DHI SOLUTION

IMPROVING THE ENERGY EFFICIENCY OF COOLING SYSTEMS

Developing advanced algorithms to monitor cooling systems

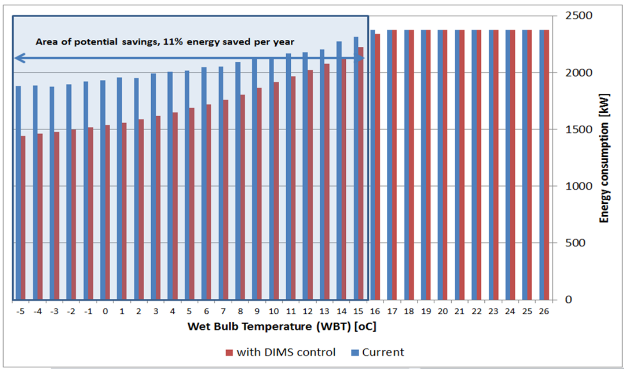
ENERGY SAVINGS

Cooling water is used extensively in a number of industries to lower process temperatures. Cooling systems used to circulate the water across cooling towers and operate fans in forced draft units consume a significant amount of energy. The efficiency of the cooling system has a major impact on production in some industrial plants. Often there is a direct link between the cold water temperature and process efficiency. Using our research and development resources, we examined various ways to improve the energy efficiency of cooling systems utilising new advanced algorithms based on on-line water distribution models.

We conducted a study using historical data and operational measurements from a major petrochemical production site. At this site, crude oil is processed into petrol, diesel fuel, furnace oil, aviation fuel, plastics and other petrochemical products. The efficiency of a cooling tower is closely related to weather conditions, including humidity and temperature. As such, during our study it was assumed that the mix of water and air flow (L/G ratio) in cooling towers could be optimised in real-time following long-term (seasons) and short-term (diurnal) weather variability.

Our study revealed the potential for substantial energy savings, especially in cold and moderate climates using various options, such as changing the:

- L/G ratio
- water flow
- air flow using fan settings
- water pressure
- cooling water distribution



Saving potential of one of the algorithms in the studied range of wet bulb temperatures

SUMMARY

CLIENT

- Industrial plants
- Cooling system operators
- Consultants
- Contractors

CHALLENGE

- Need for energy efficiency
- Need to ensure process safety and keep it within acceptable thresholds
- Need to optimise cooling capacity
- Need to improve process efficiency and maintenance

SOLUTION

Real-time control using on-line water distribution models, weather information and production data

VALUE

- Improved energy efficiency of water cooling systems
- Increased energy savings
- Reduced CO_2 footprint
- Improved heat exchangers monitoring
- Compliance of risk levels with target values

Applying optimisation to some of the identified options in the cooling system resulted in potential energy savings of 11% per year. Opportunities for further savings were identified.

The highest saving potential is directly linked to reduced cooling water flow and pressure. Caution is, however, required as this may have a negative impact on the production processes. In order to avoid adverse effects, an in-depth understanding of the system's hydraulics is required. To safely reduce cooling water flow and pressure, it is necessary to continuously monitor the water conditions of all significant heat exchangers using an on-line water distribution model that calculates flows and pressures in the entire system. The results of these calculations are then combined with basic process data to monitor critical water-side heat exchange parameters such as:

- heat transfer coefficients
- flow speeds
- skin temperatures

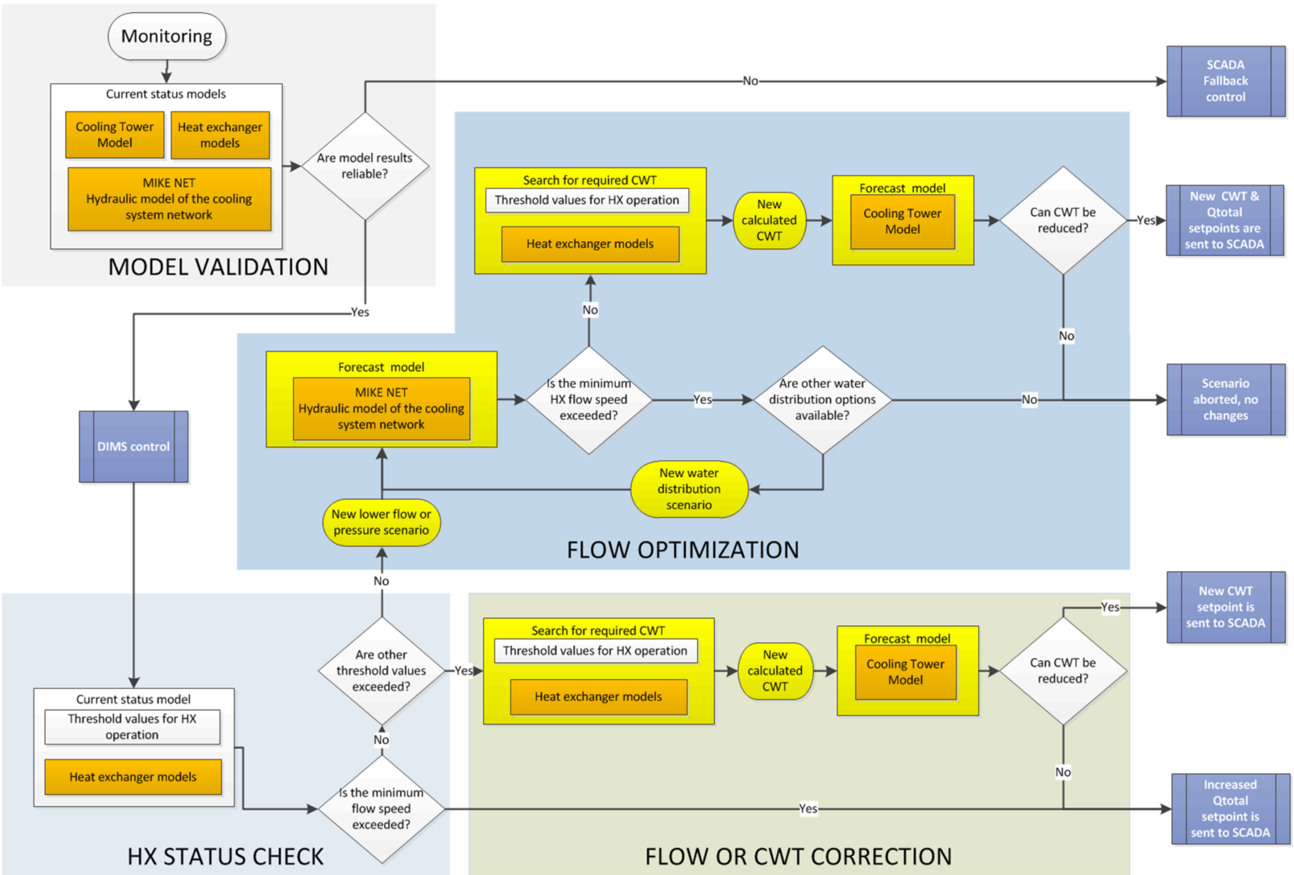
Our control system then compares the calculated values against predefined threshold values that trigger alarms when the process safety is threatened. This ensures that any optimisation step does not adversely affect the production process.

MONITORING HEAT EXCHANGERS

The method described above can also be applied to existing process monitoring and control systems. In plants where cooling capacity is a limiting factor (in warm climates, for example), continuously monitoring critical water-side heat exchanger parameters can answers questions such as:

- When and where is the risk of scaling significant?
- When should the water flow be increased to improve process safety?
- Which installations have the greatest 'cooling comfort'?
- What will be the impact of reducing cooling water flow on various process nodes?
- How should the cooling water be distributed to particular process nodes in order to achieve the highest plant productivity?
- How should the cooling system be adjusted for daily and seasonal air parameters changes?

With the use of our monitoring, modelling and optimisation technology, such questions can be answered. This enables operators to increase process safety, reduce energy costs and enhance productivity significantly.



General overview of the flow optimisation algorithm

Contact: Jan Kwiatkowski - J.Kwiatkowski@dhigroup.com or Palle Lindgaard-Jørgensen - plj@dhigroup.com
For more information visit: www.dhigroup.com