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DEVELOPMENT OF BIOENGINEERING PROCESSES TO TRANSFORM GREENHOUSE WASTE INTO ENERGY, FERTILIZER AND TOMATO

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ABSTRACT The greenhouse industry needs to develop sustainable production systems to reduce its ecological footprint and maintain its competitiveness. Anaerobic digestion (AD) and nitrification processes are bringing solutions to issues in greenhouse production regarding waste, nutrient management and energy consumption. Among these issues, organic soluble fertilizers are costly (30-35\$/m²), and high-quality products are difficult to obtain on the market. It is therefore a strong limitation for converting conventional greenhouses to organic practices. Our previous works have shown that AD is a promising solution for disposal of tomato leaves pruned during greenhouse operations. AD generates also end-products (supernatant, sludge) with high agronomic potential. Previous studies have shown agronomic benefits of land application of AD end-products for forage and cereal crops. However, little has been done for horticultural crops. Contrary to field crops, nitrification of digester effluents is a key step for using AD effluents as fertilizers for vegetable greenhouse plants. Greenhouse vegetables require nitrogen mainly under the nitrate form (NO₃⁻) for an adequate growth, the other forms (NO₂⁻ and NH₄⁺) being detrimental to plant and fruit quality. However, nitrification of AD supernatant can be challenging because of its high ammonia content (>1000 mg NH₄-N/L) and its inhibition potential of nitrifying micro-organisms. Only few nitrification processes have the potential to operate under these conditions. They are designed to mitigate the toxic effects of ammonia on aquatic ecosystems and to maximize biological nitrogen removal. Consequently, there is a need to develop a nitrification process suited for handling AD effluents for greenhouse use, with specific considerations to design criteria and operating strategies.

Keywords: greenhouse waste; anaerobic digestion; nitrification; sustainable greenhouse production; organic fertilizer; digester effluents