

Using fluorescence quenching effect to investigate the electrical neutralization ability for different aromatic organic compounds

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The sources of organic matter in water include natural organic matter and synthetic organic matter. Most part of natural organic matter in water is humic acid which molecular weight is counted for hundreds to hundreds of thousands. The existence of humic acid not only affects the color and smell of water, but also produces toxic disinfection by-products. In addition, in synthetic organic matter, dye is used in the textile industry and the issue of process that produced waste water has been aware of increasingly. Therefore, effectively removing organic matter from water through the chemical coagulation process continues to be considered as a fairly important index of water purification efficiency. When the organic matter contains an aromatic heterocyclic structure and is excited by absorbing a specific radiation, it will eventually release the absorbed energy to the lower electronic energy level. Normally, the energy is released in the form of fluorescence. On the other hand, if the organic matter and metal ions are bonded to each other, the fluorescence intensity will be reduced. This phenomenon is known as the fluorescence quenching effect. In this study, the Stern-Volmer formula $F_0/F = 1 + K_q[M]$ will be used to evaluate the ability of the Al^{3+} coagulant complex with organic matter. Where F_0 is the fluorescence intensity in the absence of Al^{3+} quencher and F is the fluorescence intensity in the presence of Al^{3+} quencher, $[M]$ is the concentration of the quencher, and K_q is the equilibrium constant or quenching constant. Furthermore, the value of K_q also represents the electrical neutralization capacity of coagulant under different conditions such as pH, molecular weight, hydrophilicity, functional groups of organic compound and coagulant dosage etc. The results in this study show that (1) under conditions of solution pH=6, the order of K_q values with different aluminum chloride dosage are Humic acid > Quinic acid > Salicylic Acid. Indicating that the molecular weight of organic matter is an important factor causing the degree of electrical neutralization ability; (2) under different solution pH, Reactive Blue 49 obtains the maximum K_q values than Direct Red 28 and Disperse Red 60 those often used in textile industry demonstrating the more number of sulfonic groups in the dye molecule, the more intensify electrical neutralization ability. (3) The K_q value of hydrophilic molecule (Direct Red 28) is higher than hydrophobic molecule (Disperse Red 60). These results indicate that the hydrophilicity of organic matter has a certain influence on the electrical neutralization by aluminum ions. All of results in this study show that the Stern-Volmer formula is a viable and simple method in operation to find the influencing factor of electrical neutralization ability between organic matter and aluminum coagulant and find the optimum coagulation conditions.

Keywords: Aluminum chloride, Coagulation, Aromatic organic compounds, Fluorescence quenching effect, Electrical neutralization