ASSESSING WATER EFFICIENCY IN A CHEMICAL PLANT

Water audit and identification of alternative water sources to increase water efficiency in a chemical plant on Jurong Island, Singapore

The heavy use of high quality water is common practice in industries. However, population growth, increased water scarcity, and tighter wastewater discharge limit have collectively inspired a specialty chemical plant in Jurong Island to look for strategies to minimise water usage. To support this initiative, DHI provided recommendations to increase water efficiency by up to 45% through a water audit.

INCREASING PLANT EFFICIENCY THROUGH WATER AUDIT

The specialty chemical plant, located in Jurong Island, Singapore, utilised about 150 thousand cubic meters of water in 2015. This necessitates it to submit the Water Efficiency Management Plan (WEMP) mandatory for large water consumers—those who consume more than 60 thousand cubic meters per year.

DHI carries out water audits to assess water efficiency of industrial plants. © Shutterstock / Mihai Simonia

The high cost of water and the large amount of fresh water used in all consuming units of the facility translates to a huge expenditure for the company. Thus, a more pragmatic solution was needed in order to cut expenses and increase plant's water efficiency. DHI's water audit has helped plant operators in understanding water consumption and evaluates the feasibility of using alternative water sources in their processes. The strategies designed and suggested by DHI through this water audit, if implemented, can help reduce total fresh water consumption by up to 45%.

CLIENT

A specialty chemical plant

CHALLENGE

- Water efficiency in production and utilities areas
- Polluted wastewater as a result of chemical processes in the production area
- Identification of alternative water sources to minimise the water demand

SOLUTION

Development of potential scenarios for water usage minimisation and plant efficiency based on a plant-wide water audit, water balance chart, flow measurements and results from a water quality analysis.

VALUE

- Assessment of available alternative water sources
- Recommendation using part of DHI's 6R scenarios (Reduce, Renew, Reuse, Recycle, Reclaim, Return) for fresh water minimisation
- Increase plant's water efficiency by up to 45%

LOCATION/ COUNTRY

Jurong Island, Singapore

SOFTWARE USED

WEST

This project was carried out by the client using MIKE Powered by DHI software.

PLANT-WIDE WATER AUDIT FOR WATER CONSUMPTION ASSESSMENT

As part of assessing the overall efficiency of the plant, DHI has carried out a water audit to analyse the plant's processes. The historical operational data and batch process behaviour have been studied and taken into account in the water balance chart. Using DHI's clamp-on flowmeter, unmetered water consuming units were measured to get an accurate reading of the amount of water consumed.

With MIKE Powered by DHI's WEST software, a water network was developed to quantify water usage in various water consuming units. The software was selected for its limitless flexibility in developing customised model libraries for different types of industries.

DHI's water audits provide flow monitoring to quantify water usage and analyse flow behaviour. © Shutterstock / Pan Demin

ASSESSMENT OF ALTERNATIVE WATER SOURCES

In identifying alternative water sources to be used in replacement of fresh water, DHI has evaluated four alternative water sources in the area that can be used for processing purposes:

- Harvested runoff water
- Cooling tower blowdown
- Steam condensate
- On-site wastewater

Due to its low mineral content, rainwater is a good alternative to fresh water. Collected rainwater runoff can be used as cooling tower make-up after simple filtration treatment. For collected storm water runoff, additional treatment may be required.

Cooling tower blowdown can also be recycled as cooling tower make-up. Combined softening and filtration processes can be applied to remove suspended solids and other constituents.

Currently, different types of wastewater streams from production and utility areas are mixed in the internal wastewater treatment plant (WWTP) before further treatment by an external link. We have recommended that the plant's internal WWTP only receives contaminated streams from production and utilities areas, such as process water and chemical wastewater, and recover relatively clean streams—such as steam condensate, cooling tower blowdown—for potential alternative water sources.

PLANT OPTIMISATION THROUGH WATER EFFICIENCY APPROACHES

We adopt an integrated approach to production and technology. In assessing water efficiency in a production plant, we look at the entire industrial value chain including:

- the use of resources
- the potential for water re-usage and optimisation in the production area
- the reduction of wastewater and environmental impacts

POTENTIAL FRESHWATER MINIMISATION

The water audit study has identified and assessed several strategies using part of DHI's 6R scenarios to minimise fresh water consumption:

- Reduce

  Reducing overall water usage by improving cycle of concentration of the cooling towers, reducing condensation losses and steam leaks and employing a water harvesting system.
- Renew

  Prevent non-revenue water loses within the facility by optimising the cooling tower system through the installation of an automated blowdown control and a temperature control system to monitor heat transfer.
- Reuse/ Recycle

  Used water obtained from processes with high water quality requirements may be reused in processes with lower quality requirements. Steam condensate with low mineral content can be reused directly in the production or utility area.
- Reclaim

  This is the end-of-pipe solution where water from different sources mixes. The water collected will then be treated using advanced water treatment processes to be utilised in other parts of the plant and can be used as an alternative to fresh water.

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