



Effects of polyacrylamide molecular weight on the effectiveness of sludge-recycling enhanced flocculation

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ABSTRACT

Although synthetic polymeric organic compounds have been widely used in sludge-recycling enhanced flocculation (SEF) process as the coagulant aid, effects of their molecular weight (MW) on strengthening ability and floc characteristics variation of SEF, that is, floc recovery ability, floc morphology structure and distribution, remained unclear. In this study, those effects under two colloidal destabilization mechanisms, namely electrostatic patch (EP) and near charge neutrality (NCN), in kaolin colloidal system and humic acid–kaolin colloidal system were investigated using response of SEF and traditional flocculation (TF) to polyacrylamide (PAM) with various MW. Results showed that when PAM with MW of 6 and 12 million Da was chosen, compared with TF, residual turbidity of SEF decreased by 21.45% and 27.72%, respectively, in system I, EP; –7.50% and 13.20%, respectively, in system I, NCN; 12.86% and 9.38%, respectively, in system II, EP and –98.46% and 2.10%, respectively, in system II, NCN. In most cases, the fractal dimension of SEF floc was higher than that of TF floc. And SEF could not reduce frequency of small floc, which is not beneficial to the strengthening ability exertion of SEF. However, when using PAM with MW of 18 and 20 million Da, SEF could significantly reduce the frequency of small floc, and the fractal dimension of SEF floc was lower than that of TF floc. SEF residual turbidity of PAM with 18 and 20 million Da MW decreased by 22.21% and 22.89%, respectively, in system I, EP; 21.61% and 32.19%, respectively, in system I, NCN; 33.99% and 35.29%, respectively, in system II, EP and 18.28% and 28.15%, respectively, in system II, NCN. These findings suggest that PAM with high MW and EP status was more beneficial for SEF to exhibit the strengthening ability to TF than PAM with low MW and NCN status. In addition, the recovery factor of TF floc was larger than 1, while sludge-recycling exerted a flocculation enhancement role. This suggested that the recovery ability of broken flocs had definite indication effect on exertion of SEF strengthening ability.

Keywords: Polyacrylamide; Molecular weight; Sludge recycling; Floc formation mechanism; Floc morphology

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