

CHEMICAL PROCESSING

LEADERSHIP | EXPERTISE | INNOVATION

Water/Wastewater
Special Report



Make the
Most of Water



Is Water The New Carbon?

Companies face increasing pressure to disclose, as well as optimize, water use.

By Mark Rosenzweig, Editor in Chief

THE RISING cost and tighter regulation of water, coupled with concerns about adequate long-term availability in many regions, is prompting many chemical companies to treat water conservation as an imperative in their sustainability efforts, as our March cover story highlights.

“State of Green Business 2011,” a report released in early February by GreenBiz.com and downloadable via www.greenbiz.com/business/research/report/2011/02/01/state-green-business-report-2011, trumpets the trend. In a section titled “Water Footprinting Makes a Splash,” it notes: “Water has been rising as a sustainability issue... we’ve referred to it as ‘the new carbon’ due to its parallels to companies’ efforts with their greenhouse gas footprint: understanding and measuring it, reducing it, even offsetting it to the point of being ‘neutral.’”

Yet, the report points out that accounting for water can be even tougher than accounting for carbon. The amount of water used to make a product can vary significantly depending up where a plant is located and the process it uses. In addition, analyses should consider the source and quality of the water. Nevertheless, the report stresses: “Despite the complexity, companies are finding that conducting a water footprint analysis

can help them seek opportunities for efficiency and optimization. It can also lead to innovation.” It adds: “Growing pressures to disclose water footprints -- much as companies have done with their carbon footprint -- will lead many companies to dive in.”

Some of that pressure stems from an initiative of the Carbon Disclosure Project (CDP), London (which around 3,000 organizations from 60 countries use as a conduit for disclosing their greenhouse gas emissions). In 2010, it launched CDP Water Disclosure.

Paul Dickinson, CDP’s executive director, summarizes the thinking behind the effort: “So is water the new carbon? In the sense that water presents an equally pressing challenge to the long-term sustainability of business, yes it is, and the need for greater transparency and access to high quality information to inform and improve decision-making is just as vital. As companies have repeatedly demonstrated with carbon, what they measure they manage. Thinking about challenges in a strategic way will enable them to mitigate risks and identify opportunities, putting companies in a far stronger position to navigate a water-constrained world than would otherwise be the case.”



Dickinson adds, “In other respects water is very different from carbon. Whereas sustainable alternatives to carbon do exist, for water there is no substitute. The challenge therefore lies in managing what we have among competing users, be they businesses, communities or ecosystems. Those competing users or ‘rivals’ (from the Latin for a neighbor who shares a stream) are linked by the geography and politics of their local water systems, making water a local rather than a global management issue, even if its impacts can be felt across the world through the displacement of populations and higher commodity prices.

“CDP Water Disclosure’s goal is to make meaningful, systematic and comparable reporting on water a standard corporate practice globally, enabling investors, companies themselves, governments and other stakeholders to put this data at the heart of their decision-making.”

The group sent its first annual water questionnaire to 302 of the world’s 500 largest companies (according to the Financial Times’ “Global 500” rankings), and got 175 responses. “The strong response rate in this inaugural year is indicative of the high level of importance being placed on water by global corporations across sectors and geographies,” notes the report summarizing the findings (available

at <https://www.cdproject.net/CDPResults/CDP-2010-Water-Disclosure-Global-Report.pdf>).

The chemicals sector boasted the highest response rate -- all ten chemical companies surveyed (a group that includes Akzo Nobel, BASF, Dow and DuPont) provided inputs, compared to 17 of 21 pharmaceutical firms and just 15 of 51 oil and gas outfits. Besides presenting data, the report highlights best practices from companies in a number of industries.

Risks cited by chemical companies include: tougher regulation of water withdrawals and discharge quality, coupled with better contaminant-detection techniques, will boost treatment and management costs and make obtaining production licenses more difficult; and falling levels of both surface and groundwater will limit operation and expansion of facilities relying heavily on potable water.

On the positive side, the companies see opportunities to contribute to overall water availability through better water- and wastewater-treatment chemicals, water-efficient fertilizers, and processes and products to produce and recycle water.

In this green thrust one point is clear: How efficiently and sustainably a chemical company uses water ultimately will affect whether it sinks or swims economically. ●

WE UNDERSTAND WATER & WASTEWATER TECHNOLOGIES

Severn Trent Services offers innovative treatment solutions for a variety of water and wastewater applications. Our solutions include:

- **Capital Controls®** chlorine dioxide generators ensure efficient production, low maintenance and dependable operation throughout the product life.
- **Capital Controls®** gas feed systems and accessories are capable of feeding various gaseous solutions including chlorine, sulfur dioxide, ammonia and carbon dioxide.
- **Capital Controls® / MicroChem®2** analyzers, controllers and detectors for chlorine, sulfur dioxide, ammonia and carbon dioxide.
- **ClorTec®** on-site sodium hypochlorite generation systems offer efficient and effective disinfection. The innovative systems reduce disinfection by-products, minimize transportation of hazardous chemicals and reduce operating costs by as much as 20%.
- **EST™** wet and dry scrubbers for emergency gas abatement, odor scrubbers, and particulate scrubbers.

For more information on our water and wastewater treatment technologies
e-mail info@severntrentservices.com or visit www.severntrentservices.com

UNDERSTANDING
A VALUABLE RESOURCE





Optimize Water Use

Four major drivers are spurring increasing interest in optimizing water use.

By Tabatha Pellerin and John Woodhull, ENSR International

A PROCESS plant cannot function without water-based utility systems. While the importance of these systems isn't usually contested, expenditures to expand or upgrade these operations often are avoided because no direct payback can be assigned to any utility capital expenditures. However, four major drivers are spurring increasing interest in optimizing water use:

1. Higher water-use demands and flows;
2. Water-utility-cost increases;
3. Wastewater-discharge-cost rises; and
4. More-stringent regulatory limits.


Higher water-use demands and flows. Increased demands can push the hydraulic limitations of the existing water-treatment, steam-production and wastewater-treatment equipment and decrease performance. Operating costs will likely rise due to the additional stress placed on the equipment while capital spending may be necessary to increase capacity to meet the demands.

Water use at a plant can increase for many reasons. Plant expansions and unit conversions can impact utility systems by boosting flows and contaminant loading. In addition, new and modified units may contribute additional stormwater runoff. Tighter product specifications also can lead to increased water demands from, for instance, additional washing steps. Another common source of higher demand is aging

or failing equipment. Heat exchangers with leaking tubes that have been plugged or clogged tubes, for example, may require more water to meet cooling demands. Often external cooling from hoses serves as the supplemental cooling source.

Water-utility-cost increases. The cost of supplying water for steam, cooling and processing varies extremely depending on the water source. Water typically comes from sources such as on-site groundwater wells, surface water or an off-site provider. These supplies often have flow limit restrictions and purchased water costs can be prohibitive. There also may be additional regulations enforced when demands exceed certain permit limits. Costs for raw-water treatment (chemicals, sludge disposal, pumping, etc.) rise with demand.

Wastewater-utility-cost rises. There is a direct relationship between water demand and flows to wastewater treatment. Many wastewater-treatment units are designed for peak flows only experienced during storm conditions. Treatment costs during these peak flow conditions can climb exponentially due to increased pumping, aeration demands, sludge management and solids disposal requirements. Most importantly, extra water use cuts into treatment capacity to handle peak flows and often results in the need for additional storage capacity to dampen the peaks. Plants that discharge their wastewater stream



to an offsite treatment authority are generally billed for usage based on metered flows — thus higher wastewater flows could represent a significant cost burden.

More-stringent regulatory limits. Regulations that can affect water-based utility system costs include vapor control limits (national emission control standards for hazardous air pollutants, etc.), wastewater discharge limits (National Pollutant Discharge Elimination System or state limits), and land disposal restrictions that regulate contaminants present in unlined storage/treatment ponds or collection systems. Control systems or equipment modifications designed to comply with these regulations often are sized based on flow or contaminant loadings. Increasing flows to existing treatment systems can lead to decreased performance if the systems either are not managed to accommodate these changes or cannot meet these new demands. For example, higher loading on a biotreatment system can result in the existing aeration system not meeting the new oxygen demand or in significantly lower hydraulic residence time or mixing capabilities, both of which can decrease performance and possibly cause a discharge permit violation.

WATER BALANCE

Water-use systems impact nearly all plant operations either directly or indirectly. Steam, for example, is a common heat source in tubular exchangers. In reactor systems it can serve as a heat sink, as an inert diluent or for mixing. It also is used for duties as diverse as powering turbines, keeping instruments cool in an incinerator and as a barrier fluid in the seals of a compressor. Steam condensate and boiler feedwater provide a source of clean low-dissolved-solids water not only for boilers, but for makeup for chemical solutions, pump seal fluid or wash water for removal of precipitated salts. Cooling water goes to users ranging from large tubular exchangers to air conditioning units and sample coolers. Figure 1 shows the water balance for a typical plant.

Aqueous utility streams (steam, boiler feedwater, cooling water) pick up contaminants as they circulate throughout the system and when they contact process materials. Eventually these streams must be

discharged to the wastewater-collection system for treatment. Some of the most significant contributors of flow and contaminants to wastewater treatment in many plants are:

- Raw-water treatment streams, e.g., sand filter backwash, reverse osmosis reject, and regeneration from deionization;
- Blowdown streams from cooling towers, boilers and process steam generators;
- Unrecovered condensate and cooling water; and
- Stormwater.

Figure 2 shows typical water users and contributors to wastewater-treatment loads.

THE MAJOR PLAYERS

As water demands rise, flows to wastewater treatment increase proportionally unless water reuse and recycle is boosted. Therefore, it makes sense to focus on the major contributors of wastewater flow and contaminants for potential opportunities to reduce, reuse, recycle or eliminate these streams.

Generally water requiring either discharge or treatment can be classified into four types: process wastewater, non-process wastewater, maintenance wastewater and stormwater. Process wastewater consists of streams that directly contact other unit process streams and that, therefore, may require controls for volatile emissions and treatment prior to discharge. Non-process wastewater consists of streams that don't directly contact other unit process streams. Non-process streams typically contain contaminants at concentrations below all regulatory triggers and may be recovered for re-use or subject to less-stringent treatment requirements. Stormwater is defined as runoff collected throughout the site. Runoff from non-process areas is generally suitable for direct discharge via stormwater outfalls. Maintenance wastewater is generated during activities such as pump, heat-exchanger and instrument/analyzer clearing, filter changes, equipment washdown, deluge system testing, winterization and turnaround. Maintenance streams, depending on regulations and their potential contamination, often are subject to controls similar to those applicable to process streams.

Non-process streams frequently account for a majority of flow to wastewater treatment. Data from



numerous facilities show that these streams can account for well over 50% of the total flow to wastewater treatment. Stormwater also can have a huge impact on wastewater hydraulic loading because runoff rates often set the instantaneous peak flow rate to waste treatment. It is not unusual for peak runoff rates to exceed average wastewater flow rates by a factor of 100, particularly at a Gulf Coast location. Both of these “clean” streams not only contribute to the hydraulic loading at wastewater treatment but also affect treatment performance.

Wastewater treatment capacity is tied to volumetric flow rate and contaminant mass loading, both of which are likely to increase following significant modifications such as plant expansions or unit conversions. In such situations, most facilities undertake a series of wastewater treatment modifications and make any cost-effective changes to the treatment facilities. This leaves four approaches as the only viable options for matching treatment system capacity with wastewater load:

1. Reduce need for water-based utilities;
2. Decrease peak flow from stormwater;
3. Segregate clean streams for direct discharge; and
4. Recycle/reuse treated wastewater.

REDUCE NEED

Decreasing demand is almost certain to result in a corresponding cut in wastewater volume and potentially less contaminant loading.

Non-process sources, stormwater and many common process wastewater sources can effectively serve as substitute supplies in many applications. Success depends upon carefully matching the water quality requirements with the characteristics of the wastewater. It is necessary to take into account any impact that water reuse may have on the quality of the wastewater. Build-up of contamination within a recycle loop can occur. Also, water reuse can affect the quality and characteristics of the remaining wastewater that is to be routed to waste treatment or to discharge.

Now, let's look at some examples of potential sources to consider for reuse opportunities and common contaminants (limitations) of each.

- **Blowdown streams.** Recirculating-cooling-tower and boiler-feed streams build up dissolved solids, especially calcium and magnesium compounds, silica and other contaminants that are relatively insoluble in water. These compounds, when heated, tend to precipitate out of solution, causing scale and corrosion. Blowdown streams are necessary to maintain low levels of solids in the recirculating streams. Blowdown streams contain concentrated levels of total dissolved solids (TDS) and for this reason are not good candidates for reuse.
- **Water-treatment regeneration streams.** Ion exchange media (salt brine for softeners, acid and bases for deionizers) used to remove both suspended and dissolved solids generally require regeneration. This typically consists of backwash, regenerant introduction and fresh-water rinse steps. These wastewater streams often have high levels of suspended and dissolved solids and may require pH adjustment depending on the exchange medium. The high dissolved or suspended solids contents of these streams preclude most reuse options.
- **Condensate.** By returning condensate to the boiler for use as feedwater, facilities reduce the makeup source demands and lower regeneration flows because condensate does not typically require water treatment. Condensate streams have low TDS and often high heat-recovery potential.
- **Unrecovered cooling tower water or once-through cooling water.** Water that is not returned to the cooling towers for recirculation contributes to the blowdown flows. Lowering unintentional losses of cooling water allows the blowdown rate to be controlled, which then enables the operator to control cycles of concentration. Maximizing water returned to the once-through cooling water system reduces hydraulic loading to the wastewater collection and treatment system. Cooling water generally has low TDS. These streams, though, potentially may have elevated hydrocarbon concentrations if there is a heat exchanger leak or other abnormal situation.

- **Stormwater.** Stormwater from non-process areas typically is acceptable for direct discharge. However, because of the potential for contamination, runoff from process areas must be collected and treated or (at a minimum) tested to determine if concentrations are below those specified in the plant discharge permit. Process-area runoff has the potential to contain soluble and insoluble contaminants. It is becoming more widely accepted for facilities to design systems for first flush, which allows for the collection and treatment of an initial volume of stormwater expected to contain the majority of potential contaminants and then for discharge (or collection and reuse) without treatment of the remaining flows.
- **Stripper effluent.** Strippers are used widely to remove volatiles, lower organic concentrations and potentially recover certain components. Effluent is commonly discharged to wastewater treatment. However, there may be reuse opportunities for these streams depending on stripper effluent quality.

If the concentration of soluble organics in the effluent is low, then this stream can be reused as cooling tower makeup or boiler feedwater. However, soluble organics provide food for microorganisms and thus will cause biofouling rates to increase.

Many plants use strippers on process condensate streams. The effluent from this service is a good candidate for boiler feedwater makeup.

Another possible use for stripped sour water is for steam generation. Ethylene, styrene and tall oil plants commonly generate low-grade steam from “dirty” plant condensate such as stripped sour water. This steam can then be used for services involving hydrocarbon contact such as stripping or vacuum jets.

Appropriate measures for recycle or reuse of wastewater differ depending on the specific situation. One feasible option often employed for recycling is to group streams based on TDS or contaminant content, e.g., recycle of low-TDS sour-water-stripper bottoms (in preference to high-TDS cooling tower blowdown). Specifications for water to be reused must be based on solid justification — however,

being overly conservative drives up pretreatment cost and limits possibilities for reuse.

Operating practices can tax water-use utility systems and increase flows to wastewater treatment — and often provide promising opportunities to save water through installation of additional equipment, modifications to systems or operator training/awareness. The table lists some examples of common water-use practices that should be evaluated for reduction or elimination.

CUT PEAK FLOW

While direct discharge of stormwater runoff from non-process areas usually is acceptable, runoff from process areas generally must either be treated or, less commonly, sampled prior to direct discharge. Permit conditions may also allow for either direct discharge following collection of first flush volumes or decreased treatment requirements of segregated stormwater streams. Options to reduce the impacts of stormwater on wastewater collection and treatment include:

- Covering process areas and routing segregated non-contact stormwater to direct discharge;
- Segregating non-process-area stormwater and sending it to direct discharge;
- Implementing first flush for management of stormwater — this requires a segregated collection and storage capacity system;
- Boosting storage capacity;
- Increasing the permeability of non-process areas to reduce total runoff; and
- Decreasing, if possible, the size of runoff collection zones in process areas.

Storage tanks can be used to lower wastewater-treatment peak hydraulic loadings, which dictate equipment sizing. The use of tanks also allows for better management of biotreatment systems, which do not effectively respond to sudden changes in flow and contaminant loadings.

SEGREGATE CLEAN STREAMS

Many non-process streams are eligible for direct discharge depending on the governing discharge-permit requirements. Potential streams that should



be considered for direct discharge include:

- Steam blowdown;
- Groundwater seepage;
- Fire water, potable water, clarified water, hydrotest water and non-contaminated construction water;
- Non-contact cooling water and condensate;
- Cooling tower blowdown;
- Steam tracing condensate; and
- Condensate and cooling water from heating/ventilating/air-conditioning units.

Other non-process streams may be considered for direct discharge if sufficient data and process knowledge are available to assure the discharge permitting authority that the streams are non-contaminated.

Reducing flows of non-oily wastewater obviously will lower the hydraulic loading of the collection and treatment system, which in turn should improve operations. However, such a move offers other benefits, too.

First, most hydrocarbon species have a limited solubility in water. By introducing non-oily wastewater into an oily wastewater stream that contains free oil, additional hydrocarbon will enter into solution based on saturation of the previously non-oily water with sparingly soluble hydrocarbon species. This has the effect of significantly increasing the soluble chemical oxygen demand (COD) load at treatment (generally biotreatment is used to remove soluble COD). The impact is most apparent when a low flow stream containing free hydrocarbon is mixed with a high flow clean stream.

The second reason for segregating clean streams from oily ones (process wastewater) is that some of the large flow non-process streams contain solids or form fine precipitates when mixed with other streams that are at a higher pH. Examples include blowdown from cooling towers and boilers. The solids and fine precipitates combine with hydrocarbons that may be present in the process wastewater to form emulsions. These emulsions can be difficult to remove with separation technologies (separators, air flotation units, etc.), thus increasing the hydrocarbon load to secondary treatment (typically biotreatment).

RECYCLE AND REUSE

The reuse of treated effluent does not reduce the total flow rate of wastewater requiring treatment and thus, is generally less desirable than the direct reuse of clean wastewater. This option does, however, decrease water demands.


One of the more-common unit operations for wastewater treatment at process plants is biotreatment, which is effective for decreasing soluble organic concentrations. Reuse of effluent from biotreatment systems may require reducing solids concentrations through filtration or other technologies; residual organic concentrations must be low to minimize the need for pretreatment before reuse. Such treated effluent often is suitable for washwater from hose stations and other uses that can tolerate relatively high dissolved solids content. Removing the dissolved solids often opens up other opportunities such as cooling tower makeup, boiler feedwater makeup, process water or once-through cooling water but adds to cost and reduces operability in that the reused water supply is only available when the dissolved solids removal equipment is online.

BUOYANT PROSPECTS

Significant opportunities generally exist to reduce the total load on the water-use system (Figure 3). Employing measures to recycle or reuse streams, eliminate or reduce water-use-intensive practices, decrease stormwater impacts, and segregate clean streams for direct discharge will help to optimize the utility system. They may lead to reduced capital costs for upgrades and expansions and lower operating costs, as well as improved treatment performance and in turn fewer discharge permit violations.

Tabatha Pellerin, P.E., is a process engineer with ENSR International, Westford, Mass. E-mail her at tpellerin@ensr.com.

John Woodhull, P.E., is the manager of process engineering for ENSR International, Westford, Mass. His e-mail address is jwoodhull@ensr.com.



Regulations are increasing. Available fresh water is decreasing. Environmental compliance is high on every agenda. Yet, chemical plants still need to operate efficiently and profitably.

Turn obligation into opportunity...

with proven
wastewater treatment
from Calgon Carbon

Wastewater treatment using activated carbon adsorption technology cost-effectively removes a broad range of organic contaminants to meet regulatory obligations. Even more, thermal reactivation gives you the opportunity to recycle and reuse activated carbon to:

- Reduce cost and waste
- Save energy and lower CO₂ emissions
- Conserve natural resources
- Eliminate any long-term liability of spent carbon disposal

Our industry-leading granular activated carbons, carbon adsorption systems, and reactivation services are at work in hundreds of chemical plants worldwide. Call us now — we're ready to put them to work for you!

+1 800 422-7266
www.calgoncarbon.com

**CalgonCarbon**
*Making Water and Air
Safer and Cleaner*



Chemical Pollutants in Water Emerge

High profile contaminants make for murky regulatory waters.

By Lynn Bergeson, Regulatory Editor

RECENT ADVANCES in contaminant identification methodologies, sampling instrumentation, and analytical chemistry have caused an explosion of knowledge about the presence of previously undetected organic micropollutants. While it doesn't follow that the mere presence of chemical contaminants results in harm, public health experts, regulators, and others aren't sitting idly by.

Given the necessity of water to all life forms, emerging data about the presence of previously undetected substances has garnered the attention of consumers, regulators, elected officials, and the media. Following are examples of water and wastewater organic micropollutants that have emerged as high profile contaminants, and the technical challenges regulators and others face in defining, managing, and communicating potential risk posed by these substances.

ENDOCRINE DISRUPTING COMPOUNDS

A heightened concern about potential effects of exposure to endocrine disrupting compounds (EDC) was reflected in Congress' 1996 enactment of the Food Quality Protection Act and amendments to the Safe Drinking Water Act. Both laws include provisions requiring the U.S. Environmental Protection

Agency (EPA) to identify, characterize, and regulate EDCs, as appropriate. After much work, in April 2009 EPA published the final list of the first group of chemicals to be screened under the Endocrine Disruptor Screening Program. EPA began issuing testing orders in October 2009 to obtain data on whether endocrine effects exist.

PHARMACEUTICALS/PERSONAL CARE PRODUCTS

There's heightened concern about the presence in wastewater and drinking water of pharmaceuticals and chemicals commonly found in personal care products (PCP). Pharmaceuticals (including those for veterinary use) are prescribed to address and/or prevent illness or infection and are intentionally designed to interfere with a biological system. PCPs are typically synthetic organic compounds derived for use by individuals in soaps, lotions, beauty aids, sunscreens, fragrances, and related PCPs and aren't typically designed to interact with biological systems.

ENGINEERED NANOMATERIALS

Consumer applications of nanoscale materials have recently received much attention. An inventory of consumer products maintained by the Project on Emerging Nanotechnologies (PEN) at the Woodrow



Wilson International Center for Scholars, Washington, D.C., identifies more than 1,000 nano-enabled products in commerce today, marketed in more than 21 countries. While the PEN inventory is only one and an admittedly imprecise measure of rapid deployment of nanotechnology in consumer products, it's frequently cited as a fairly reliable gauge of nano commercialization.

Releases from these products into the environment may occur during product manufacture. Nanoparticles embedded in products may be released when the products are used as intended. The intended use of certain products may result in nanoparticles either becoming a contaminant in a water body or part of the influent being treated at a publicly owned treatment works. Nanoparticles also may be released into the environment when fabrics that contain embedded nanoparticles as a fiber finish are laundered or as certain antifouling paint and coatings for use on vessels and/or off-shore structures weather and degrade over time. Nanoparticles also may be released into the environment when products containing them are discarded and degrade, and potentially contribute to groundwater or surface water pollution.

TECHNICAL CHALLENGES

While debate continues over whether there's evidence of a link between exposure to these micropollutants and adverse health effects, there's consensus that much more can be learned about the presence of these compounds in water, and the effectiveness

of conventional drinking water and wastewater processes to remove them. Other issues arise from application of conventional pollutant treatment methodologies and tools to address newer, more exotic pollutants found in very low concentrations. Current sampling methodologies may not be able to identify and/or characterize in all cases the presence of organic micropollutants in complex water matrices.

It's also important to recognize these new challenges are in addition to existing, more "routine" challenges facing wastewater treatment operators. As the population grows, municipalities must process more water with fewer resources and with an aging infrastructure.

How these substances are managed, and how well and accurately they are profiled by regulators, the media, and other stakeholders may influence how other micropollutants are managed for years to come. All stakeholders must be scrupulously mindful of what's known, and what should be fairly and impartially communicated, and seek to contribute meaningfully to helping resolve the complex science challenges that deserve open and transparent reporting and deliberation. ●

Lynn is managing director of Bergeson & Campbell, P.C., a Washington, D.C.-based law firm that concentrates on chemical industry issues. The views expressed herein are solely those of the author. This column is not intended to provide, nor should be construed as, legal advice. You can e-mail Lynn at lybergeson@putman.net.

We gave blower technology an energy efficient **twist!**



The **ZS range** of screw blowers



5

year element warranty

\$0

no need to pay more for this technology

24/7

support

30%

average energy savings

**ISO
8573-1**

setting a new standard in air purity



Call Us: 866-472-1013

Log On: www.efficiencyblowers.com

Sustainable Productivity

Atlas Copco