Development of High-Speed Dewatering System of Particulate Suspensions Using Sodium Chloride

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Summary

Recently, the compatibility of a high-speed separation and a reduction in quantity of the sludge is desired in the wastewater treatment earnestly. The major purpose of this study is to develop a new method for successfully achieving high-speed dewatering of particulate suspensions by making good use of sodium chloride (NaCl).

Prior to the development of a high-speed dewatering system, the properties of the filter cake in microfiltration of particulate suspensions were investigated in order to obtain the fundamental information. Titanium dioxide of the rutile form, a kind of metallic oxide, was used as a fine particle in this study, and the average specific filtration resistance and the average porosity in the filter cake were measured in dead-end microfiltration experiments of rutile suspensions under various conditions. The experimental data clearly demonstrated that these cake properties are markedly influenced by such factors of the solution environment as pH and the addition of NaCl, which control the electrostatic charges on the particles involved. Particularly, it is of interest that the average specific filtration resistance in the filter cake is minimal and the average porosity has a maximum around the isoelectric point (pH 8.1 for rutile in this study). Since the van der Waals attraction is dominant around the isoelectric point, the rutile particles tend to flocculate as a result of destabilization, and the very porous flocs are then formed. Consequently, the filter cake formed becomes loose and permeable. It was also shown that by the addition of NaCl the average specific filtration resistance in the filter cake decreases remarkably, while the average porosity is markedly augmented. This is because the addition of NaCl destabilizes the suspension by reducing the double layer repulsion between rutile particles.

As mentioned above, it is very difficult to attain high filtration rate (small specific filtration resistance) and a compact cake (small porosity) simultaneously. This study has suggested a new method for solving this problem, on the basis of the physicochemical nature of the particulate suspensions. Filtration is performed under a condition of the addition of NaCl which enhances the flux by the construction of the very porous cake, and subsequently a reduction of the cake porosity is completed by permeation of the salt-free solutions which may bring about the destruction of the structure of flocs in the cake. The experimental results demonstrated unequivocally that this method can reduce the total operation time taken to produce the filter cake having low porosity from a particulate suspension and is considered to be more efficient than the conventional filtration process from this advantage.