

THM GENERATION DURING WATER TREATMENT PROCESS AND INSIDE THE WATER DISTRIBUTION SYSTEM

¹ANCA ELENA GURZĂU, ²DANIELA VIOLETA DUMITRESCU

¹Environment and Health Centre, ²National Institute for Nonferrous and Rare Metals, Bucuresti

Abstract: The water chlorination procedure, successfully used for the control of water borne infections diseases for more than a century determines the formation of chlorination byproducts, such as halogenated trihalomethane formed from the reaction of natural organic matter present in all types of water, with chlorine used as a disinfectant in water treatment. The total concentration of trihalomethane and the formation of individual THM species in chlorinated water strongly depend on the composition of the raw water, especially on the presence of the natural organic matter in water, on operational parameters, such as ultrafiltration and chlorine dose, reaction time, temperature/season, pH and in the distribution system by the pipe environment created from the occurrence of residual chlorine, the material specific from the pipe wall (PVC), the bio film and the bioactivity of bacterial growth in bio film.

Keywords: water, trihalometans, chlorination, distribution system

Rezumat: Procedul de clorinarea a apei folosit cu succes timp de mai mult de un secol în controlul bolilor infecțioase de natura hidrică, determină formarea unor produși secundari, cum sunt trihalometanii halogenați, ce apar din reacția materiei organice prezente în toate tipurile de apă cu clorul utilizat ca dezinfectant în tratarea apei. Concentrația totală de trihalometani și formarea speciilor individuale de trihalometani (THM) în apa clorinată, depind foarte mult de compoziția apei brute și în special de prezența materiilor organice, de parametrii operaționali ca ultrafiltrarea, doza de clor, timpul de contact, temperatura/sezonalitate și pH iar în sistemul de distribuție de mediul ambiental intratubular creat de: existența clorului rezidual liber, materialul din care este realizată tubulatura (PVC), prezența biopeliculei și bioactivitatea microbiană.

Cuvinte cheie: apa, trihalometani, clorinare, sistem de distribuție

INTRODUCTION

An important indicator for the population health it's that the covering level with safety sufficiently quantity of drinking water it having the maximum values of standard parameters.

To be safety to drink the water it,s treated by water plant classic processes including: the flocculation /

settling, filtration and disinfection, wich generats a lot of disinfection by products (DPB). The trihalometans (THM) and haloacetic acids (HAA) are the main classes of DPB.

THM is formed from the reaction of natural organic matter present in water, considered as precursors of THM and chlorine used for disinfection thereof, the organic compounds derived from methane, by substitution of 3 hydrogen atoms with halogen.

Normally, in water, are only 4 THM: bromdiclormetanul, dibromclormetanul bromoformul and chloroform, the last one being most often cited in literature (2.4) as having the highest concentration in both chlorinated water for public consumption as well during the experimental clorination.(2)

The total concentration of trihalometans and individual species of THM formation in chlorinated water, are highly dependent on the particular raw water matrix, high temperature/seasonally differences, alkaline pH, different operational parameters as filter sand/anthracite or ultrafiltration by membranes system, chlorine dose, contact time, and reclorination.

Furthermore, recent studies have revealed that certain aspects that depend of internal environment distribution system, such as: the existence of residual chlorine (generally from 3 mg / l and above), the pipewall material (PVC), biofilm and the microbiological activity level, all may contribute to the appearance of a complex system reaction wich influents the THM formation.(2.4)

The most important involved parameter in the dynamic generation THM in aqueous medium, is the **concentration of used chlorine**, that varying according to other parameters such as temperature, pH or concentration of natural organic substances. Thus typically high chlorine concentrations cause large amounts of chloroform.(4)

The formation of THM and implicit the chloroform, are also influenced by the **composition raw water** as like the presence of natural organic substances (humic substances, microbial exudates and other materials dissolved originating from soil and terrestrial vegetation or from other aquatic biological processes).(2,4,5)

Numerous studies have examined the relationship between the **bromine concentration** durring water treatment and various species of THM formation.

CLINICAL ASPECTS

The concentration of bromine increases the concentration of THM increases and more brominated THMs forms. In the presence of bromine and chlorine hipercloros acid can lead the both brominated, chlorinated and mixture by products.(2.4)

Water temperature is another factor that influences THM formation, which explains the seasonally differences in amount of total THM concentration.(2.4)

Some studies have shown that the THM formation is slower durring the winter time when there are low temperature conditions or also in the presence of lower levels of natural organic substances. Under these conditions the chlorine demande is lower therefore the chlorine dose required to maintain an adequate residual in the distribution system is also smaller.(2)

An other factor, mentioned by various authors is the **alkaline pH**, wich has an influence on THM concetration. An increase of 10-25% was measured for a change of pH between 6,5-7,9.

When the water treatment was associated with additional filtration sand / anthracite and ultrafiltration by membranes system, it was reduced the concentration of chloroform in the downstream station effluent, as well as in the distribution system while practice of rechlorination, required procedure by the matrix of raw water, creates premises for additional free residual chlorine appearance so that filtered water, appear to take advantage of such favorable conditions for further formation of chloroform.(2)

It was noticed that, despite an excellent performance level of the water treatment process, in effluent an high yield chloroform formation after chlorine disinfection which indicates that it not selectively removes organic precursors responsible for the formation of chloroform in large volumes of water this water treatment technology.

In the inner tubular wall surface of distribution system it produced the **biofilm** by **adsorption mechanism of different present compounds** in water such as bacteria, protoplasm from bacteriolysis process caused by chlorine and even by some humic substances, biofilm which has an significant impact on THM formation.

Some authors have pointed out that some such adsorbed compounds may participate in the formation of aqueous chloroform even without a valid forerunner.(2)

Another factor indirectly involved in THM synthesis is **the stuff with what is made piping system**, often customary as **PVC**. It was involved only to generate biofilm structure whose organic matter matrix is a real vital support microbial for survival strategy in the pipe environment presence of residual chlorine.

Some authors have studied the system relationship between **THM formation** and **chlorine**, demonstrating that the more the free residual chlorine concentration is higher than 3mg / l also chlorine reaction time with water in distribution system grows as much as chloroform generation amplitude.(4)

Other major factors that participate in the process of THM formation in water distribution system is the **bacterial attachment** to surfaces and **bioactivity** of these organisms, including the microbial regeneration process and production of extracellular polysaccharides.

It seems that chlorination acts selectively and unpredectibly on bacteria, which explains their persistence and regeneration, while promoting additional formation of chloroform.

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