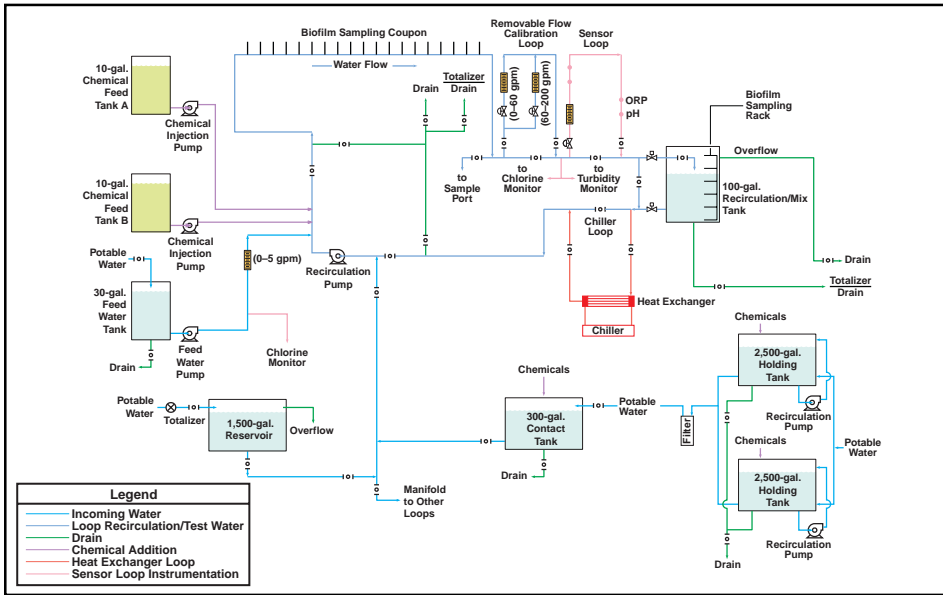


Simulated Water Distribution System— Demonstration

National Risk Management Research Laboratory
Water Supply and Water Resources Division
Water Quality Management Branch and Microbial Contaminants Branch



Schematic of Distribution System Simulator (DSS)



Distribution System Simulator - Top View



Distribution System Simulator - Front View

Overview

The EPA designed and fabricated the distribution system simulator (DSS) to evaluate and understand the dynamics which influence water quality within water distribution infrastructure systems in the United States and worldwide. This DSS unit is designed to simulate continuous flow conditions observed in a typical distribution system. There are six individual 75 feet lengths of 6 inch diameter ductile iron pipe arranged in “pipeloop” configurations to simulate a distribution system. The pipeloop system can be configured to operate in various modes: 6 individual loops, collectively as one unit, or in various experimental configurations. It is equipped with two 1,500 gallon reservoir tanks to simulate a comprehensive simulated distribution infrastructure system. This unique engineering design permits operating any number of the six loops under various experimental operating parameters. It also has two 2,500 gallon holding tanks that can be filled with off-site source water. The distribution system is in-

terfaced with a Supervisory Control and Data Acquisition (SCADA) system which can monitor and control pH, temperature, chlorine, flow, and chemical addition operating conditions and parameters. Liquid samples can be collected from various locations along the DSS. Biofilm samples can be collected from 18 different coupons in the main pipeloop and from the Biofilm sampling slide rack in the 100 gallon recirculation/mix tank. The unit also has additional operating controls to achieve experimental requirements. These include sensor and flow calibration loops, as well as a chiller loop. The DSS units are above ground to permit easy access to the entire distribution systems. Experimental studies are designed to evaluate the physical, chemical, and biological phenomena that occur in drinking water distribution systems. Results will be used to provide guidance on how to maintain high water quality through the infrastructure of distribution systems.

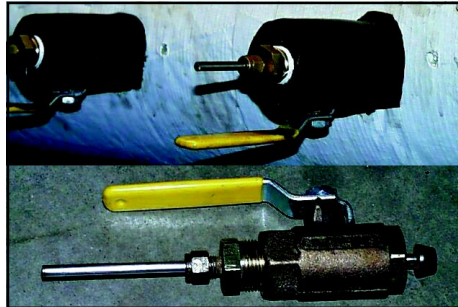
Relevance

Throughout the world there are millions of miles of water distribution pipe lines which provide drinking water for use by individuals and industry. Although these distribution systems provide drinking water to the world, very little is known about the physical, chemical, and biological phenomena that occur within them. Some of these water distribution systems have been in service well over one hundred years. As water moves through these distribution systems, it comes into contact with a wide range of material which can cause significant changes to the quality of the finished water supply. For example, solids in finished water can settle under low flow conditions and

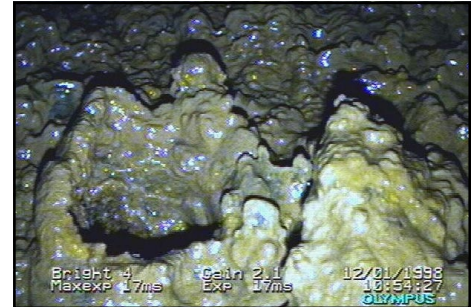
can be resuspended during high flow. Various disinfection agents and water additives react with organic and inorganic materials within the distribution system, generating by-products which may be undesirable in the water supply. Oxidant resistant microorganisms colonize pipe surfaces, producing a complex micro-environment known as "biofilm." Biofilms are highly resistant to many disinfection methods and techniques. The current research will investigate experimental parameters that influence biofilm growth, water quality, and disinfection by-products. The research will also allow a better understanding of the dynamics inside distribution systems.



Pipe deterioration over time



Coupons in pipe (top); Coupon (bottom)



Biomass inside pipe

Objectives

The DSS provides researchers with a mechanism to study how water quality is affected during distribution. The system also provides researchers with a tool to evaluate the effects of water conditioning on the quality of delivered water. Results from such research will be used to provide guidance on how to maintain high water quality during distribution. A secondary objective of this project is to develop, evaluate, and demonstrate real time monitoring of water quality parameters within distribution systems using remote telemetry. Results from this research will be used to provide guidance on how to remotely monitor water quality within distribution systems.

Goals

Conduct experimental studies under controlled conditions to develop a better understanding of the physical, chemical, and biological phenomena that occur in drinking water distribution systems. Determine what factors influence biofilm growth within such systems. Develop and test mechanisms for the enhancement and control of biofilm growth within a simulated distribution system. This research will also evaluate real time monitoring and archiving of water quality data using remote telemetry.

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