Water Quality Modeling of Drinking Water Storage Reservoir Noardburgum

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Abstract

The water storage reservoir at the WTP Noarburgum is used to even out demand and supply and ensure a stable drinking water production capacity. At Noardburgum groundwater is used as a source for the drinking water production and no chlorine is used as a disinfection method in the last step of the production process. The residence time of the water in the storage facility should not be too long. The microbiological water quality could deteriorate by aging of the water. Water quality deterioration in tanks and reservoirs can result from many causes. These include taste and odor production, biofilm development on surfaces and sedimentation.

At the moment the rectangular reservoir has a single pipeline which serves as an inlet during the fill cycle and as an outlet during the draw cycle. This study aims to examine the current mixing characteristics of the reservoir and to investigate possible design improvements to the given configuration to ensure good mixing. A possible configuration is the implementation of an extra outlet pipeline and the use of baffles to prevail plug flow conditions.

Two and Three dimensional numerical simulations have been performed with COMSOL Multiphysics®. The numerical results were validated with a physical scale model and tracer injections (see figure 1). The present configuration was found to be insufficient for good mixing. By improving the inlet flow momentum and the inlet location better mixing conditions could be established. Residence Time Distribution curves were derived and evaluated for a number of baffles with the plug flow configuration. A number of five baffles were sufficient to establish plug flow conditions with a minimum of short cutting and stagnant zones.

COMSOL Multiphysics® proved to be a valuable and a cost-effective design tool.
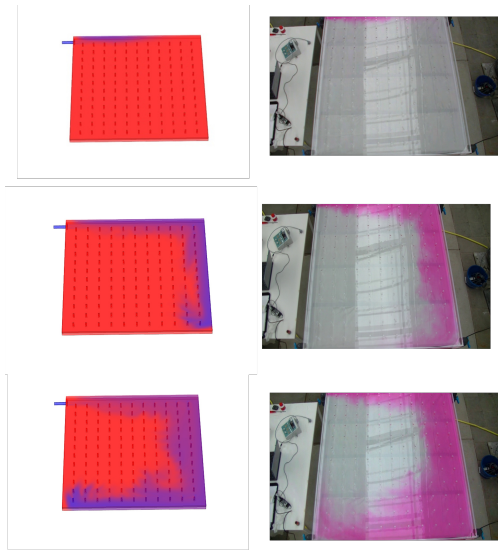
Figures used in the abstract

Figure 1: Snapshots of model and tracer experiment at 120 s, 240 s and 400 s