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Plants Save Water

Operating companies step up conservation and re-use efforts

By Seán Ottewell, Editor at Large

AS OUR February cover story “The Tide is Turning,” www.chemicalprocessing.com/articles/2013/sustainable-water-management-the-tide-is-turning/, highlighted, chemical makers increasingly are focusing on water-related issues. In particular, concern over availability is spurring leading operating companies to implement a host of novel strategies and technologies to optimize water use.

For instance, as part of its contribution to World Water Day on March 21st, Dow Chemical, Midland, Mich., outlined how it’s optimizing water use at two of its major facilities — at Brazosport, Texas, and Terneuzen, the Netherlands.

Brazosport, which covers more than 5,000 acres near the mouth of the Brazos River and which Dow claims is the largest integrated petrochemical facility in the world, is in an area that experienced severe drought conditions in 2011. This prompted the company to launch a number of initiatives aimed at conserving water — including establishing a water strategy director and steering team, a community water symposium and a contest for employees for water-conservation-project ideas.

As a result of all these efforts, Dow identified and implemented:

- *Chlorine once-through cooling-water recycle.* This project recycles the once-through cooling water for the rectifiers at one of the chlorine plants, as well as the once-through cooling water for an air compressor station to the site’s clarified water system for general re-use, and represents about 1,300 gpm in savings.
- *Eliminating one-pass fire-water monitor cooling at a power station.* Installation of piping allowed

use of seawater for cooling, saving 200 gpm of continuous freshwater use and 200–600 gpm during startups and shutdowns;

- *Demineralization plant resin change.* This project significantly improved the operation of a resin bed, and also included modifications to a reservoir to maintain the gains in efficiency;
- *Supplemental cooling automation at another power plant.* The idea initially was to change from water cooling to air cooling for a section of the power plant that required intermittent cooling. However, space was insufficient to install the required fin-fan exchangers. So, instead, existing equipment was slightly modified and process control was implemented to allow for the automation of the cooling water valve;



Figure 1. Access to fresh water long has been a challenge for Terneuzen facility. Source: Dow Chemical.

- *Improved cooling-tower chemistry.* Dow worked with its water treatment chemical provider to modify the water treatment chemistry on 25 cooling towers to reduce makeup water by 400 gpm;
- *Soft water recycle.* Installation of piping, valves, flow meters and other instrumentation enabled recycling soft water from a propylene oxide plant to the site river water header when only two trains are running — saving 3,000 gpm;
- *Improved maintenance of many older river water lines.* Identifying and fixing leaks as part of a maintenance strategy reduced water draw by another 1,000 gpm; and
- *Other efforts.* Eliminating slab washing and watering landscaping saved another 3,500 gpm.

In addition to the almost 10,000 gpm saved by these projects, temporary water-conservation measures further reduced consumption by 3,500 gpm.

At Dow's Terneuzen facility, which is another massive chemical complex and the Dutch city's heaviest industrial water user, one of the main challenges has been the plant's location — at a seaport where for decades fresh water has had to be piped in from a distance of over 120 km (Figure 1).

Over the years, Dow has worked with local desalination plant operator Evides to re-engineer its plant with reverse osmosis membranes, low-pressure feed pumps and improved process automation. In 2010, the city's wastewater treatment plant was equipped with a membrane bioreactor (MBR). The MBR serves various objectives — for example, it adds 20% treatment capacity to the municipal plant while dramatically improving the quality of effluent sent to Evides' facility.

As a result, Dow and its partners now are twice reusing the community's treated wastewater through an innovative wastewater recycling program, thereby using every liter of water three times instead of once.



Figure 2. Santa Clara, Calif., hydrogen plant now uses recycled water as makeup for cooling system. Source: Air Products.

Today, Evides purifies 10,000 m³/d of municipal household wastewater for Dow, which uses it to generate steam and feed its manufacturing plants. Steam condensate serves in cooling towers until the water finally evaporates into the atmosphere. Compared with conventional desalination of seawater for the same use, recycling Terneuzen's wastewater cuts energy use by 95% — the equivalent of reducing its carbon dioxide emissions by 60,000 tons each year, says the company.

Not only is membrane separation inherently more energy efficient than desalination but using municipal effluent instead of seawater as the raw water source requires less driving force (pump pressure) to remove salt from the water because it has a lower salt content. In addition, the lower-salt-content effluent pares use and cost of chemical treatment of the membrane systems in half.

FOCUS ON ASSESSMENTS

In January 2011, Air Products & Chemicals, Allentown, Pa., had its water team begin work on water

assessments in conjunction with GE Water, Trevose, Pa., its long-time primary provider of water treatment chemicals and services.

“The assessments are very focused on looking at operating procedures and so far we have carried out 25 globally. They are also very much focused on larger water consumers such as air separation and hydrogen conversion production facilities. Opportunities are identified by our operating staff working closely with GE Water,” explains Julie O’Brien, Air Products corporate sustainability manager.

Overall, this had led to changes in two main areas. The first is an up-to-four-fold increase in cooling tower cycles — saving between 2 and 10% of water consumption, depending upon the facility. The second is greater use of recycled water, particularly for cooling.

Using this approach at Air Product’s Santa Clara, Calif., HyCo hydrogen production plant has helped save 62 million gal/yr of potable water.

“At Santa Clara, we’re using water that previously has been used by others and pretreating it prior to use on-site. The main lessons from this site are that there are increasing opportunities for grey and recycled water to be used for cooling, and opportunities for greater water reuse within the facility — for example, using process condensate in the cooling tower makeup water (Figure 2). There have been other opportunities at other plants, but they’re very site specific. For example, at one we are upgrading our monitoring systems to better quantify our ongoing water usage,” notes O’Brien.

Air Products is sharing the recycling and reuse lessons learned at Santa Clara among its sites. In addition, the company is going beyond individual assessments to look more systemically at other strategies to improve overall water consumption. For example, it’s developing technologies to reduce consumption and reuse water in water-constrained geographies.



Figure 3. Water at Tarragona complex primarily goes into semi-closed circuits such as those for cooling water. Source: BASF.

Initiatives such as the use of waste heat for water purification may influence the way it plans, designs and builds plants.

Overall, greater use of recycled water, combined with process improvements, enabled Air Products to decrease water consumption by 1.2 billion gallons between 2011 and 2012. The company already has met its 2015 water reduction goal but continues to focus on eliminating waste, increasing recycle and reuse, and offsetting water withdrawals from primary sources with reclaimed supplies.

O’Brien offers a cautionary note about how water is treated as a business cost: “First there was a push on carbon emissions, which led to questions about energy consumption and this, in turn, has led to questions about water consumption. They are all linked; so over time, more and more companies will likely appreciate

SEVERE WATER-STRESSED AREAS

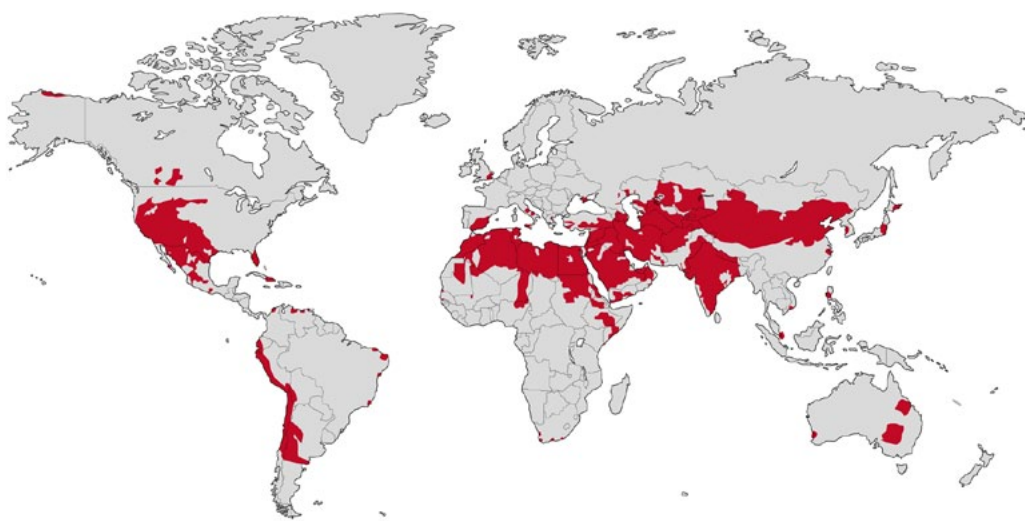


Figure 4. Water supplies in many regions around the globe already are heavily exploited. Source: BASF.

that water scarcity and quality are business risks. At the same time, it may be difficult to justify water system improvement projects, such as the installation of pre-treatment systems for recycled water, because water is not fully costed in many places, so the project paybacks might not meet hurdle rates. This will change as water rates increase.”

A WATER STEWARDSHIP FIRST

On May 3rd, BASF, Ludwigshafen, Germany, set an industry milestone when its production facility in Tarragona, Spain, (Figure 3) became the first chemical site ever to achieve gold-level certification to the European Water Stewardship (EWS) standard.

The EWS was developed by governments, businesses and nongovernmental organizations under

the leadership of the independent European Water Partnership (EWP), Brussels, Belgium, and became effective at the end of 2011.

The award came after an audit by third-party certification body TÜV Nord Integra, Berchem, Belgium, assessed the entire water-management performance at the site, from extraction of water at its source to its reintroduction in downstream water bodies.

The assessment includes more than 50 indicators. These address the four principles of water stewardship: sustainable water sourcing, ensuring good water quality, protecting vulnerable areas and equitable water governance (which is defined by EWP as making certain of an adequate quantity and quality of water supply for all members of the population including



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the most disadvantaged). In addition, the assessment checks whether a site has a water recycling strategy and a cohesive crisis management strategy.

The Tarragona site relies upon the nearby Ebro River (for industrial and drinking water), groundwater (for industrial duties) and sea water (for production of demineralized water). It’s just starting to tap treated municipal wastewater for industrial duties.

The plant uses water between two and seven times in cooling towers (semi-closed circuits) and nine times in steam production (via condensate return).

Tarragona is in a water-stressed area (Figure 4), i.e., one in which more than 60% of the naturally available water sources are already exploited. In total, around 20% of all BASF sites are located in such water-stressed areas. Last year, the company sourced around 7% of its worldwide water supply from these areas.

“By the year 2020, we want to introduce water management to the EWS standard at all sites where water is scarce,” says Ulrich von Deessen, head of BASF’s competence center, environment, health and safety.

Chemical makers in other water-stressed areas also are taking action. For instance, Sabic, Riyadh, Saudi Arabia, aims to significantly reduce its consumption of fresh water from the current level of 124 million m³/yr. The goal is to cut by 2025 fresh-water use intensity (m³ water used/metric ton of product sales) from the 2010 level of 3. It’s implementing a number of water conservation and reduction projects in plants located in water-scarce regions such as Saudi Arabia, Brazil and Spain.

For example, at the Al-Jubail and Yanbu complexes in Saudi Arabia, the company has developed a seawater cooling system to minimize use of desalinated water. This is Sabic’s only seawater cooling system and has been purposely designed not only to save desalinated water but also to minimize damage to plant equipment and prevent any possible toxic chemical leaks to the seawater environment.

The company has reduced water usage at its Campinas, Brazil, facility by 20% while increasing production by 16%. This was achieved by improving the integrity of underground water supply pipelines and reusing treated industrial wastewater.

At its Cartagena, Spain, plastics plant, Sabic uses micro-filtration to clean and reuse process wastewater from multiple sources within the complex. In the last six years, this has saved more than 850,000 m³ of raw potable water and over \$1.2 million in associated costs.

Since 2010, DSM has been working to optimize water use at its engineering plastics compounding site in Pune, India. The company says that the Pune facility is one of the first in the group to have completely eliminated release of waste water. A treatment and checking regime allows the waste water to serve for gardening purposes. This year the facility, through a combination of increased process water recycling and strict monitoring of potential leakages, has slashed by two-thirds the amount of water used in the manufacture of thermoplastic polyester and polyamide compounds. ●

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