Factors affecting activated carbon’s bromate removal ability from concentrated, organic load rich cooling water, in the presence of residual bromine

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ABSTRACT

Bromination, in the form of hypobromous/hypobromite addition, is a broadly applied disinfection method used in cooling water treatment. One of bromination’s most hazardous by-products is bromate, which results from hypobromous/hypobromite decomposition. Such decomposition is promoted by favorable conditions prevailing within a typical cooling circuit. In this work bromate removal from cooling water, using activated carbon, is studied. A number of commercial activated carbons are evaluated with respect to their ability to adsorb/reduce bromate from ultrapure water. Using sampled cooling water as reference matrix, isotherm curves are constructed under increasing pH values as well as applying 1:1, 1:2 and 1:3 mass ratios of polyacrylate/phosphonate anti-scaling agents, copper ion and residual bromine. The resulting curves fit the Freundlich model best. In terms of adsorption quality, as expressed by Freundlich model’s $K_F$ constant, pH is an important determinant of activated carbon’s bromate removal ability, as it is also the case in drinking water. Appreciable copper ion presence, followed by polyacrylate/phosphonate and residual bromine, also has negative influence. Dubinin–Radushkevich model, which provides the second best fit, is used to evaluate activated carbon’s maximum adsorption capacity. It is proven that all the above parameters significantly affect it.

Keywords: Cooling water treatment; Disinfection; Bromate; Hypobromous decomposition; Activated carbon