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Susan Hennessey Uses Pink Beads Make a Greener Solvent

DuPont Chemical Engineer Susan Hennessey, a 16-year company veteran, is using pink beads the size of lentils to produce DuPont™ Xolvone™, a readily biodegradable solvent for cleaning metals and electronic parts such as computer circuit boards.

The beads â• " bacteria cells encapsulated in a gel â• " are proving to be a highly efficient way to convert MGN, a co-product from the manufacture of nylon, into Xolvone™. Enzymes in the encapsulated bacteria cells cause a reaction that creates a molecule unique to DuPont. Because the bacteria cells are only two to three microns in diameter (a micron is one-thousandth of a millimeter), encapsulation makes them easier to handle.

The encapsulated cells are agitated for a few hours in a resin kettle (shown in photo) or other reactor vessel containing the MGN. As the liquid passes through the beads, it reacts with the bacterial enzymes to become a new compound and then exits the beads, leaving them intact. Because the enzymes are not consumed in the course of the reaction, the beads can be used again and again.

This is the second time Susan has used encapsulation to produce a new product. She previously used encapsulation in the production of the specialty herbicide MilestoneÂ® for the DuPont Crop Protection business.

"Encapsulation has been widely written about and applied in academia, but it's rarely been used in manufacturing," Susan notes. "In situations where a biocatalyst is superior to a chemical catalyst, encapsulation can make it cost-effective, too." Advantages of biocatalysts include their specificity, which means they create less waste than chemical catalysts. In addition, the enzymes react in water at lower temperatures, making the reactions more stable and less toxic than a reaction in an organic solvent. The result is better yields and fewer impurities than the chemical route.

About Susan Hennessey

A native of Baltimore, Md., Susan started her DuPont career in Towanda, Pa., with the Photo and Imaging products business in 1986 and later moved to Tech Services for the Electronics business in Wilmington, Del. In 1990, she joined DuPont Crop Protection where for 10 years she worked in process development and scale-up for herbicide manufacture. Her work has included commercialization of the rice herbicide GulliverÂ® and the bioprocess to form 5-cyanovaleramide, an intermediate in the specialty herbicide MilestoneÂ®. Her interests also include reaction calorimetry and lab automation to facilitate process development. In 2000, she transferred to DuPont Central Research and Development, joining the biological science and engineering group working on enzymatic reactions.

She received a bachelor of science degree in chemical engineering from Widener College in 1986 and a master of science degree in chemical engineering from the University of Delaware in 2001. She and her husband, Craig, also a DuPont chemical engineer, have three children.

As a chemical engineer, Susan plays a special role in bringing useful products to market. "At DuPont, I work with some of the world's leading scientists," she says. "After they make a discovery in the laboratory, I figure out how to actually apply it to improve our products and the methods we use to make them."

About DuPont

Gel beads make a greener solvent

ED LALLO

Susan Hennessey, who has worked for DuPont for 16 years, has successfully encapsulated biocatalysts to make new products.

Susan Hennessey, EG 2001M, of Avondale, Pa., is using biotechnology to make cleaning products that are safer for the environment.

A chemical engineer with the DuPont Co., Hennessey is working on a process that utilizes biocatalysts and encapsulation to make biodegradable solvents useful for cleaning metals and computer circuit boards.

A catalyst increases the rate of a chemical reaction without itself undergoing any change. Encapsulation is the process in which biological substances—in this case bacterial cells—are enclosed in gel beads so they can serve as catalysts and then be recycled to be used again and again.

"Encapsulation has been widely written about and applied in academia, but it's rarely been used in manufacturing," Hennessey says. "In situations where a biocatalyst is superior to a chemical catalyst, encapsulation can make it cost effective."

Biocatalysts are more specific, creating less waste than chemical catalysts, she says, and the enzymes react in water at lower temperatures, making the reactions more stable and less toxic.

Currently, Hennessey is working on a more environmentally friendly cleaning product for metals. It is a biodegradable, clear colorless liquid with a mild odor, good chemical stability and low toxicity. It also has better solvency properties that make it a more efficient product, she says.

The bacterial cells encapsulated in a gel cause a reaction that converts MGN, a co-product from the manufacture of nylon, into a unique product that DuPont has named Xolvene.

Before she joined the biological science and engineering group working on enzymatic reactions in 2000, Hennessey worked in crop protection and central research and development at DuPont. That group used encapsulation to make two new herbicides. The new encapsulation techniques reduced the amount of catalyst waste by a thousandfold, simply by changing from a heavy metal catalyst to the biocatalyst, she says.

With an undergraduate degree from Widener University, Hennessey has worked at DuPont for 16 years. She started taking chemical engineering classes at UD in the fall of 1994. At that time, she was working full-time at DuPont and was the mother of two. She had her third child in 1996, when she was almost halfway through completing her degree.

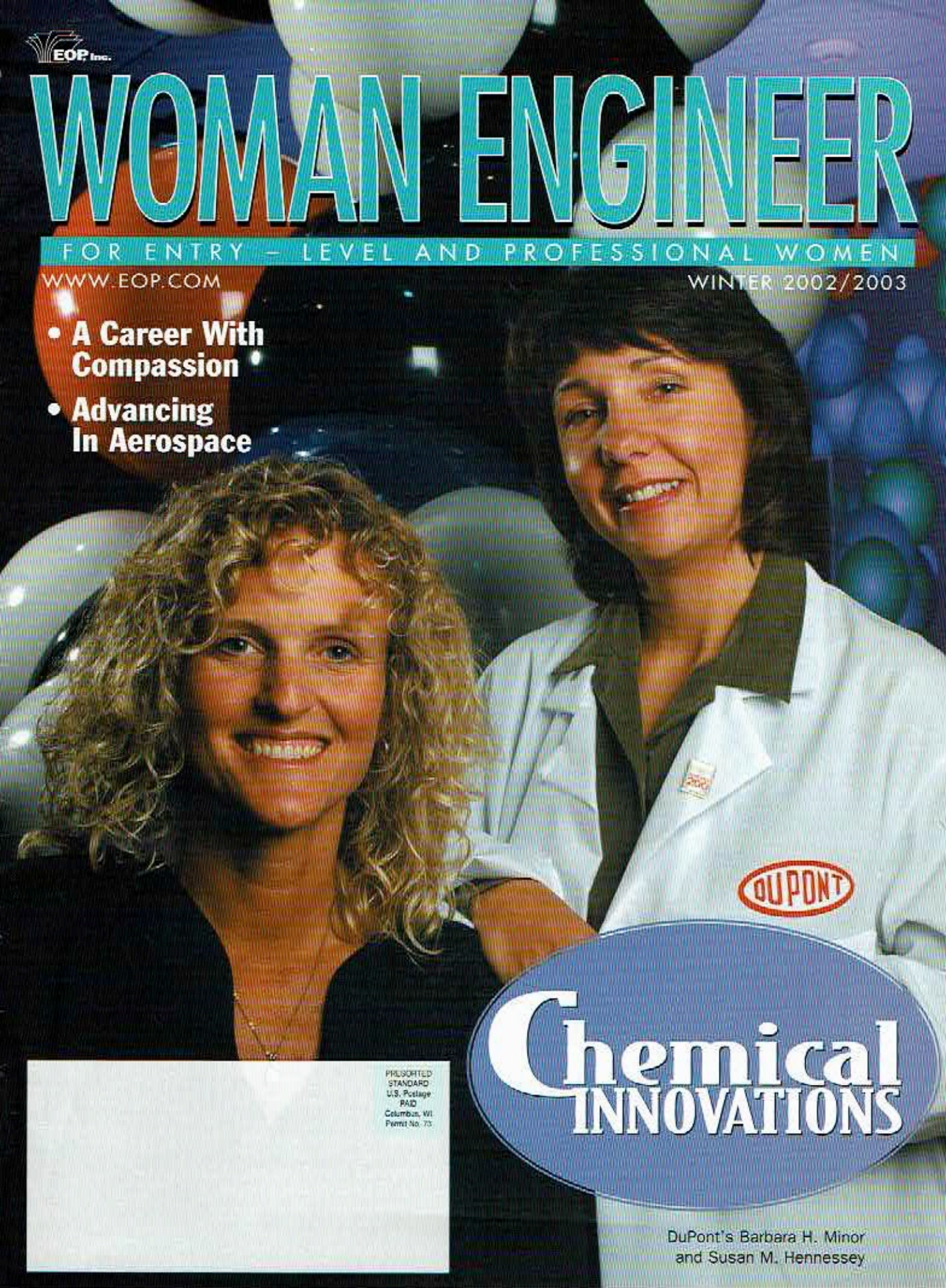
With her busy schedule, she took one class during the fall and spring semesters. She also opted to pursue a nonthesis master's degree.

Hennessey says that without help from Engineering Outreach director Kathy Werrell, she probably would have not been able to complete her degree.

"The department was extremely helpful in allowing me to work and attend class at the same time," she says.

She says her degree gave her a deeper understanding of the principles and theories of chemical engineering, which have made her a better engineer because she can more easily tackle projects.

—Tracy Ortiz, AS 2003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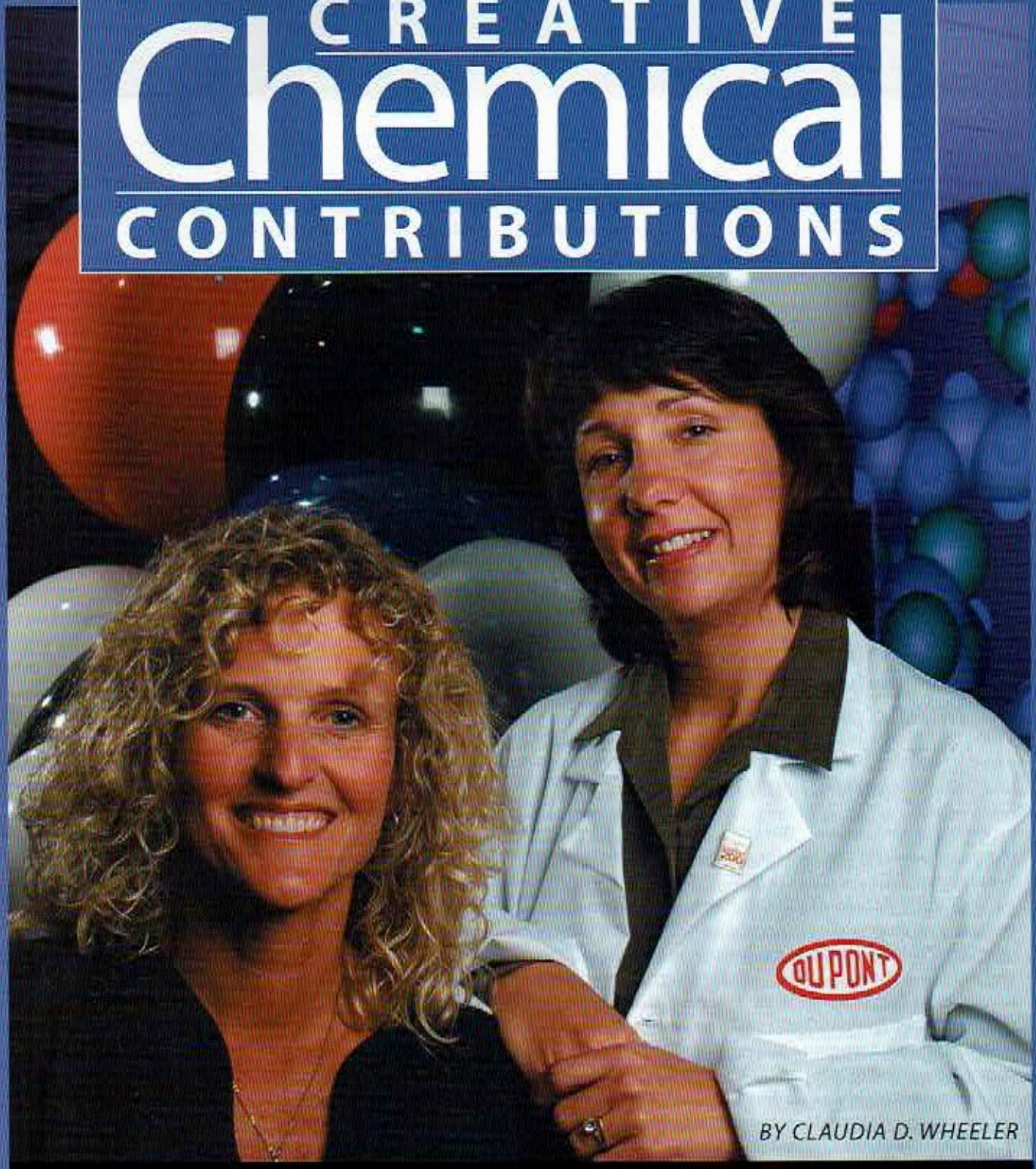

BY CLAUDIA D. WHEELER

Two Chemical Engineers Achieve Long-Term Career Success At DuPont.

Although chemical engineers Susan M. Hennessey and Barbara Haviland Minor have different specializations, they both share solid chemical engineering educational backgrounds and longtime, successful careers at DuPont, based in Wilmington, DE. In 2002, DuPont celebrated its 200th year of scientific achievement and innovation, providing products and services—in food and nutrition, health care, apparel, home and construction, electronics, and transportation—that improve people's lives.

Here, we celebrate the achievements and career successes of Hennessey and Minor as chemical engineers who have made strides at DuPont in the areas of biocatalysis and safer refrigeration, respectively.

SUSAN M. HENNESSEY

"I work in an area that is new and emerging," explains Hennessey, senior research engineer and 16-year DuPont veteran. "Biocatalysis using immobilized whole cells is a new area for the production of chemicals. It allows us to replace chemical processes with higher yielding and more environmentally friendly processes."

Hennessey earned her BS degree in chemical engineering from Widener College in 1986 and her MS degree in chemical engineering from the University of Delaware in 2001. She started her career in photo and imaging products at the DuPont Towanda, PA, site. Later, she moved to technical services for the electronics business in Wilmington, DE.

From the decade of 1990 through 2000, Hennessey worked as a process development engineer in crop protection chemicals business, her most interesting position at DuPont.

From the decade of 1990 through 2000, Hennessey worked as a process development engineer in crop protection chemicals business, her most interesting position at DuPont. One example of her work in herbicide process development and scale up is the commercialization of the rice herbicide, DuPont Gulliver. "The ability to take the process for manufacturing Gulliver from early in its development stage, and to learn, improve, scale up, and commercialize it, was highly rewarding," notes Hennessey, who enjoys the continuous learning that occurs when she is faced with new challenges and projects.

In 2000, Hennessey transferred to DuPont's central research and development organization, joining the biochemical science and engineering team who work with a multidisciplined group on enzymatic reactions. "We work as a team to discover and develop enzymatic routes to produce chemicals," details Hennessey. "When we find a biocatalyst that works, we immobilize the whole cell to stabilize the enzyme activity, to easily isolate the reaction mass from the catalyst, and to increase reactor productivity—all leading to an economical process."

Biocatalysts create less waste than chemical catalysts. Other pros to using biocatalysts are that the enzymes react in water at lower temperatures, lessening the environmental impact of the process. Biocatalysts also give better yields and produce fewer impurities.

Her advice to other women interested in engineering careers: "Go for it! Engineering is a great career with lots of opportunities, and, if you decide it's not for you, you still have a great background to start other careers."

BARBARA HAVILAND MINOR

"Engineering has advantages in that it provides a wide range of career opportunities," concurs Minor, senior research associate, refrigerants product development and technical service. "In my career, I have worked at plant sites supporting large manufacturing operations, in research developing new products, in technical service assisting customers with technical issues, and in business analysis."

After earning her BS degree in chemical engineering from Bucknell University in 1981, Minor worked at DuPont as a chemical engineer in technical services for customers of the company's titanium dioxide pigments business. Her next position was to provide technical service for DuPont's surface treatment products, such as DuPont Teflon.

All together, Minor has worked at DuPont for 20 years, more than half of which have been engaged in investigating hundreds of potential alternative molecules for refrigeration. Today, she has 46 U.S. patents for refrigerants.

Today, Barbara Minor has 46 U.S. patents for refrigerants.

At this year's International Refrigeration and Compression conference at Purdue University, Minor presented a paper about reducing greenhouse gas emissions from both residential and commercial buildings.

"In my current position, I interact with colleagues in many fields associated with ozone depletion and global warming, including HVACR [heating, ventilation, air conditioning, and refrigeration] industry customers, government organizations, universities, and industry committees," explains Minor. "What I like most about this position is the broad range of activities, including new product development, laboratory and field testing, helping our business

groups understand technology trends and the future impact on business, and assisting customers with the transition away from ozone-depleting chemicals."

According to Minor, one of her most interesting assignments was providing technical service for DuPont's Teflon carpet and fabric protection products. "The chemicals provide stain resistance to clothing and installed carpet after cleaning," says Minor. "I supported accounts such as Stanley Steamer and visited textile mills across the U.S. and Europe to assist in application of our products to fabrics. Also, I provided troubleshooting support and evaluated customer samples in our technical service laboratory."

Although Minor encounters many women engineers at DuPont, there are only a few in her field of air conditioning and refrigeration. More women will enter the field of engineering, suggests Minor, if they are encouraged as young girls. "Programs such as 'Take your Daughter to Work Day,' in which young women are exposed to engineering occupations, should continue, as should mentoring programs where experienced women engineers provide support and guidance to new women engineers," recommends Minor.

SUPPORT LEADS TO SUCCESS

According to Hennessey, DuPont supports its female engineers and encourages their career advancement. Engineers work in many areas—from management to sales, research and development, and tech service.

DuPont prefers to recruit chemical, mechanical, and electrical engineers, but also seeks out those graduates with materials, civil, environmental, and textile engineering degrees. To bring more women engineers into the company, DuPont recruits at career fairs, on college campuses, and at the meetings of professional associations such as the Society of Women Engineers (SWE).

"Our field engineering program conducts behavioral-based interviewing to assess candidates' technical and analytical, leadership, teamwork, and active learning skills, geographic flexibility/adaptability, motivation/drive, and ability to get results," notes Letha A. Hammon, manager of the DuPont field engineering program. "Technical experience is required and can be in the form of cooperatives or internship assignments." Once a candidate is hired into the field program, training begins immediately, according to Hammon.

DuPont also makes efforts to retain its women engineers. "DuPont gives women engineers real assignments with real responsibilities and holds them accountable for their results," states Deborah L. Grubbe, P.E., corporate director for safety and health, DuPont safety, health, and environment center, and leader of the healthcare safety initiative, DuPont safety resources business. "When I graduated with my BS degree in chemical engineering in 1977, I had 17 job offers, but I chose DuPont and the field engineering program because of the job and its challenges. I felt that my skills and results mattered more than my gender. DuPont has never disappointed me."

The company's benefits are outstanding and available to all employees. "We make it easier for our women engineers and their families to balance the time demands of career and care," adds Grubbe. Some of the benefits include flextime, flexplace, six weeks paid maternity leave and unpaid maternity leave for up to six months with return job guarantee, tuition reimbursement, and health and dental care, generous vacation time, and 401(k) plans.

"I felt that my skills and results mattered more than my gender. DuPont has never disappointed me."
—Deborah L. Grubbe

Grubbe also cites a unique global corporate women's network in which women employees share information on career opportunities, mentoring, and work/family balancing needs. "Over 2,300 women across cultures share and learn from each other via a database that receives over 1,700 hits per month and during five global conference calls per year," relates Grubbe.

Furthermore, women engineers at DuPont have advanced into positions such as group vice president, global operations director, engineering director, plant manager, technology director, global marketing manager, and corporate director. Many of them serve as mentors to younger women engineers.

Notes Grubbe, "DuPont's employees give of themselves to others. Over 60 women engineers and scientists participate in MentorNet, the E-mail mentoring process that pairs up women engineering students and practicing women engineers."

To learn more about DuPont, visit <www.dupont.com>.