Wu, C. Y., Dr. Zhuang, Y., Dr. Lee, T. G., Dr. Kim, Y. J., Dr. Biswas, P., Dr. Wang Z.M., Dr. McMurry, P. H., Dr. K. S. Woo, Dr. R. Weber, Dr. Chen, Da-Ren, Dr. Pui, D. Y. H., Dr. Wu, C. Y., Dr. Zhuang, Y., Dr. Lee, T. G., Dr. Kim, Y. J., and Dr. Biswas, P.: “Experimental and Theoretical Studies of Ultra-Fine Particle Behavior in Electrostatic Precipitators”, J. of Electrostatics, Vol. 48, Nos. 3-4, 245-260, 2000.


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An Industrial Partners Group has been established in the Environmental Engineering Science Program at Washington University in St. Louis. The objectives are to provide access to cutting edge, state of the art research and developments in Environmental Engineering and allow interaction of faculty and students with counterparts in the Industrial sector.

**Why be a member?**

- Participate in fundamental and applied research projects at Washington University
- Technology transfer of novel developments
- Access to state of the art research facilities
- Pooling of Industrial Funding with Federal Research Funding
- Specialized Training Programs for Industrial Sponsors
- Access to Graduate Student Interns who will participate in Industrial Research and development as part of the Degree Program
- Opportunity to collaborate with Faculty in areas of mutual interest
- Participate in an Industrial Advisory Board for the Program
- Annual Meeting at Washington University where results of current research will be discussed
- Annual Newsletter highlighting key research projects, list of publications, list of current and graduated students

The annual membership fee is $3000 (checks payable to: Washington University, mailed to address below). Please contact us if you need any additional information (env@seas.wustl.edu), or call 314-935-5548.