



electronics update

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new UHP ammonia distillation plant in Korea on-stream

Air Products has completed construction on a new ultra-high purity (UHP) ammonia distillation plant in Ulsan, Korea. The new plant, which is now on-stream, will service the Asian and global electronics industry and will be operated by Air Products subsidiary Korea Industrial Gases (KIG). Air Products will continue to produce UHP ammonia at its Morrisville, Pa. and Hometown, Pa. facilities in the United States.

"The opening of our UHP ammonia distillation plant in Korea, our first in Asia, reinforces Air Products' position as the global leader in UHP ammonia manufacture and supply," said Mike Hilton, vice president, Electronics Business for Air Products. "As purity and volume requirements continue to rise for UHP ammonia, this technologically-advanced facility will allow us to better serve customers in this region and throughout the world."

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Air Products' new Ulsan, Korea UHP ammonia plant will serve customers in Asia and elsewhere.

Ermentrout honored with SEMI Akiri Inoue Award

Jerry Ermentrout, vice president and general manager of the Air Products' Electronics Division, has been honored with the 2005 Akira Inoue Award from SEMI, a global industry association serving equipment, material, and service providers of the semiconductor industry. The Akira Inoue Award, presented at SEMICON Japan in December, recognizes outstanding achievement in environmental, health, and safety (EH&S) performance in the semiconductor industry.



Jerry Ermentrout

"Under Jerry Ermentrout's leadership, Air Products' Electronics Division has achieved industry-leading status in environmental, health and safety performance while growing roughly three times in size," said Stanley Myers, president and CEO of SEMI. "Through his visionary business model, Jerry has established himself as a capable, responsible steward of the environment and demonstrated that companies can achieve outstanding financial performance while simultaneously protecting the health and safety of employees, customers, and neighbors."

Air Products' achievements cited by the Akira Inoue Award committee in the selection of Ermentrout include:

- Attainment of the lowest U.S. OSHA recordable injury rate among member companies of the American Chemistry Council from 2000 to 2003—at roughly half of the industry average.

- Implementation of a division-wide Basic Safety Process (BSP) that identifies hazardous situations to prevent accidents.
- Provision of turnkey operation of hazardous materials handling at customer sites, minimizing the potential for customers to come into contact with potentially harmful substances resulting in an average 93 percent reduction in incidents per container change since 1998.
- Annual reduction of 8.2 million pounds of hazardous wastes and an additional 20 million pounds of raw material and process gases at the world's largest specialty gas manufacturing facility at Hometown, Pennsylvania.
- Development of a fundamental understanding and advanced process analytical capability in support of NF₃ chamber cleaning, which led to a significant reduction of global warming gas emissions.

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electronic
specialty
gases



Carlsbad ESM facility receives environmental award



From left to right: John Kane, Diana Costantino, Rob Clark (holding the award), Randy Skow and Tom Ricketts pose with the award our Carlsbad ESM site received from California's Industrial Environmental Association.

The Industrial Environmental Association and the California Manufacturers and Technology Association presented an environmental responsibility award to the Air Products Carlsbad, Calif., site that manufactures a variety of ESM

products, including our line of Schumacher specialty chemicals.

Special challenges exist for the chemicals and allied products sector serving the semiconductor industry to achieve significant waste reduction. Specifically, customers of our Carlsbad site

have very stringent product specifications—impurities in the ppb range—that require very close attention to any changes made in facility operations.

Starting in 2003, Carlsbad ESM undertook a series of projects in all phases of their business operations to reduce their hazardous waste and reduce raw materials use.

Efforts included increasing the yield of TEOS distillation, which reduced TEOS hazardous waste generation by 6.6k pounds annually and lowered raw material usage by 22k pounds per year; selling off-spec TEOS, TCA, and Trans LC product to suppliers or third-parties, which reduced hazardous waste generation by 14k pounds a year; and reducing the

amount of isopropyl alcohol (IPA) used to clean stainless steel containers, which reduced IPA hazardous waste generation by 7.5k pounds annually.

Total efforts resulted in an overall reduction in the amount of hazardous waste generated by 49 percent when comparing year on year. The absolute annual reduction was 45k pounds. This reduction has also resulted in savings of \$25k for disposal expense, as well as a cost avoidance of more than \$50k yearly in raw material expense.

Robert Clark, Diana Costantino, John Kane, Mily Le, Raymond Skow, and Robin Meckling were on the award-winning team. Adjunct members included Albert Usherenko and Tom Ricketts. ▲

CONTACT: Randy Skow: skowrr@airproducts.com

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Ermentrout honored with SEMI Akira Inoue Award

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- Development of a screening procedure that was adopted by the Compressed Gas Association to identify products that should be designated as “Restricted Use” and a process for qualifying potential customers to whom materials should be provided.
- Development and implementation of a Security Vulnerability Assessment (SVA) system for the Division, which was recently approved and adopted by the American Chemistry Council.
- Demanding and receiving the same high level of safety and environmental performance from his teams around the world, regardless of local customs or competitive pressures.

Ermentrout began his career with Air Products in 1975 as a participant in the company's Career Development Program, becoming a sales engineer in 1976. In 1983, he was named business area manager for Standard Plants, and in 1987 became general manager of the Process Industries Department. Appointed general manager for the Electronics Division in 1992, he assumed his current position as vice president and general manager in

1996. Ermentrout earned a BS in engineering from the U.S. Naval Academy in 1970 and an MBA from Lehigh University in 1980.

The Akira Inoue Award is named after the late Akira Inoue, past president and representative director of Tokyo Electron Limited and a former member of the SEMI Board of Directors. Mr. Inoue was a champion of environmental protection and employee health and safety within the semiconductor industry. SEMI established the Akira Inoue Award to recognize individuals in industry and academia who have made significant EH&S contributions to the semiconductor industry and to society.

SEMI is a global industry association serving companies that provide equipment, materials and services used to manufacture semiconductors, displays, nano-scaled structures, micro-electromechanical systems (MEMS) and related technologies. SEMI maintains offices in Austin, Beijing, Brussels, Hsinchu, Moscow, San Jose (Calif.), Seoul, Shanghai, Singapore, Tokyo, and Washington, D.C. For more information, visit www.semi.org. ▲

CONTACT: Pete Marouli: maroulpj@airproducts.com

new UHP ammonia distillation plant in Korea on-stream

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UHP ammonia is an electronic specialty gas crucial in the manufacture of flat panel displays such as thin film transistor-liquid crystal displays (TFT-LCD), integrated circuits, and light emitting diodes (LEDs), which are used in applications such as cell phones and automotive lighting and are displacing conventional lighting alternatives based on their ability to operate at reduced power, lower temperatures, and with extended lifetimes.

Air Products will manufacture two grades of ammonia at its new facility in Korea—VLSI Ammonia (99.999% purity), which is used to produce flat panel display and integrated circuits, and its White Ammonia™ (99.99999% purity), the purest line of ammonia available today and a critical component in the production of LEDs.

Air Products' UHP ammonia distillation plant in Korea enhances the company's supply chain by leveraging its industry-leading purification technology and Bulk Specialty Gas System (BSGS) offering, a service that includes proprietary bulk ISO module packaging. Air Products' plant in Korea is equipped with the most comprehensive fleet of ISO units in the industry and the capability to supply bulk quantities of UHP Ammonia in a variety of containers, increasing customer service throughout the region. ▲

CONTACT: Jessica Cheng: chengjs@airproducts.com

two

AIR PRODUCTS ELECTRONICS UPDATE, SPRING 06

China/Korea Teamwork wins Air Products key ESG China contract

The Air Products China and Korea electronics staffs teamed up recently to win a major Electronics Specialty Materials (ESM) contract from Hynix Semiconductor Korea. The China electronics group will provide both electronic specialty gases (ESG) and electronic specialty chemicals (ESC) to the new Hynix chip fab at Wuxi City in China's Jiangsu Province.

The new fab—a joint investment of Hynix and STMicroelectronics—is scheduled to begin mass-producing eight-inch silicon wafers later this year and then expand to incorporate cutting-edge technology to make 12-inch wafers.

The supply of ESG products cover about 60 percent of the requirements of the Wuxi fab. Air Products will also supply several ESC products. Additional ESG and ESC products may be needed.

Corning Painter, vice president of Asia Electronics said, "This award is the result of the hard work and great teamwork of our China and Korea teams. We took a big step forward with Hynix last year when they awarded us the supply for many electronic

specialty materials at their new 300mm line in Korea. This win is another sign that we are on the right path with Hynix. It also further strengthens our relationship with Hynix and solidifies our No. 1 ESG-supplier position with this growing semiconductor manufacturer." K.Y. Kim, general manager of Air Products Korea ESM and David Price, until recently general manager of Air Products China Electronics, also extended special thanks to the two regional teams.

"One-company teamwork was a key to the success. We would like to thank the team for their great contribution and regional teamwork," said Kim.

Price added, "Hynix came into this bid with a very good impression of the service and support that our Korea team provided. This combined with the strong customer focus of the China team positioned us to win the business."

Hynix Semiconductor is one of the world's largest DRAM producers. It has contracted with Wuxi City, Jiangsu Province in China for setting up a plant in China. By completing the contract, Hynix explained it is able to obtain solid footing for the long-term competitiveness and enforcing cost competitiveness by utilizing a low-cost manufacturing environment to maintain a leading position in the Chinese market. ▲

CONTACT: Shirley Tang: tangs@airproducts.com

India JV wins Tata BP Solar recognition

INOX Air Products, our 50-50 joint venture with Industrial Oxygen Company Ltd. (INOX) in India, recently won the "Award of Excellence" from Tata-BP Solar. The award recognizes the out-

standing product quality and reliability supplied by INOX Air Products since the start-up of Tata BP Solar's Bangalore fab in 2000.

Tata-BP Solar is the country's largest solar cell manufacturer, as well as the largest electronics customer of INOX Air Products.

Hafeez Contractor, general manager of Electronic Specialty Gases for INOX Air Products, said selection criteria were quality and consistency.

"Tata BP Solar noted its appreciation for our efforts in achieving 100 percent on-time deliveries for the last five years. I would like to offer my special thanks to S.P. Krishnamurthy and his team at our INOX Air Products Bangalore facility for their truly devoted efforts."

He said the award not only means a lot to INOX Air Products, but also to other Air Products Electronics Division locations across the globe. INOX Air Products has historically sourced most of its ESG products from our plants in Dubai, at Kuemee, Belgium, and in the U.S. at Hometown and Morrisville, Pennsylvania.

"Recently with strong support from our global Electronic Specialty Materials (ESM) organization, INOX Air Products has implemented a new sourcing plan to procure more electronic specialty gases in the Asia region. Opportunities include gases such as NH_3 , SiH_4 , C_2F_6 , CF_4 , and carbon monoxide. This move is in keeping with our global ESM supply strategy to optimize supply chain operation to respond to customer needs more promptly," Contractor said.

Formed in 1999, INOX Air Products is a 50-50 joint venture between INOX and Air Products. By combining the international experience of Air Products and the local capabilities of INOX, INOX Air Products is able to offer a wide range of products and services to various industrial segments in the fast-growing Indian marketplace like healthcare, electronics, metals (ferrous and non-ferrous,) petrochemicals, cement, pharmaceuticals, food, and others.

INOX Air Products operates more than 40 facilities and has more than 1,000 employees in India. ▲

CONTACT: Andy Tuan: tuana@airproducts.com

Ask the Expert



Reinaldo M. (Ray) Machado, Ph.D.
Research Associate for Ion Implant

Q Are there any alternatives to the standard subatmospheric delivery options for my ion implant gases?

A Delivering another solution through innovation, Air Products has developed a cost-effective alternative to traditional subatmospheric gas systems (SAGS) for ion implantation gases such as arsine (AsH_3), boron trifluoride (BF_3), enriched boron trifluoride (11BF_3), and phosphine (PH_3).

Air Products' proprietary GASGUARD® subatmospheric systems (SAS) store and deliver these gases subatmospherically at the point of use, thereby minimizing the potential of accidental release. While the unique technologies which enable these systems vary based on the desired ion implantation gas, they have one thing in common. Their amazing designs and simplicity will deliver reliable, consistent gas. Learn why Gases & Technology recently awarded us with the 2005 GASSY Innovation Award. Let us put our knowledge and innovation to work for you.

For more information or to submit a question for "Ask the Expert," visit us at www.airproducts.com/sas or call 800-654-4567 or 610-706-4730.



tell me more
www.airproducts.com/sas



Air Products Leading Producer of WF_6 (Tungsten Hexafluoride)

A technician prepares cylinders of WF_6 (tungsten hexafluoride) for shipment at our Hometown, Pennsylvania electronic specialty gases manufacturing facility. As the leading maker and supplier, Air Products is positioned to meet the growing demand for WF_6 with its two Hometown production plants that can manufacture in excess of 600,000 pounds annually.

Nickel construction, automated process systems, and on-line analytical capability enable our WF_6 product consistency to reach ppb and sub-ppb levels, the purest in the industry.

Non-reactive nickel vessels and cylinders are used to transport WF_6 for added purity assurance. ▲



"Fluorine Plasma Chemistry for High-AR Dielectric Etching," B. Ji, S. A. Motika, P. R. Badowski,

S. Dheandhanoo, J. R. Stets, and E. J. Karwacki. *Solid State Technology*, November 2005.

Contact: Barbara Schwabe: schwarba@airproducts.com ▲

technical
papers

news of interest:

Johnson Re-Elected AMCham President

Tom Johnson, vice president of Air Products San Fu, has been reelected president of the American Chamber of Commerce in Taipei by the organization's 2006 Board of Governors and Supervisors.

The 2005 officers were also reappointed. They are Jane Hwang, State Street Bank, Taipei Branch, first vice president; Scott Williams, Federal Express, second vice president; Peter Chen, GE Corporate Financial Services, treasurer; and Chris Fay, Saatchi & Saatchi, secretary.

Dr. Richard P. Vuylsteke, executive director of AmCham, announced the slate.

First Technical Symposium in Asia A Success

The Air Products Asia Electronics Team successfully held its first technical symposium in December in Hsinchu, Taiwan with 145 customers participating. It was a full-day event based on the theme of this year's annual report, "We're With You Everywhere," a theme that expresses the Air Products' commitment of strong customer focus—"to be with our customers everywhere to help them find the right solutions and to deliver value and innovation."

The symposium stressed the company's latest technology and the importance of local Electronics R&D and applications expertise. Speakers from global and local teams covered topics relating to different stages of wafer production.

Presentations covered several topics:

- Schumacher CVD and ALD precursors for FEOL applications.
- Novel Sub-atmospheric Pressure Gas Sources for Ion Implanters.

- PDEMS™ ILD: A PE-CVD-Based Ultra Low-k Dielectric Material.
- Cost-effective CMP Process Technology Solutions for Current and Future Nodes.
- Post-CMP Cleaning of Cu-Advanced Low-k Dielectric Substrates
- CVD Chamber Cleaning: Reducing Global Warming Emissions While Enhancing the Cost of Ownership.
- Advanced Photoresist Strippers for Use with Organosiloxane Sacrificial and ILD Films.
- Post Development Treatment to Improve Pattern Collapse and Line Width Roughness.

More than 80 percent of those attending said the symposium was helpful to their jobs and 88 percent said they would attend similar events in the future.

"These are really excellent results for our first technical symposium in Asia. They confirm the good feeling we all had at the event. As a result of the organizers' guidance, the speakers' technical knowledge and professional delivery, and good teamwork from all involved, the event was a big success," said Corning Painter, vice president of Asia Electronics.

CONTACT: Pauline Chuo: chuop@airproducts.com

Carlsbad ESM Provides Much Needed Tools to Local Fire Department

As a producing facility, emergency response preparedness is an integral part of our Carlsbad ESM business plan. We take planning for emergencies very seriously.

Our business plan is updated yearly to make sure that local response agencies know the nature of our products and where they are produced in our building. The business plan is required by San Diego County. Our plans (along with the business plans of all of the



From left to right: Firefighter Nate Pearson; Fire Captain Kennedy; Carlsbad Mayor Bud Lewis; kneeling Randy Skow (AP environmental manager); Fire Captain Skip Clark; Fire Captain Mike McFadden; Eileen Turner Carlsbad plant manager; Fire Department Division Chief Heiser; Joe Sayles Carlsbad manufacturing manager.

other businesses in Carlsbad) are provided to our local emergency response agencies on a CD-ROM by the county.

The Carlsbad facility learned that our local fire department did not have laptop computers, so they couldn't access the business plan information when they arrive at our facility in the event of an incident. The Carlsbad Fire Department has been very committed to and supportive of our company in the past, and we wanted to thank them for their commitment and arm them with the tools they need.

On February 6, Eileen Turner (Carlsbad site manager), along with Randy Skow (environmental manager) and Joe Sayles (manufacturing manager) presented the Carlsbad Fire Department with three state-of-the-art Dell laptop computers. The computers are a win-win situation for both the fire department and Air Products—the fire department can be better prepared to help us in an emergency, and we know that they will have the most up-to-date information on our facility when they arrive to support us. ▲

CONTACT: Randy Skow: skowrr@airproducts.com

tell me more

www.airproducts.com/electronics

company information

Air Products is a Fortune 500 company with sales over \$5 billion annually and with major operations in 30 countries around the globe. We are a leading supplier of industrial gases, related equipment and services. Our success in industrial gases has come primarily through the development of new technologies that help our customers reduce their overall costs.



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Air Products and Chemicals, Inc.
7201 Hamilton Boulevard,
Allentown, Pennsylvania, U.S.A. 18195-1501
Tel 610-481-4911
www.airproducts.com/electronics

Air Products PLC, Electronics Group
Hersham Place; Molesey Road,
Walton-on-Thames, Surrey, England KT12 4RZ
Tel 44-0-1932-249959
Fax 44-0-1932-258063
E-mail euroelec@airproducts.com

Air Products Asia, Inc. (Jessica Cheng)
Wanchai HK Central Plaza Building
Suite 6505-7 Central Plaza, 18 Harbor Road
Wanchai, Hong Kong
Tel 852-2-8630585

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