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Surveying activated sludge changes during acclimation with artificial wastewater

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Many processes in the chemical and pharmaceutical industries generate wastewater containing organic toxic compounds and other kinds of xenobiotics. Usually, biological treatments are used to degrade a great quantity of these substances. However, most of the time, the microorganisms are not adapted and the treatment can be blocked. Therefore, the first step to make a continuous reactor operative is the acclimation, i.e., the adaptation of the microorganisms to a specific substrate. During this particular step of the process there is a selection and a multiplication of specialized microorganisms and physiological transformations can occur in their metabolic system. Furthermore, combining image processing techniques have already been successfully used to elucidate the activated sludge morphological changes for both aggregated and filamentous bacteria contents, during such processes.

The experimental set-up is composed of an aerated reactor and a clarifier. The sludge is recycled from the clarifier by a peristaltic pump. The complete mixing inside the reactor is guaranteed by the diffusion of air from its bottom. The reactor was inoculated with biomass collected from a wastewater treatment plant and fed with an artificial wastewater based on meat extract. During acclimation, chemical parameters were measured in the influent, reactor and effluent, in order to verify the stability of the process. To complete the evaluation of the process, microscopy acquisition and image processing and analysis techniques were performed for aggregates and filamentous bacteria characterization for bright field, Gram and poly-β-hydroxybutyrate (PHB) staining images. The information extracted from those images allowed for aggregates and filamentous bacteria contents inspection, identification of PHB storing microorganisms and, gram-positive and gram-negative filamentous bacteria recognition. Figure 1 presents activated sludge samples at the beginning and at the end of the acclimation phase. It was found in this study that biomass changes during the acclimation phase could be effectively monitored, combining image analysis information and chemical parameters.

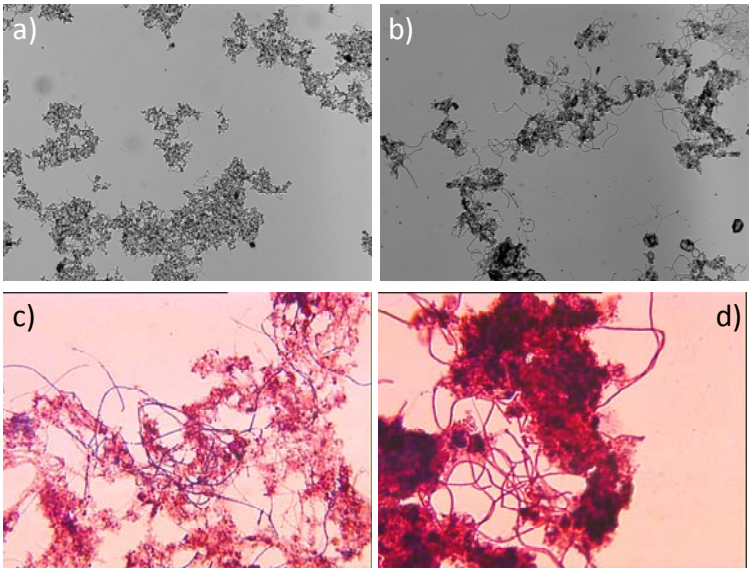

Figure 1. Activated sludge within the aerated reactor (a, c) before and (b, d) after the acclimation step. Grey images (a, b) were obtained using bright field microscopy, and color images (c, d) were obtained using gram staining.