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Break-point chlorination drawbacks for a complex impurified groundwater sources (NH_4, Fe, Mn) potabilization treatment

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Chlorine is the only chemical oxidant used in drinking water treatment for the ammonium removal. Break point chlorination takes place at a pH range of 7-8 with significant efficiencies, the chlorine demand for oxidation of $N\text{-}NH_4^+$ being influenced by pH, $N\text{-}NH_4^+$ concentration, Cl_2: $N\text{-}NH_4^+$ ratio and temperature.

Taking into consideration chlorine reactivity against most of the inorganically oxidizable compounds (NH_4^+, NO_2^-, SO_3^{2-}, S^{2-}, Fe^{2+}, Mn^{2+}, Br^-) and organic compounds (humic acids, organic compounds with nitrogen within the molecule) the chlorine dose for $N\text{-}NH_4^+$ oxidation varies across a large domain Cl_2: $N\text{-}NH_4^+$ = (7.6 ÷ 20) : 1, being experimentally determined for each source that requires treatment.

For a special case of an impurification matrix resulting from the association between $N\text{-}NH_4^+$ concentrations above 1 mg /L, alkalinity < 200 mg HCO_3^- /L and organic nitrogen compounds (organic N > 1 mg/L), the impossibility of a practical treatment was demonstrated do to: (1) the chlorine action on the organic nitrogen structures that leads to their degradation with ammonium release, there for the chlorine demand for initial NH_4^+ + the formed NH_4^+ oxidation being very high, above 60 mg/L and (2) the water pH becomes acid (pH = 3-5) during the chlorination process due to the low buffering capacity of the water.

In this paper chlorine treatment at different Cl_2: NH_4^+ ratios under specific work conditions is presented comparatively for a few groundwaters containing a variable amount of $N\text{-}NH_4$ (0.96 ÷ 2.35 mg/L) and organic N (0.04 – 1 mg/L).

The article presents the reagent selection (Cl_2, $KMnO_4$, ClO_2) and the oxidation parameters (pH, dose, reaction time) of Mn^{2+} found in the groundwater source in concentrations of 83-92 µg/L.

Furthermore, the adapted water treatment flow for groundwater with this type of impurification matrix is also presented.

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