

Veronique Bourgier, Veolia Water Technologies, USA, looks at the ways in which downstream plants can utilise process data to digitally optimise and manage their water consumption.

FLOODS OF DATA

It is almost 2020. The hydrocarbon industry is seeing refiners and petrochemical plant operators looking to decrease water consumption. More than ever, water is thought of as a precious resource in the petroleum industry. But it is hard to measure how many issues impact the amount and quality of water required for a plant to run. Many plant operations personnel feel unaware of their own water optimisation performance, or of opportunities to improve. Operations personnel may know that digital water management solutions exist but may not understand how much impact they can have.

There are several new industry-specific factors that point refinery managers toward needing to think about plant upgrades and better water management techniques. For starters, the processing of dirtier crudes with specific gravities closer to water – such as slop oil, which is harder to separate from wastewater – plus desalting is more difficult. Sour crudes cause an abundance of wastewater contamination. There is also more public awareness of environmental issues, and plant operations personnel are seeking better environmental stewardship. The global energy companies even include water

management in their bi-yearly sustainability reports for the public to track their progress. We are seeing stricter emissions regulations than ever, with regulators looking for more gas flows to scrub and more water contaminants to remove. There is more desulfurisation, which can overload sour water strippers and sulfur recovery units which impacts wastewater qualities; and, as we are seeing less rainfall in some communities, this can mean less dilution of final effluent. These new variables point to a need for centralised water management at oil refineries and petrochemical plants.

Besides current national/global external factors signalling a need for centralised water management, there are also growth-orientated internal reasons that lead plants to seek better planning. Water optimisation and tracking can help enable expansion, for example. It can improve effluent quality with reduced contamination, lessen fouling and corrosion in process equipment, and can offer better desalting of crude oil. Optimised plant water management can also facilitate delivery of consistent high-quality makeup water, allowing plants to develop cooling tower blowdown discharge and water reuse solutions.



Figure 1. Effective management of water and energy in refineries and petrochemical plants can lower production costs, minimise downtime, ensure environmental compliance, and expand treatment capacity.



Figure 2. Lowering chemical usage costs is a 'soft cost' that is hard to monetise when evaluating or justifying water management initiatives or purchases.

Upgrading digital water management (smart) systems in plants is achievable and cost-effective, but there are operational challenges, which can hinder progress. For example, water reuse needs are often spread across an entire plant (other than cooling towers and steam generation), which makes recycle/reuse efforts less feasible. Tough-to-measure metering hinders proper analysis to get started, or set internal key performance indicators (KPIs). Smaller plants/refineries cannot realise economies of scale savings, and some geographical areas have a relatively low cost of water, which makes return on investment (ROI) justification hard to rationalise. There can also be a natural reluctance to make large-scale sweeping plant changes because future contaminant interactions/complex chemistry could be created unnecessarily.

With better water management a goal for operations personnel, but hard to actually implement, a methodology is needed to track water allocation and signal where improvements can realistically be made.

Digital water management in refineries and petrochemical plants

The concept of using data collected from plant operations to optimise water usage is not new. However, this overabundance of collected data provides limited value, unless advanced digital tools can mine that data to unlock actionable insights. Veolia Water Technologies' digital service, AQUAVISTA™, minimises water management operational costs by using analytics to achieve process optimisation. It uses information already being collected through human interface and programmable logic controllers. This system also gives operators confidence that treatment systems will run smoothly and require less workload of operations personnel, thus lowering chemical needs so refineries see lower costs from multiple places.

AQUAVISTA can be applied to a single plant or multiple plants, to help organisations benchmark water usage KPIs. The system includes data collection devices at predetermined time intervals. This data is then integrated into a plant's existing IT infrastructure using a cloud platform. The service offers cybersecurity and confidentiality, using security certificates to encrypt and validate data exchanged between the plant and the cloud, while ensuring the data is always safe. Once in the cloud, the platform can then apply smart algorithms, using analytics to organise and interpret available data. The cloud platform gives plant operations staff more mobility because information gathered can be monitored from anywhere. Operators receive alarm and event notifications, making personnel more proactive than reactive.

To meet the needs of refinery and petrochemical plant operations, this new technology operates on four levels:

- AQUAVISTA Portal is a monitoring and reporting tool that provides a complete overview of all water data collected. It features a dashboard customised to meet the needs of any type of water treatment operation. It has alarm management, document

management, order management tools, and a maintenance module. The Portal enables remote monitoring in real-time on any device. This capability is particularly useful for large facilities, multiple sites, or remote locations.

- AQUAVISTA Insight is a performance tool that applies algorithms and benchmarking metrics to the water treatment process. Plant operations can monitor KPIs 24/7. The result is typically cost savings from reduced energy and chemical consumption. Predictive maintenance can minimise downtime of water treatment systems as well as production processes. This tool notifies operators with opportunities to take proactive improvement steps.
- AQUAVISTA Plant offers online smart automation, with a full auto-pilot function. This suite of intelligent software and holistic solutions offers online optimisation, monitoring and forecasting to meet operational targets. Using a combination of hydraulic, process, and economic models, the software is based on machine learning and AI concepts. Benefits include reduced overall capital and operations costs, increased hydraulic and biological capacity, improved performance, easier operation, better system stability, and a high level of safety.
- AQUAVISTA Assist provides access to a network of Veolia's experienced water experts to offer process support. Features include troubleshooting, emergency support, feedback, and training courses. Augmented reality technology enables off-site experts to see what the operator is seeing remotely. The company can address problems right away to reduce risks associated with upset events or off-spec influent. Operational experience and data compiled from other facilities using the same processes enables offsite experts to troubleshoot problems.

Water systems already compile a significant amount of data that enables system automation, and are available to refiners/operations. True value is from being able to compare data from multiple plants all over the world using the same processes. The data is already being collected, but new tools enable plants to use it for better management of environmental stewardship, plant safety, water efficiency, chemical usage, and this ultimately results in less downtime.

A case study

A major petroleum refiner in Northern Europe utilised an activated sludge plant within its wastewater treatment facility. The wastewater treatment plant was running very well with low effluent values of total nitrogen, but the refinery was planning for a production increase which would increase wastewater production. This refiner was restricted to the present discharge load with regards to nitrogen, so it had to look for upgrade solutions. Besides focusing on cost-efficiency, the refiner had space constraints which prohibited new construction. Instead,



Figure 3. AQUAVISTA™ collects data and applies analytics and algorithms to optimise operations.



Figure 4. The virtual engineer feature of AQUAVISTA offers access to Veolia's staff 24/7. Augmented reality enables off-site experts to see what the operator is seeing remotely.

the refiner chose to implement AQUAVISTA as an optimisation tool.

Apart from the nitrogen removal, this refinery looked for other potential benefits which could be achieved from this tool. It achieved increased process stability from maximum flow control of upstream buffer tanks; optimised control of the activated sludge plant due to return activated sludge (RAS) and waste activated sludge (WAS) control; and the refinery saw improvement of process skills from its operators and engineers.

The digital upgrade at this refinery was commissioned in early 2019 and is performing according to the agreed KPI's and expectations. AQUAVISTA helps to increase stability of the wastewater treatment plant and reduces nitrogen discharge, but also prevents the refiner from needing to invest in an expensive biological polishing at the existing treatment plant.

Refining and petrochemical plants are embracing digitalisation. Analytics can help plants find supply, and streamline water management operations. It is almost 2020, and the power of big data in water treatment is here. Smart digital systems facilitate better understanding of data that already exists, giving operations personnel the assistance needed to make more educated water management decisions. 