

ACIDOGENIC ANAEROBIC DIGESTION OF URBAN SEWAGE WATERS IN SBR AT DIFFERENT TEMPERATURES

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INTRODUCTION

Among the processes of biological wastewater treatment, activated sludge and anaerobic digestion are adapted for the decomposition of organic matter. The purification of urban sewage water, for spilling in sensitive areas to eutrophication, includes the joint removal of carbon, nitrogen and phosphorus compounds. When the objective is the simultaneous carbon, nitrogen and phosphorous removal, organic matter transformation into volatile organic acids (VOA) is more interesting than complex disposal due to phosphorous and nitrogen bacteria need biodegradable organic matter to carry out their metabolism for removing both nutrients (Wu and Rodgers, 2010).

OBJECTIVES

To study the acidogenic-anaerobic treatment at different temperatures of an urban wastewater. In particular, one of the aims of this study has been to determine the conditions that maximize the acids production (VOA yield, maximum concentration and the time to be reached) to each studied temperature (35, 25 and 15°C).

METHODS, RESULTS AND DISCUSSION

An anaerobic sequential batch reactor (SBR) was used for VOA generation as intermediate in anaerobic organic matter degradation. VOA yield, maximum VOA concentration and the required time to reach this maximum concentration were the most important variables to be determined.

Additionally, the behaviour of an anaerobic culture was evaluated at different temperatures and a kinetic model which simplifies the process scheme was proposed. The kinetic model permitted to the evolution of the different carbon forms involved in the anaerobic digestion of urban sewage water to be predicted, showing the occurrence of a reduction in the kinetic constant values parallel to a drop in temperature. Concretely, temperature had more influence over the hydrolytic steps kinetics, corresponding with the organic matter transformation to VOA, than over the methane generation, getting slower when temperature decreased for all the anaerobic mechanism steps.

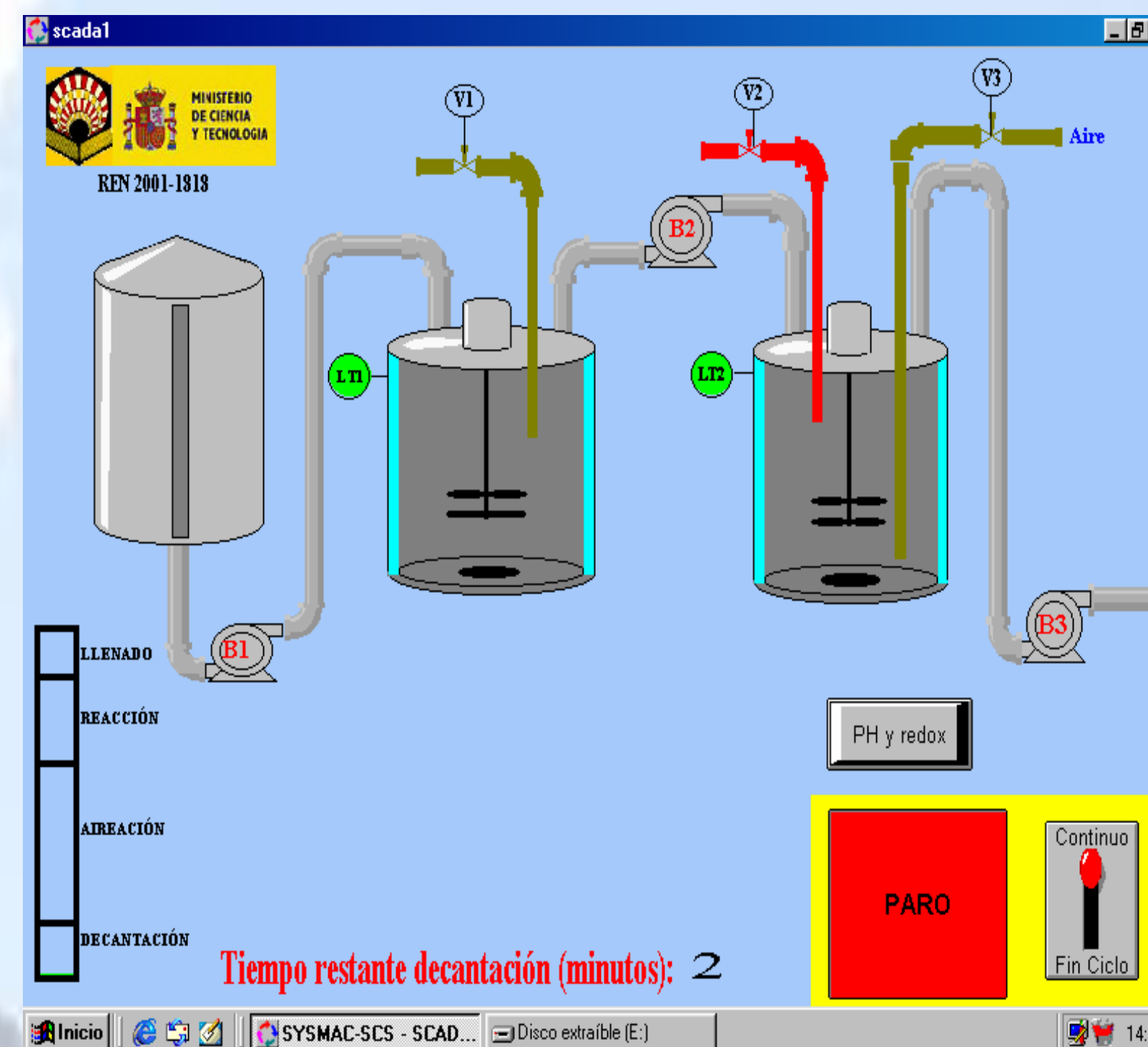


Figure 1. SBR System Scheme

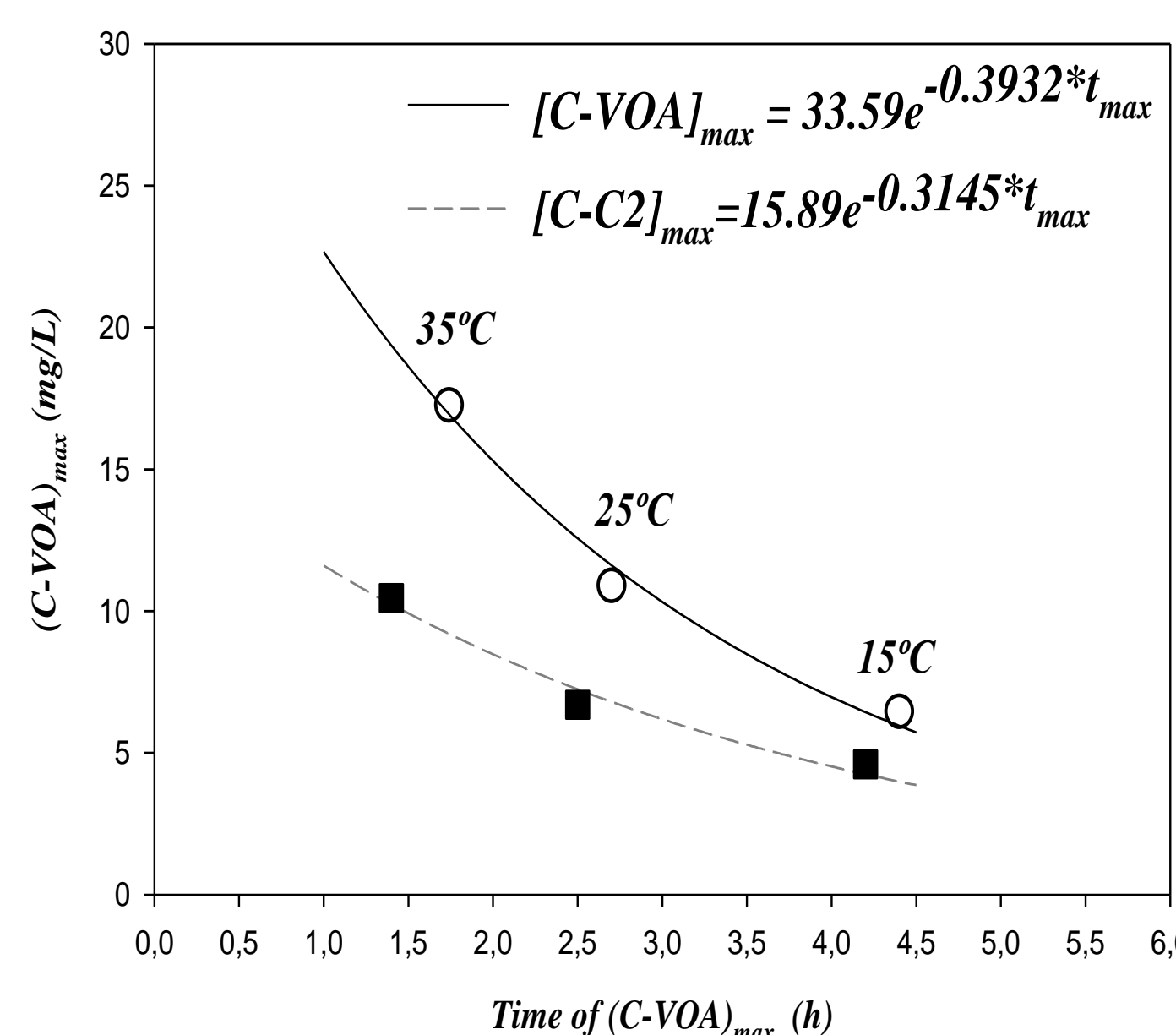


Figure 2. Mean value of maximum VOA concentration versus time of maximum VOA concentration

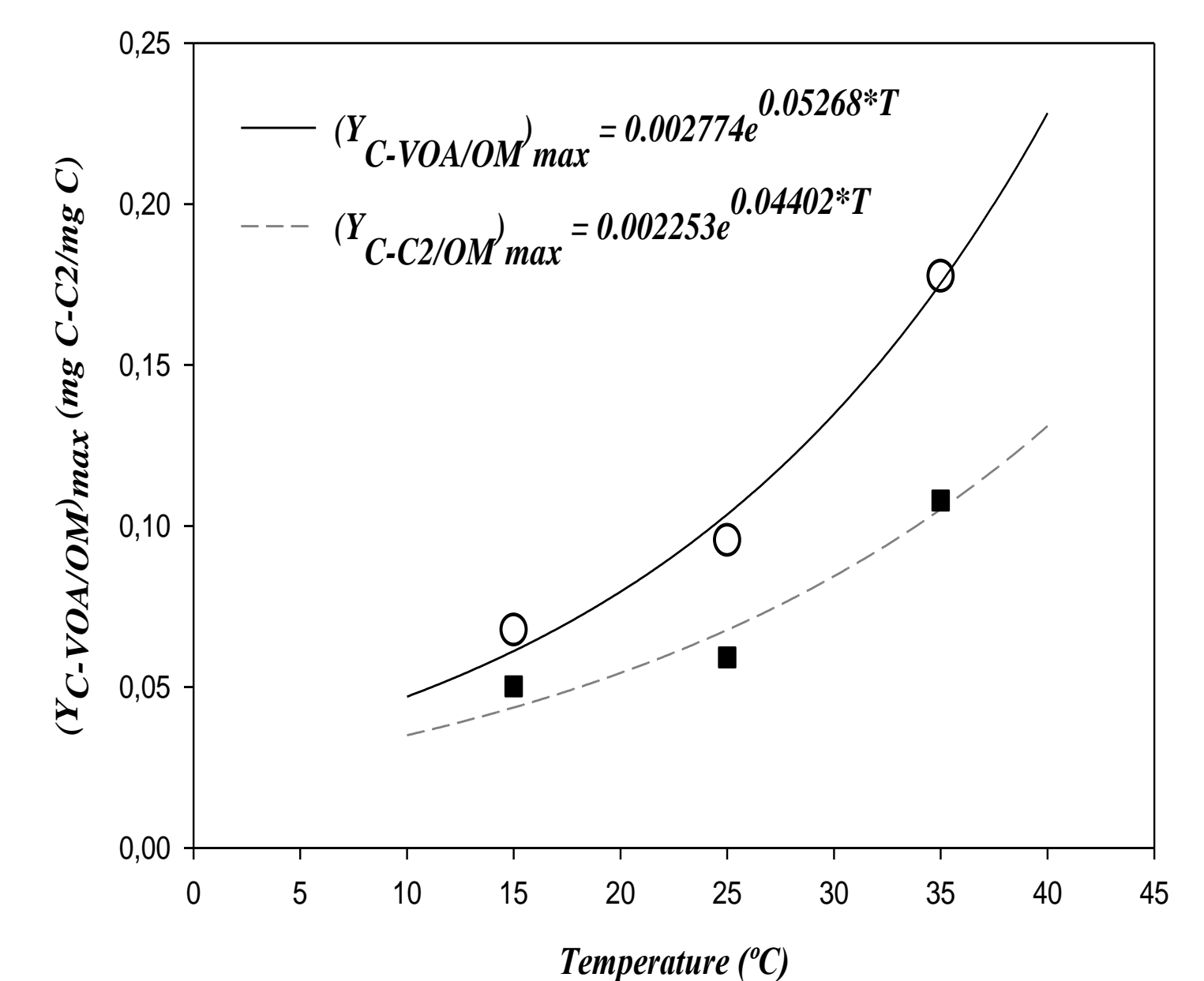


Figure 3. Mean value of maximum VOA yield versus temperature

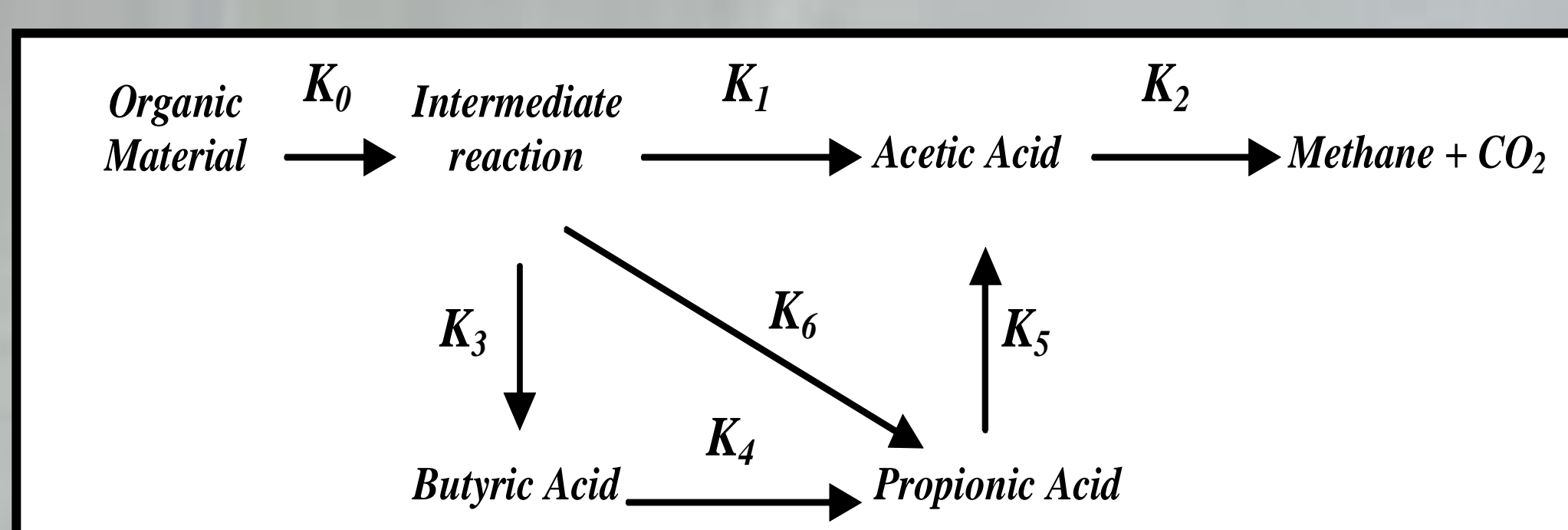


Figure 4. Scheme of the mechanism proposed for the acidogenic digestion of the organic matter

$$\begin{aligned} \frac{-d[OM]}{dt} &= K_0 \cdot \{[OM] - [OM]_{nb}\} \\ \frac{d[I]}{dt} &= K_0 \cdot \{[OM] - [OM]_{nb}\} - (K_1 + K_3 + K_6) \cdot [I] \\ \frac{d[C2]}{dt} &= K_1 \cdot [I] + K_5 \cdot [C3] - K_2 \cdot [C2] \\ \frac{d[C3]}{dt} &= K_6 \cdot [I] + K_4 \cdot [C4] - K_5 \cdot [C3] \\ \frac{d[C4]}{dt} &= K_3 \cdot [I] - K_4 \cdot [C4] \\ \frac{d[Biogas]}{dt} &= K_2 \cdot [C2] \end{aligned}$$

Figure 5. Differential equation system

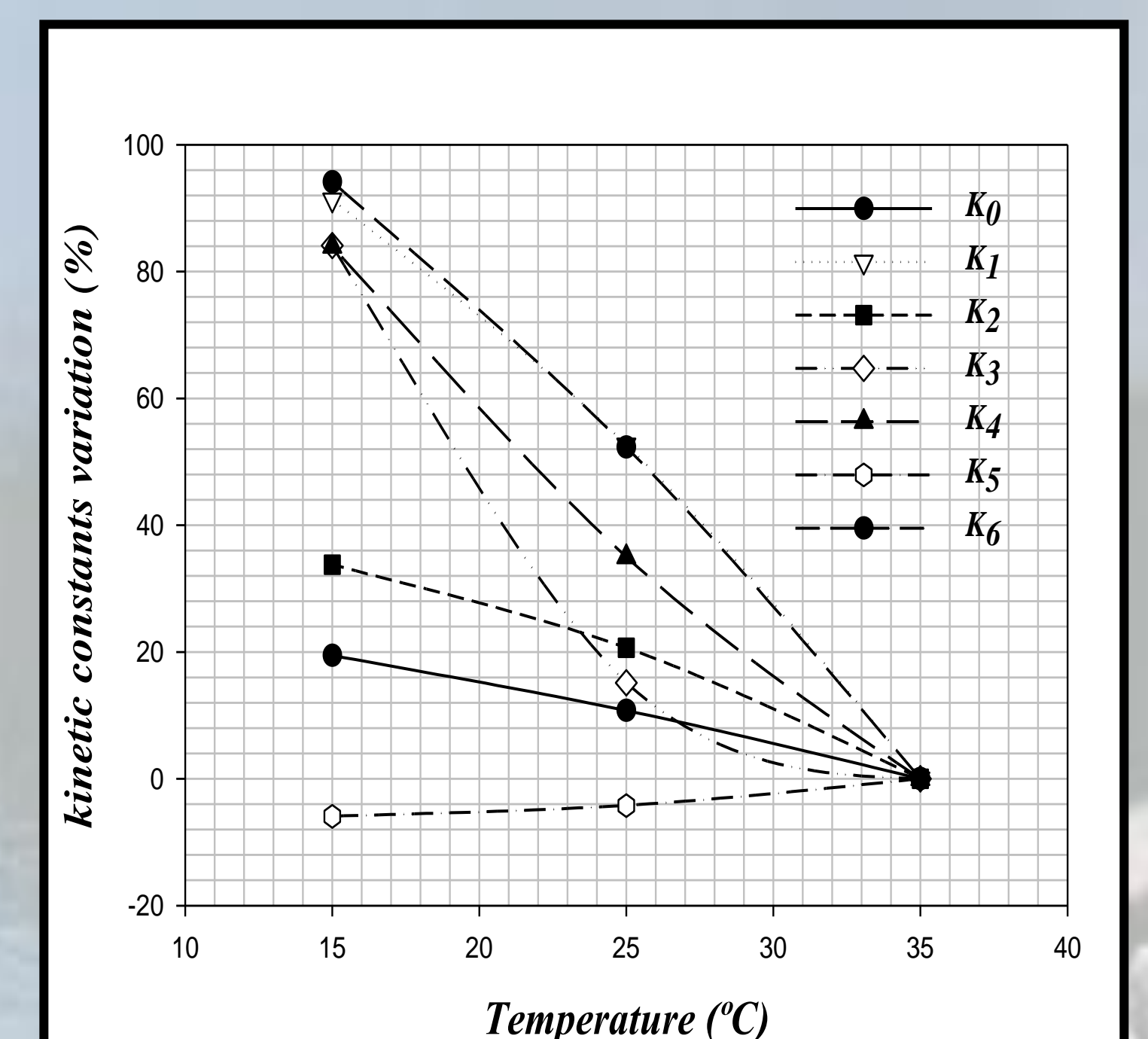


Figure 6. Variation percentage of the kinetic constants with temperature

CONCLUSIONS

It was possible to predict the organic matter evolution through a first order kinetic model. The model parameters allow the anaerobic microorganisms behaviour to be compared in the range of temperature studied. The short chain volatile organic acid generation was observed at the three temperature studied (35, 25 and 15°C), decreasing the maximum concentration value when temperature decreased. The predominant acid was acetic acid, which facilitated the subsequent phosphorous removal, although it was deteriorated at short temperature due to the low availability of biodegradable acids. The kinetic model proposed was able to predict the evolution of the different carbon forms involved in the anaerobic digestion of this wastewater, showing the occurrence of a reduction in the kinetic constant values parallel to the temperature drop. Temperature had more influence over the hydrolytic steps kinetics, corresponding with the organic matter transformation to VOA, than over the methane generation, getting slower when temperature decreased for all the anaerobic mechanism steps.

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