DHI SOLUTION

ANALYSIS OF MICROBIAL BARRIERS IN WATER SUPPLIES

Raw water quality • Treatment processes • Microbial risk • Upgrade of water works

EMERGING PATHOGENS AND INADEQUATE MICROBIAL BARRIERS

In recent years, drinking water-borne disease outbreaks have been increasingly reported from developed countries and also from water supplies operating normally without malfunction. These outbreaks are usually caused by inadequate microbial barriers in the water treatment process. Most water works were designed several decades ago and are now trying to cope with changes in raw water quality. Climate change is affecting temperature and rainfall patterns. This is a likely explanation for the increasing levels of natural organic matter and more frequent episodes of high turbidity observed in raw waters. The increased variability in raw water quality negatively affects the performance of the microbial barriers in conventional treatment processes.
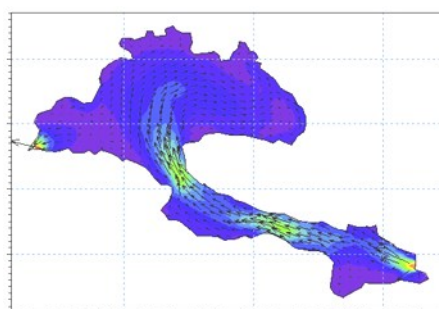
With increasing analytical power, emerging pathogens are being discovered in raw waters. Chlorine-resistant organisms like *Cryptosporidium* were often not taken into consideration when the water works were designed. Consequently, consumers may now be exposed to unacceptable risk of infection. In addition to this, water regulations have become stricter. Health risk-based drinking water management such as Water Safety Planning, are required by many countries, including those in the European Union.

We offer comprehensive support in health risk analysis and evaluation of treatment processes for water works, with respect to the barriers against microbial contamination. The evaluation provides water managers with the information necessary to adapt their water works to current and future challenges.

RAW WATER QUALITY

The vulnerability of raw water is evaluated based on water quality analyses and mapping sources of contamination upstream of the water intake. Thereby the magnitude and variability of contamination with pathogenic microorganisms can be estimated.

The sources and transport of pathogens in the water source may also be described in a hydrodynamic model.

A three-dimensional (3D) hydrodynamic model in MIKE 3 of a Swedish lake used to describe the transport of contamination in the water source. The red and green areas indicate rapid water flow. Blue and purple areas are those with almost stagnant water

SUMMARY

CLIENT
- Water supply companies
- Water works
- Water industry associations
- Food industries

CHALLENGE
- Ageing infrastructure
- Changing raw water quality
- Emerging pathogens
- Stricter regulations on risk management
- Documented waterborne outbreaks in water supplies without malfunction

SOLUTION
- Investigation of the raw water quality, variation and threats
- Analysis of the efficacy of existing microbial barriers in water works
- Application of established risk analysis and management methods such as Quantitative Microbial Risk Assessment (QMRA), Good Disinfection Practice (GDP), Hazard Analysis and Critical Control Points (HACCP) and Water Safety Planning
- Identifying a strategy for upgrade of filtration and disinfection processes at the water works

VALUE
- Information on the status of the microbial barriers for water supplies with regards to the state-of-research and current national regulation
- Sound base for making technical decisions with respect to upgradate of the water works
- Meeting the criteria for the pre-design of process equipment and specifications in bid documents
- Enabling documentation to facilitate the application for funding of investments in necessary upgrades

The expert in **WATER ENVIRONMENTS**

DHI

MIKE 3 Ecolab can be used as a tool for scenario studies of contamination events or used online as a forecast model.

EXISTING TREATMENT PROCESSES

The function and variability of treatment processes are investigated as part of the risk assessment. These include dosages of disinfectants and operational strategies such as the 'filter to waste' practice after backwash. A tailor-made sampling program and online measurements can be carried out to quantify the performance of the treatment plant for microorganism removal.

RISK ANALYSIS AND MANAGEMENT TOOLS

At DHI, we apply tools for risk analysis and evaluation in drinking water treatment and supply such as Good Disinfection Practice (GDP) developed by Norsk Vann and Quantitative Microbial Risk Assessment (QMRA). The tools provide input to Water Safety Planning by identifying critical control points and parameters for operational monitoring. We have successfully applied these tools to a number of water supplies. For example, water works may comply with the demands for reduction of bacteria and viruses, but have insufficient removal of the chlorine-resistant parasites *Giardia* and *Cryptosporidium*. In such a situation, we can help to implement a state-of-the-art disinfection strategy.

POSSIBLE NEED FOR UPGRADE

With our comprehensive understanding of treatment processes and risk analysis results as well as our many years of experience, we can identify the need to upgrade the treatment chain. This could include the introduction of UV disinfection, or membranes for improved particle retention. If waterworks need to be modernised, we can assist with the choice of state-of-the-art processes which fulfil current and anticipated future requirements.

ASSISTANCE WITH PILOT PLANT TRIALS

We offer our clients independent support in planning, conducting and evaluating pilot plant trials of water treatment processes. In this way, the inclusion of biological filters or membrane technologies (such as ultrafiltration or nanofiltration) can be thoroughly tested before an investment decision is taken.

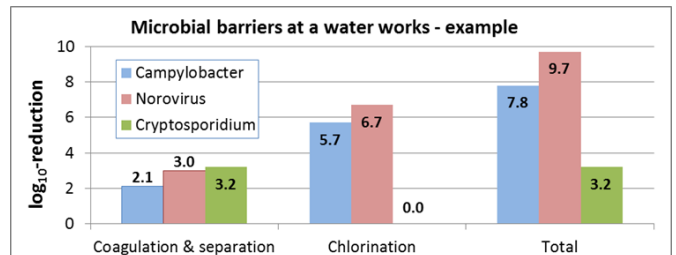## CRITERIA FOR DESIGN AND PROCUREMENT OF PROCESS EQUIPMENT

With the criteria for the process upgrade specified, the client has the best available foundation for pre-design of the process equipment and for formulating the technical specifications in the bidding documents. Specific criteria for the removal or inactivation of microorganisms over the procured treatment equipment help to ensure the supply of safe water in the future.

Microbial contamination often poses a public health risk

Trailer with online analytical equipment in the field

Calculation of microbial barriers against bacteria, virus and parasites

Estimate of probability of infection by QMRA

©DHI

The expert in **WATER ENVIRONMENTS**