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Predicting SVI from activated sludge systems in different operating conditions through quantitative image analysis

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In wastewater treatment it is well documented that a variety of bulking phenomena, as well as other disturbances, can affect the normal behaviour of an activated sludge system, leading to lower treatment efficiency and biomass settleability. In the last few years, quantitative image analysis approaches, coupled to multivariate statistical analysis, have been increasingly used to clarify filamentous bulking detection and monitoring in activated sludge processes [1,2]. The present study focuses on predicting the Sludge Volume Index (SVI) for different types of conditions affecting an activated sludge system. To that effect, four experiments were conducted simulating filamentous bulking, zoogleal bulking, pin-point floc formation, and normal conditions. Alongside the SVI determination, the aggregated and filamentous biomass contents and morphology was studied, as well as the biomass Gram and viability status. Upon the determination of the image analysis data, regression analysis and partial least squares were used to reduce the dataset and model each studied condition. The obtained biomass contents and morphology data allowed establishing an SVI prediction ability presenting a regression value (R^2) of 0.8834, whereas the Gram and viability status data allowed for a regression value (R^2) of 0.793. It was also found that reasonable to good SVI prediction abilities were obtained using the biomass contents and morphology data, presenting correlation factors (R^2) of 0.7686 for the filamentous bulking conditions, 0.7831 for pin point floc formation, 0.9261 for zoogleal bulking and 0.8275 for normal conditions.

[1] Mesquita DP, Dias O, Dias AMA, Amaral AL, Ferreira EC, “Correlation Between Sludge Settling Ability and Image Analysis Information Using Partial Least Squares”, *Analytica Chimica Acta*, (2009) **642**:1-2:94-101.

[2] Mesquita DP, Dias O, Amaral AL, Ferreira EC, “Monitoring of activated sludge settling ability through image analysis: validation on full-scale wastewater treatment plants”, *Bioprocess and Biosystems Engineering*, (2009) **32**:361-367.