Public Abstract

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Title:Management of DBP Formation Using Enhanced Treatment Technologies & an Array of Prediction Tools

Disinfection is a vital part of a drinking water treatment process and chlorine is the most widely used disinfectant in the world. Though known for its effectiveness, usage of chlorine does lead to the formation of carcinogens which are commonly called Disinfection By-Products (DBPs).With the introduction of the Stage-II Disinfectant and Disinfection By-Product (D/DBP) regulations, water utility systems must be increasingly cognizant of water quality as it progresses through the supply system and ultimately reaches customers. This study is performed in an effort to develop a simple, non-invasive and cost-effective technology that will effectively lower organic precursors by having water utilities reuse their treatment residuals. Jar tests are used to simulate drinking water treatment processes with coagulants - Aluminum Sulfate (Alum), Poly-Aluminum Chloride (PACl) and Ferric Chloride and their residuals. Ten Coagulant-to-Residual (C/R) ratios are tested with water from the Missouri River and alluvial ground waters. This treatment results in heavier floc formation and leads to improved sedimentation of organics and additional removal of Aluminum and Iron. An average of 21%, 28% and 33% additional TOC removal can be achieved with C/R ratios < 1 with Alum, PACl and Ferric chloride respectively.

This study will also focus on determining whether the addition of residual affects chlorine demand, chlorine residual, decay rates, and DBP formation. To simulate the DBP formation and chlorine decay kinetics in small-scale distribution systems, water treated with various coagulants and coagulant to residual ratios was tested in a jar-type simulated distribution system. The TTHM formation over time is at least 35% higher on day 0, 39% higher on day 1 and 47% higher on day 3 in all systems when treated only with coagulants versus when treated with residuals at best C/R ratios irrespective of what coagulant used. It can also be seen that higher (at least 42%) residual concentration can be maintained on day 3 in all water systems when treated with residuals at best C/R ratios versus when treated with only coagulants. Increase in turbidity doesn’t always result in increase in TOC when treated with coagulants and vice versa when treated with residuals at best C/R ratios. TOC, TTHM and chlorine residual follow the pattern of increasing and decreasing with each other and with type of treatment (C/R ratios and coagulants) while turbidity doesn’t irrespective of the coagulant used.

Compliance also requires a better understanding of reaction kinetics changes and wall effects with different materials used in the distribution system.To validate our results in full scale distribution system physical conditions, effect of different materials, wall effects, bulk reactions and water movement is analyzed using Simulated Distribution System (SDS) tests, Material Specific Simulated Distribution System (MS-SDS) tests Pipe Loop and Pipe Section Reactor (PSR); all built using materials from City of Columbia distribution system.On an average, just the choice of pipe materials such as PVC and Iron can account for as much as 36 % difference in TTHM formation and 60% difference in chlorine residual decay over time irrespective of the prediction model and operational strategy used.In case of Iron, PE is < 1, leading us to conclude that in the iron pipe systems there is a net loss of TTHM yield due to non-TTHM forming chlorine demand imposed by the pipe environment, whereas in PVC pipe, PE is > 1