

Experimental Study of Flocculation Kinetics of Latex-based Synthetic Activated Sludge in Waste Water Treatment

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Abstract

The flocculation of activated sludge is a complex process and depends on physical, chemical and biological factors. Activated sludge flocs are themselves a complex mixture of inert suspended solids, containing various micro-organisms and other organic and inorganic particles embedded in a polymeric network of extra-cellular material. Direct research on the characteristics of activated sludge flocculation is complicated by the fact that the living micro-organisms cause a continuous change in sludge characteristics. This makes it practically impossible to carry out controlled experiments or reproduce test results.

In this work, synthetic sludge flocs have been created. They have been used to investigate experimentally the effect of chemical constituents on activated sludge floc formation, floc stability and floc settling. Polystyrene latex particles of a size similar to bacteria are used to simulate individual bacteria; alginate, a polysaccharide, is used to simulate microbial extracellular polymers; fibrous cellulose is used to simulate the filamentous micro-organisms found in activated sludge; and calcium ions are used as bridging cations.

An on-line monitoring technique known as the Photometric Dispersion Analyser (PDA) is employed to evaluate the extent of flocculation. The use of PDA involves measuring the fluctuating light intensity transmitted through a flowing suspension. This technique provides a sensitive monitor of the state of aggregation, and could ultimately form the basis of an on-line technique. The assessment of the technique in monitoring synthetic sludge flocculation has been the primary objective of this study.

Calcium and alginate are added at typical concentration ranges; they determine the amount of polystyrene latex particles in the final synthetic sludge flocs. The flocs begin to form almost instantly upon the addition of calcium ions, and the rate of formation increases with concentration. Lower residual turbidity in the supernatant liquid and an improved settling ability of the synthetic sludge at higher calcium and alginate concentration both indicate improved floc formation under these conditions. These results imply that the formation of divalent ion-polymer complexes and polymer gelation are both important as mechanisms of flocculation.

Keywords: Activated Sludge Flocs, Polystyrene Latex Particle, Alginate, Calcium, Fibrous Cellulose, Photometric Dispersion Analyser (PDA).