Report on assessment of the process performance including assessment of the OBM process as a barrier (Deliverable D 2.2.2)

Natural organic matter (NOM) is a direct problem in drinking water due to color and taste. Indirectly, NOM is a problem because it reacts with the most commonly used disinfectant, chlorine, to form disinfection by-products (DBPs). Use of ozone as the primary disinfectant is increasing but the formation of ozonation by-products is also of concern, particularly due to the increase in bio-growth potential and formation of certain compounds that may be a health concern. The ozonation process will oxidize the NOM content removing color and forming more easily biodegradable organic matter in the water. The formation of biodegradable organic carbon in drinking water can cause regrowth problems in the distribution network. Biologically active filters can, however, be used to remove the biodegradable fraction from the ozonated water. This is the basis for developing an ozonation/biofiltration process for the removal of NOM in drinking water. The biofiltration step will produce/release sludge, bacteria, and particles which should be removed from the water prior to distribution. This could be achieved by for instance membrane filtration. Consequently, a novel process combination consisting of the three steps oxidation (ozonation), biodegradation and membrane filtration (the OBM-process) is being developed.

Importance

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Approach

We have investigated the process combination consisting of ozonation, biofiltration, and submerged hollow fiber ultrafiltration unit. The pilot plant consisted of the following steps; two ozone columns in series, two biofilters in parallel followed by an immersed Zenon ZW10 ultrafiltration membrane reactor module.

Result

With the process combination Ozonation-Biofiltration-Membranefiltration (the OBM-process) an average removal of 63% for UV-absorbance (UV254), 79% for color, and 28% for DOC was obtained treating NOM containing surface water. In this paper, focus has been made on the removal of particles after the ozonation and biofiltration treatment steps, using a submerged hollow fiber ultrafiltration membrane reactor. For this purpose the membrane performed adequately. The ultrafiltration step did not have a significant impact on the removal of color, UV254, and DOC. However, the SS and the heterotrophic plate count (HPC) were almost completely removed, and the turbidity was reduced by 65% by the membrane filtration, even at very high fluxes. Fouling occurred during operation, and operational factors of both the ozonation/biofiltration and the membrane reactor were important for controlling this. The experiments at pH 6.5 gave a higher permanent fouling than at pH 8.5, which was caused by the different oxidation pathways and consequently by the change in size and hydrophobicity of the by-products. On the other hand, the reversible fouling was less important at low pH. The mechanical cleaning was efficient, however, it seemed that the air scouring participated to the formation of submicron particles which favored the fouling.

More information
This study is published in Water Science and Technology under the reference: Stein W. Osterhus, Kamal Azrague, TorOve Leiknes and Hallvard Odegaard, (2007), “Membrane filtration for particles removal after ozonation-biofiltration”, Water Science and Technology, 56 (10), pp 101-108. For further information contact:

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