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Fractal characteristics of Al-humic flocs

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ABSTRACT

The characteristics of Al-humic flocs were studied through a series of experiments using microscopic and online optical monitoring techniques. It was verified that Al-humic flocs are of fractal nature and the two-dimensional fractal dimension D_2 derived from image analysis characterizes their morphological properties. At pH 5.0, the structure of Al-humic flocs formed was more compact with higher fractal dimension of 1.43 than that formed at pH 7.0 with lower fractal dimension of 1.17. The difference in floc structure was considered to be related to the different characteristics of hydrolysis and precipitation of aluminum sulfate under these two typical pH values: at pH 5.0 with a low alum dose, the products of aluminum hydrolysis are mainly soluble, while at pH 7.0 at the same alum dose, precipitates form quickly. Alum dose also affected the structure of Al-humic flocs. At pH 5.0 and at a dose to bring about charge-neutralization to $|\zeta| < 10$ mV, flocs formed are more compact with a fractal dimension ranging from 1.43 to 1.49, while at a higher dose when hydrolyzed aluminum precipitates form, flocs are more open and looser with a much lower fractal dimension. During growth, the fractal dimension of the flocs decreased gradually until an equilibrium state was reached. This implies a faster increase of floc volume than the number of primary particles the floc contains.

Keywords: Coagulation; Humic acids; Al-humic flocs; Online monitoring; Fractal dimension; Image analysis

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