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Minimization of sludge production by a side-stream reactor under anoxic conditions in a pilot plant

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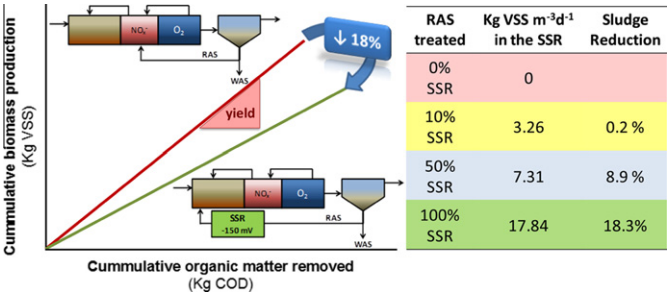
HIGHLIGHTS

- An anoxic side-stream reactor (SSR) at −150 mV minimizes sludge production.
- Treating the whole sludge line in the SSR reduces the observed yield by 18.31%.
- The applied sludge loading rate is the key parameter for sludge minimization.
- Application of an SSR improves settleability and maintains removal efficiencies.

GRAPHICAL ABSTRACT



RAS treated	Kg VSS $m^{-3}d^{-1}$ in the SSR	Sludge Reduction
0% SSR	0	
10% SSR	3.26	0.2 %
50% SSR	7.31	8.9 %
100% SSR	17.84	18.3%

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ABSTRACT

This study evaluates the application of an anoxic side-stream reactor in the sludge return line of a conventional activated sludge system for the reduction of biomass production. The oxidation–reduction potential was maintained at −150 mV while the applied sludge loading rate was modified by changing the percentage of return sludge treated in this reactor. The observed yield from the conventional system (0.513 kg VSS kg^{-1} COD) was continuously reduced when the portion of return sludge treated was increased. A maximum reduction of 18.3% of the observed yield was obtained treating the whole sludge return line. The sludge age maintained through the experiment. The organic matter removal was not deteriorated, even improved, by the proposed plant modification. Thus, simply applying an anoxic side-stream reactor would decrease the final volume of waste sludge while maintaining the sludge retention time and would, in fact, decrease the economic costs in terms of sludge handling.

1. Introduction

Wastewater treatment by activated sludge has become the most used treatment for both urban and industrial wastewater influents. The major limitation of this technology is the excess of sludge generated, which increases the post-treatment and management costs. These costs can go up by 50–60% of the operating expenses in a wastewater treatment plant (WWTP) (Yang et al., 2011). Furthermore, legislation on sludge disposal is becoming stricter. The biomass growth yield, which is around 0.4–0.6 kg VSS kg^{-1} COD (Tchobanoglous et al., 2003), leads to high energy consumption in the processes used to reduce the excess sludge. Therefore, new sustainable strategies for sludge reduction are required (Khursheed and Kazmi, 2011). Two differentiated approaches may be applied to reduce excess sludge disposed from WWTPs: (i) post-treatment methods, applying extra technologies into the waste flow, or (ii) process reduction methods, applying other strategies in the water line to reduce sludge production (Yang et al., 2011).

On the one hand, the most common methods of sludge stabilization for final disposal purposes are the biological processes of anaerobic mesophilic digestion and aerobic digestion at ambient

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