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CONTROL OF START-UP OF AN OSA SYSTEM: AN APPROACH TO REDUCE EXCESS SLUDGE PRODUCTION

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INTRODUCTION

In most biological wastewater treatment process such as conventional activated sludge (CAS) system, though they have been recognized to be effective for organic wastewater treatment, the large amount of excess sludge derived from microbial growth generates high costs in equipment, operation, and final disposal. The OSA process is a modification of CAS process which can reduce sludge production by inserting a holding tank in return sludge circuit. In this holding tank, oxygen is not supplied so that excess sludge production can be reduced by an alternating exposure of activated sludge to oxic and anoxic environments (Saby *et al*, 2003; Chen *et al*, 2003; Jung *et al*, 2006; Rodriguez-Pérez *et al* 2009, Rodriguez-Pérez *et al* 2010). However, a better understanding of the cause of the process enabling excess sludge reduction is necessary for full scale experience. In this study, our experiments were carried out in two CAS systems, one of them modified to an OSA system. Primary experiments were carried out and the control of DO, pH and temperature were investigated after the seed sludge inoculation.

METHODS

The pilot plants are illustrated in Fig. 1. The reactors had a working volume of 2.5 L and a 2.7 L settler. One of them was modified as an OSA system by inserting a 1.3 L sludge holding tank in the sludge return circuit. The air was supplied through the reactor liquid phase using an air sparger at the bottom. DO concentration and pH value in the reactors and holding tank were measured by a DO (HQ30D Flexi, Hach-Lange) and pH (GLP22, Crison) meter, respectively. The oxygen concentration was varied during the start-up until which was adjusted around 5 mg L^{-1}. The pH was maintained around 7 by phosphate buffer solution. Full mixing within the reactors and holding tank were achieved with magnetically stirrers. The feeding solution of synthetic wastewater was added to the reactors using peristaltic pumps.

The reactors and holding tank were inoculated with 1 L and 0,5 L, respectively. The sludge was taken from the recirculation line of the aeration tank of the West Urban Wastewater Treatment Plant of Sevilla, (Spain). The seed mixture contained initial biomass concentrations of 6 g_{MLSS} L^{-1} and 5 g_{MLVSS} L^{-1}. Initial mixed liquor suspended solids (MLSS) concentration in aerobic reactors was adjusted to about 2.5g_{MLSS} L^{-1}; with 1.5 g_{MLVSS} L^{-1}. The influent COD concentration was to 330 mg L^{-1}. The synthetic wastewater used in this experiment was a mineral medium, with glucose as carbon source. The hydraulic retention time (HRT) was controlled at 12 h in the aerobic reactors and at 3.5 h in the anoxic holding tank. The operation was all conducted at a room temperature (25ºC). COD, TSS and VSS were measured according to Standard Methods (APHA-AWA-WPCF, 1992).

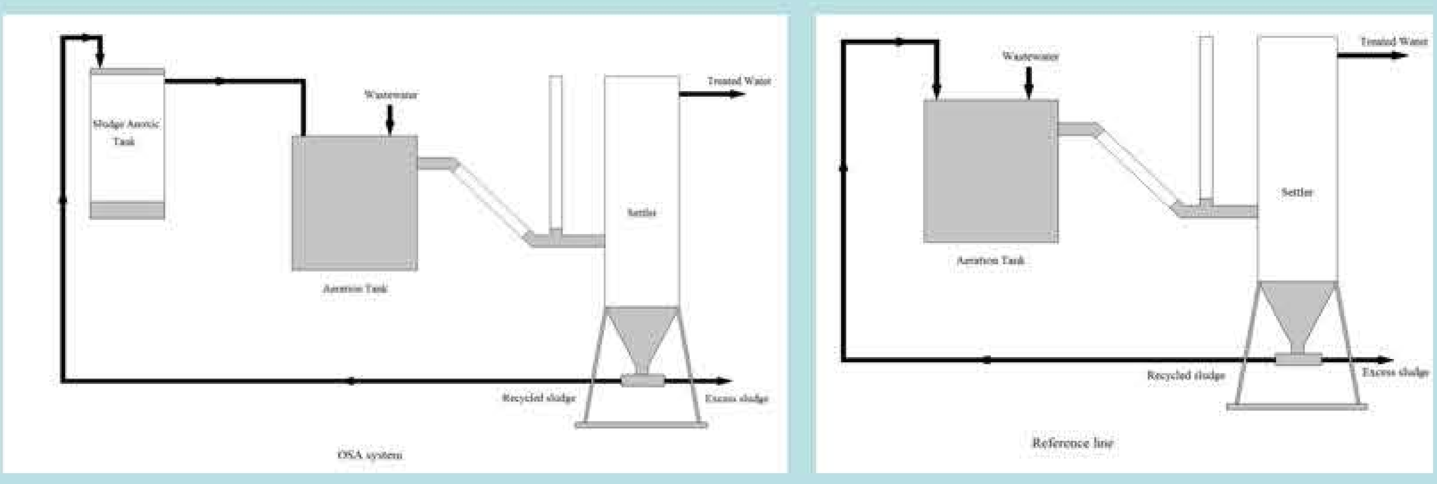

Figure 1. Schematic diagram of two experimental systems (the reference and OSA system).

RESULTS AND DISCUSSION

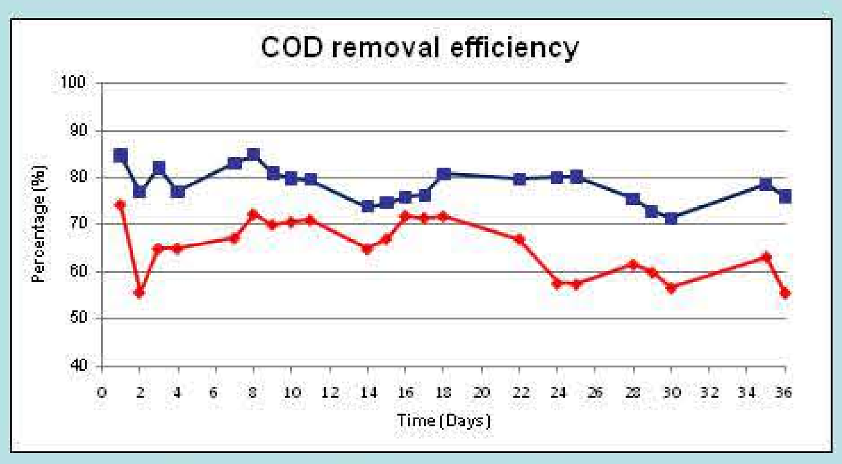

Figure 2. COD Removal Efficiency

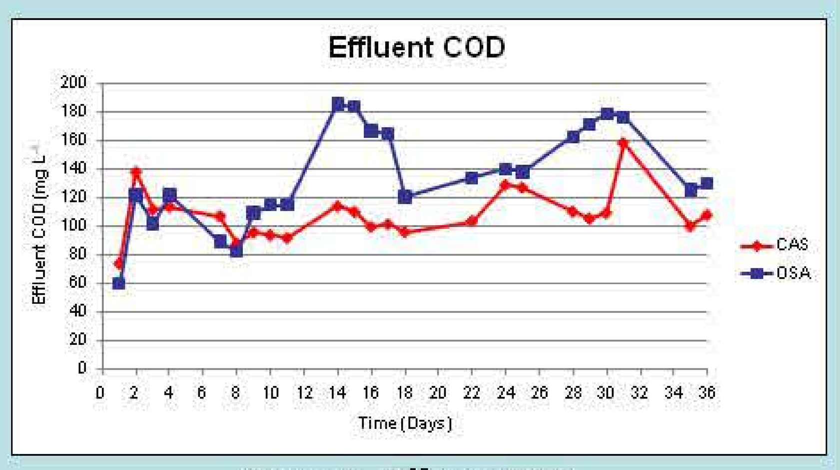

Figure 3. Effluent COD

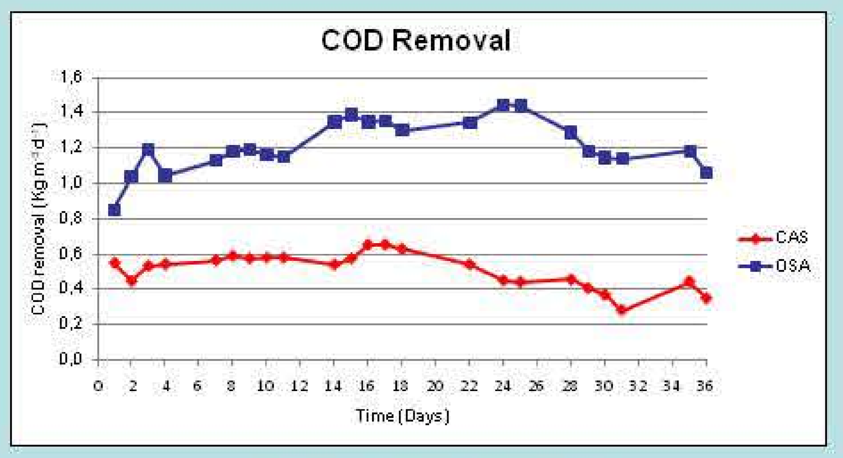

Figure 4. COD Removal

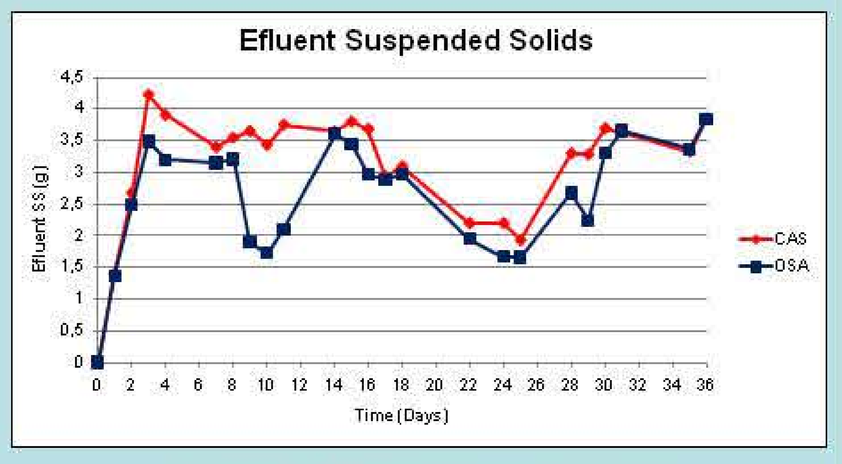

Figure 5. Effluent Suspended Solids

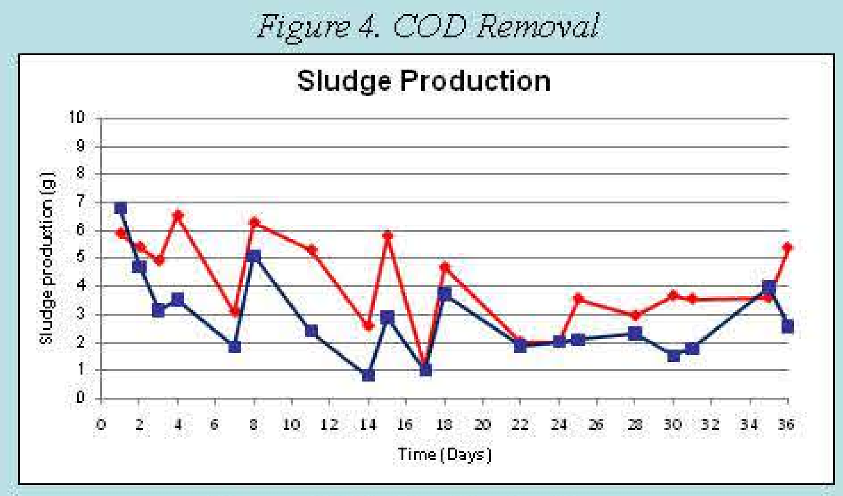

Figure 6. Sludge Production

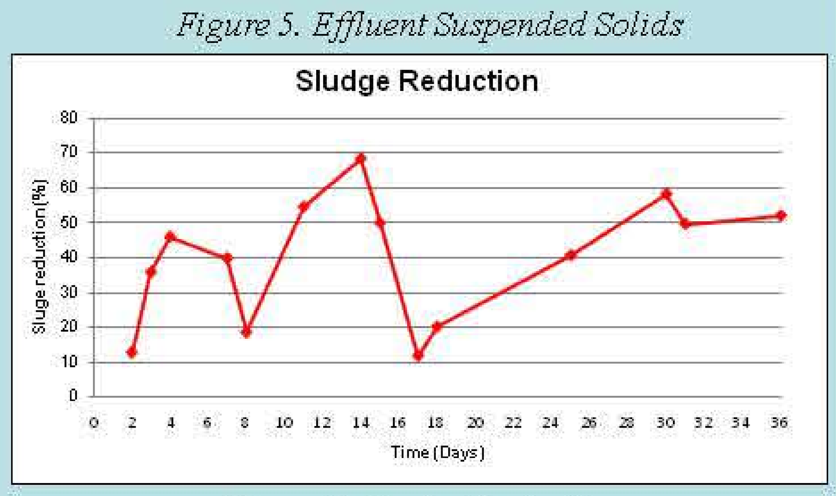

Figure 7. Sludge Reduction

During the start-up period, removal efficiencies of COD were above 64% and 73% under control CAS and OSA system, respectively as shown in **Fig. 2**. The average effluent COD is show in **Fig. 3**. It was found a variable initial period by start-up in both pilot plants. The first week was observed the same levels between both plants CAS Control and OSA process. After this period the

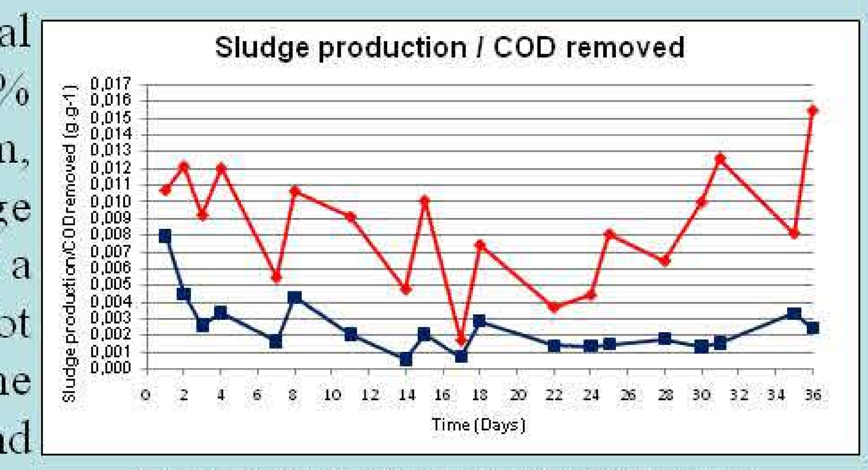

Figure 8. Sludge Production/COD Removed

levels COD effluent was increased in OSA process. It was found that concentrations under control and OSA system were 84 mg L^{-1} and 154 mg L^{-1}, respectively. The higher value for COD in OSA system could be attributed to the cell debris introduced from the anoxic tank into the aerobic reactor. **Fig 4** shows the COD removal expressed as kg m^{-3} d^{-1}, under OSA process conditions the level of COD removal was higher than under control conditions. The effluent SS from the settling tanks of the two pilots plants was also examined during the star-up and found no obvious increase in the effluent SS from the settling tank of OSA system, as shown in **Fig 5.** Sludge production is summarized in **Fig 6.** It is observed that both systems have similar levels of production, although control system production was above the OSA system production. **Fig 7** indicates the sludge reduction ratios. It was found that in the OSA system ranged between 60% under the experimental conditions, if it was compared with the reference system. **Fig 8** shows the relationship between the sludge production and COD removed. It was determined that under control conditions is higher, because of a higher sludge production and lower COD removed.

CONCLUSIONS

From this study it is concluded that OSA system shows a good potential for domestic wastewater treatment. It was tested with synthetic wastewater and presented promising performance after 36 days of operations: 60 % of carbon removal with a loading rate of 0.8 kg_{COD} m^{-3} day^{-1}. On the other hand, excess sludge production was reduced around 60% during the start-up period. Since in this work it is described the start-up of this process, it is expected better results in COD removal, sludge reduction and a process more stable. Finally, it was observed that the relationship between the sludge production and COD removed, under OSA system conditions had lower oscillation on results, thus suggests that the OSA process could be maintained over time.

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