Enhancing nutrient management and methane production in an AnMBR-UV system integrated with hydroponic controlled environment agriculture

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Abstract

The integration of an anaerobic membrane bioreactor (AnMBR) with ultraviolet (UV) disinfection with hydroponic controlled environment agriculture (CEA) offers a promising strategy for optimizing water and nutrient utilization in CEA while producing useful biogas from municipal wastewater. This study explores the development of an AnMBR-UV system designed for nutrient film technique (NFT) hydroponic systems, aiming to enhance *in situ* nutrient recovery and methane production. A key challenge for AnMBR systems is the low organic carbon content in municipal wastewater, resulting in a low organic loading rate (OLR), which can lead to suboptimal chemical oxygen demand (COD) removal and methane yields. Two potential means of increasing OLR are 1) decreasing the hydraulic residence time (HRT) or 2) co-treating other organics-rich waste streams. We are exploring whether adding ground/screened crop harvest wastes from hydroponic CEA can improve AnMBR-UV's COD removal, increase methane production, and enrich the effluent with essential nutrients such as nitrogen and phosphorus. Two scenarios are examined: (i) direct treatment of a synthetic municipal wastewater influent and (ii) incorporation of ground/screened crop harvest wastes into the influent to assess their impact on COD removal, nutrient recovery, and methane generation. Preliminary results indicate that adding crop harvest wastes can significantly enhance COD removal efficiency and boost methane production, offering a sustainable approach for nutrient recovery in both municipal wastewater and hydroponic CEA systems. This presentation will cover the experimental setup, methodologies, and initial findings, highlighting the potential benefits and challenges of implementing integrated AnMBR-UV systems into CEA practice.

Keywords: AnMBR, UV disinfection, hydroponics, nutrient recovery, methane production, wastewater treatment