Residual Dissipation in NF and RO Finished Waters Relative to other Finished Waters

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Abstract

Waters produced from five different treatment systems (aeration (G1), NF (G4), CSF-O_3-GAC (S1), IMS (CSF-NF or S2) and high pressure RO are blended and distributed to 18 different pilot distribution systems (PDS) to determine the effect of blending on distribution water quality. PVC, lined iron, cast iron and galvanized steel pipes taken from actual distribution systems were used in the construction of the PDSs. A HRT of five days was utilized for the study. Models for free chlorine and chloramines dissipation were developed using non-linear regression from the PDS data. The model parameters are pipe material, chlorine dose (mg/L as Cl_2), temperature (^oC), time (hr), and UV254 (cm^{-1}).

Free chlorine model:

$$Cl_2 = Cl_0 * \exp(-K * A^{(T-20)} * time * UV254)$$

Total chlorine (chloramines) model

$$Cl_2 = Cl_0 * \exp(-(K_B * UV254 + K_W) * A^{(T-20)} * time)$$

The models follow first-order kinetics with respect to chlorine dose. The model for free chlorine includes an overall rate constant whereas the chloramines model was further developed to separate the effect of bulk reactions from the wall reactions. The results for the models show that chlorine decay is highly affected by the pipe material. The rate of chlorine dissipation for PVC and lined iron is less than that for cast iron and galvanized steel. In general PVC pipes have the capacity to keep chlorine residual longer than the other materials. The iron-based pipes show a rapid decline in the chlorine concentration due to the reaction of chlorine with the corrosion products of iron.

The models show that the rate of chlorine dissipation increases with an increase of either temperature or organic content. TOC reduction increases PDS residual. Fifty percent TOC removal corresponded to doubling the residual presence. Residuals are difficult to maintain in waters above 25 ^oC. Pipe material was the most significant factor affecting residual presence. The free chlorine and chloramines models were verified using independent data.