



Halia[®] water and wastewater solutions for Asia

Modular water treatment solutions using pure oxygen
to bring cost efficiency and environmental benefits

At Air Products,

We have a half-century of expertise in the most fundamental substance on earth—water. Our business is industrial gases and we have used that knowledge to make our water safe and pure. We understand the pressure companies are under to meet environmental legislation relating to water treatment.

In Asia, our dedicated team of technical experts is committed to providing customer-driven solutions to complex wastewater and water treatment problems, backed by our new state-of-the-art Water Laboratory in Shanghai, China, which serves customers in the entire Asian region.

Our robust modular solutions combine all the proven advantages of pure oxygen aeration, ozone and advanced oxidation with patented high mass transfer technology. Our waste-free advanced technology delivers highly effective, low-cost solutions utilizing a modular approach to meet specific needs and specific treatment goals now and in the future.

Our Halia wastewater, drinking water, aquaculture and river oxygenation solutions are capable of handling the following diverse requirements:



- Increase wastewater treatment capacity of an existing plant
- Reduce foams, odors and VOCs released from an aeration tank
- Improve nitrification and settling efficiency
- Remove color for discharge or reuse
- Remove recalcitrant contaminants
- Raise the dissolved oxygen (DO) level and increase the aquaculture density



Air Products' Halia modular water solutions

have been successfully used in industrial and municipal water applications. Our solutions utilize the latest in gas generation technology and equipment flexibility to provide minimum overall cost and maximum performance.



Wastewater solutions

Our technical experts will work closely with you to provide the best oxygen injection solutions for optimum wastewater treatment and cost efficiency. Our advanced oxidation technologies can help you treat municipal and industrial wastewater streams to meet the required standards for water reuse in various applications.

Drinking water solutions

Our modular oxidation solutions provide a range of robust treatment solutions for municipal drinking water customers. Our advanced oxidation technologies are designed to meet the needs of communities and increased regulatory requirements while reducing operating costs.

Aquaculture and river oxygenation solutions

Air Products supplies high-purity oxygen and Halia aeration solutions to hatcheries and fish farms where oxygen is used in place of air to maintain adequate dissolved oxygen (DO) levels. This helps increase aquaculture density and quality, as well as improve productivity.

Advanced gas technologies help improve efficiency and lower operating costs





Halia aeration solutions— the benefits of pure oxygen

Pure oxygen, when used for aeration in aerobic biological processes, is widely recognized as more effective than air-based technology for treating aqueous waste. Pure oxygen can offer cost savings either as a simple retrofit to extend the capacity of an existing treatment plant or as part of a new installation.







Our proprietary injection technology is designed to provide maximum oxygen transfer into an activated sludge system utilizing pure oxygen.

Our Halia aeration solutions are designed with the customer's process in mind. The goal is to achieve >90% utilization of the oxygen delivered.

Benefits:

- Increase treatment capacity in existing system
- Reduce investment
- Provide smaller footprint
- Save power
- Increase nitrification
- Reduce release of foams, odors and VOCs
- Control filamentous bacteria
- Decrease sludge production

Halia aeration solutions benefit a diversified range of applications including wastewater biological aeration treatment, groundwater oxygenation and aquaculture.



Offering	Details
Halia mixer aeration solution 	Consists of a surface floating mixer and a gas injection device. <ul style="list-style-type: none"> • Easy installation • Higher oxygen transfer efficiency • Maximize power saving benefits
Halia propeller aeration solution 	Oxygen is injected into wastewater by propeller. <ul style="list-style-type: none"> • Wet install capability • Ideal for small basins
Halia venturi aeration system 	Oxygen is injected into wastewater by venturi. <ul style="list-style-type: none"> • Higher oxygen transfer efficiency • Significantly increase aeration capacity
Ozone vent gas reuse 	Reuse up to 80% of the current wasted oxygen. <ul style="list-style-type: none"> • Aeration tank power saving and peak shaving • Reduction in operating cost
Halia oxygen sludge digestion solution 	Use pure oxygen rather than air alone for sludge disposal. <ul style="list-style-type: none"> • Increase oxygen delivery rates to enable faster digestion and higher pathogen kill • 30%–60% solid reduction
Aquaculture solution 	A pure oxygen injection system. <ul style="list-style-type: none"> • Raise the dissolved oxygen (DO) level in water • Increase the aquaculture productivity

Halia oxidation solutions—

Powerful disinfectant and oxidation solution using ozone

Ozone is one of the most powerful oxidants commercially available today. Ozone effectively oxidizes color and various organic and inorganic compounds without leaving behind any harmful residue. These unique qualities of ozone use make it a very attractive option for water treatment.

Our ozone-based oxidation technologies benefit a range of industries, such as pigment, textile and dyeing, pharmaceutical, pulp & paper, petrochemical and coal chemical.

Offering	Details
Halia venturi mixing system 	Ozone is injected into wastewater by venturi. <ul style="list-style-type: none">• Higher ozone transfer efficiency• No annoyance of fouling formation and corrosion
Halia micro-channel solution 	A self-contained system, minimizing on-site assembly. <ul style="list-style-type: none">• High strength organic contaminants removal• Industrial wastewater treatment for reuse/ recycle or discharge after treatment to meet requirements





Ozone is used today in a variety of municipal and industrial water applications, including:

- Wastewater treatment
- Drinking water
- Cooling water biocide
- Sanitization
- Clean-in-place systems for process
- Inorganic pollutant oxidation, including iron, manganese and sulfide
- Oxidation of organic contaminants in groundwater and industrial systems



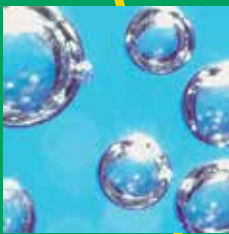
Benefits:

- Reduce halogenated disinfection by-products, like trihalomethanes and bromate
- Control odor and taste
- Improve coagulation, flocculation and filtration
- Enable flexible configurations, fully tested for easy installation
- Provide a low-cost alternative



A complete range of supply options to meet your needs

To meet your expectations, it is crucial that industrial gas supply is available when and where you need it. Air Products offers a wide variety of industrial gas supply options, from on-site to merchant-delivered liquid or gas, to meet your purity, volume and flow rate needs economically and effectively. With any of our supply options, Air Products is committed to providing on-time delivery of products that meet your specifications.



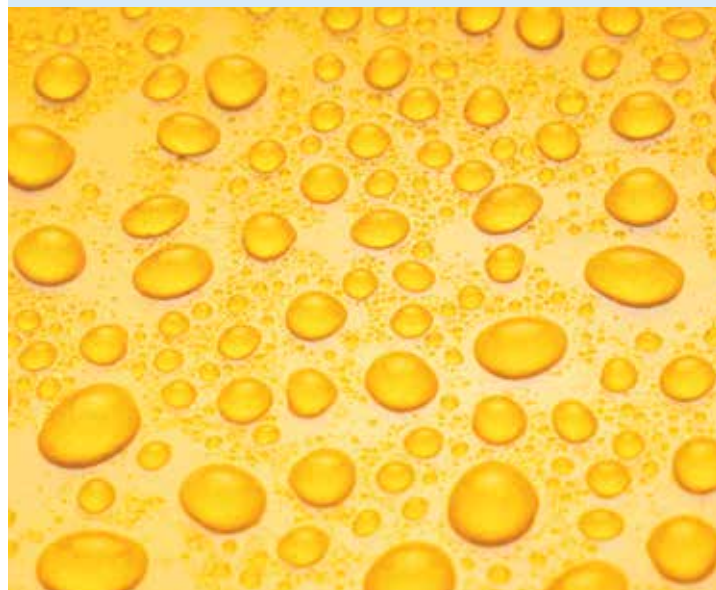


Industrial gas supply options

- **Cylinders, dewars and microbulk** for small- or medium-sized users
- **Merchant liquid**—Products are delivered in insulated tanks and stored on-site for use as liquid or gas after vaporization
- **On-site plant**—Gas generation systems and oxygen vacuum swing adsorption (VSA) generators
- **Pipeline supply**—A facility is usually built adjacent to or nearby our customer's facility, and product is delivered via pipeline

Support services

- Pilot trials
- Biological treatment systems
- Oxidation treatment systems
- Safety and operability reviews and training
- Ongoing technical support and equipment service





Count on our dedication to safety and sustainability

Air Products is a recognized leader in the safe operation and application of industrial gases and works with customers to review their systems and provide ozone and oxygen safety training. Oxygen and ozone solutions offered by Air Products incorporate all required safety features as standard.

Our Halia water treatment solutions use oxygen instead of air for aeration, which increases the oxygen dissolution capability and minimizes energy costs. Halia oxidation solutions utilize ozone as a water treatment disinfectant and oxidant in an environmentally friendly way. Ozone decomposes naturally in a matter of hours to normal molecular oxygen, leaving no residual compounds or toxins as seen with other disinfectants.

Globally, we are a safety leader in our industry and stand among the top performers of the Responsible Care® program from the Association of International Chemical Manufacturers (AICM). In Asia our stringent focus and efforts on safety have also been recognized by many industry authorities.

For example, our commitment to the development of green technologies in Asia is proven by a joint research and development agreement signed with South China University of Technology (SCUT) on water

purification technology to accelerate the development of sustainable and efficient water treatment solutions, helping local customers meet increasing energy efficiency and environmental improvement targets. Air Products has also established a scholarship program at SCUT for outstanding students at the School of Environmental Science and Engineering.

In addition, Air Products has received numerous awards and recognitions for its commitment to sustainability:

- Named to the 100 Best Corporate Citizens List 2012 by *Corporate Responsibility Magazine*
- Named to the Dow Jones Sustainability World and North America Indexes for 2012/13
- Named a Maplecroft Climate Innovation Indexes (CIIs) Leader for 2012
- Named to the Carbon Disclosure Project S&P 500 Leadership Index for 2012
- Remained a constituent on the FTSE4Good Index Series



Air Products Asia Water Laboratory



Opened in 2010, the Air Products Asia Water Laboratory is located in Shanghai, China, providing technical advice and support to customers in the entire Asian region. This state-of-the-art facility offers:

- Laboratory reactors and analysis equipment for customer water sample testing and identification of the appropriate water treatment solutions
- Research and development capabilities that enable customers to improve existing and develop new advanced oxidation technologies, as well as local development of equipment to suit the needs of Asian water treatment plants
- A well-equipped training facility for customers, partners and employees





About Air Products

Air Products is a leading global supplier of industrial gases, performance materials, and equipment and services. We serve customers in industrial, energy, technology and healthcare markets worldwide. With fiscal 2012 revenues approaching \$10 billion and operations in over 50 countries, 20,000 Air Products employees are working to build lasting relationships with our customers and communities based on understanding needs and delivering on them with integrity and passion. Through this understanding, we continually find innovative ways to help our customers win in markets around the world while maintaining our focus on being an industry leader in safety, health and preservation of the environment.

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Halia (Hā'•lēă)

A name from Greek legend

Since the 1960s, Air Products has provided customer-driven solutions to increase and improve treatment of both wastewater and drinking water for industrial and municipal customers. Our name has long been linked with oxygen and ozone applications that return a precious resource to its pure state. We bring tradition, knowledge, and understanding to the technologies of water. So when we extended our exciting line of water treatment products, we borrowed a name from Greek mythology.

Halia was a goddess of the sea. Her name is a fitting association for our products. It represents the application of modern science and technology to restoring a basic building block of life to the purity of the past.



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