

CHARACTERISATION OF ACTIVATED SLUDGE ABNORMALITIES BY IMAGE ANALYSIS AND MULTIVARIATE STATISTICS

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Abstract

The ability to distinguish between different types of abnormalities affecting wastewater activated sludge systems, by means of image analysis and chemometrics methodologies, was studied in the current work. Three experiments were performed in a pilot plant activated sludge system, during periods ranging from 47 to 85 days each, in a total of 108 samples, reflecting filamentous bulking, zooglear bulking and pin point flocs conditions. These samples were further analyzed for the determination of image analysis parameters and of the most commonly surveyed operating parameters. Regarding the image analysis methodology three aliquots of each sample were visualized by bright field and fluorescence microscopy, and a total of 150 images per sample were acquired. These images were then treated by image processing software allowing the study of the contents and morphology of aggregated and filamentous bacteria, resulting in the determination of parameters reflecting the aggregates size distribution, filamentous to aggregated biomass ratio, and biomass viability.

A Principal Components Analysis was then carried out on the obtained data to identify each studied conditions, with cross-validation (CV) as the criterion to determine the optimal number of significant components. Although the optimal number of principal components, obtained by the CV method, was found to be 7, explaining 91.9 % of the data variability, it was found that the use of the 2 first principal components (explaining 61.2 % of the data variability) allowed to clearly identify all three conditions (pin point flocs, filamentous and zooglear bulking). In fact, the samples score plot in these two principal components presented three distinct and non-overlapping zones, reflecting the three different studied conditions. Furthermore, it allowed for the identification and exclusion of 5 outliers within the dataset. Analysing the loading contribution for these 2 first principal components, it was evident the preponderance of the aggregates size distribution and of the filamentous to aggregated biomass ratio, reflecting the importance of these two groups of parameters in the identification and enlightenment of activated sludge abnormalities.