The Construction of an Advanced Crossflow Filtration System Integrating Electric Field Technology

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Membrane fouling is a major limitation in crossflow filtration systems, hindering productivity, cost-effectiveness, and outcome-centered performance. This study tested whether a crossflow filtration system integrating electric field technology could reduce fouling and improve filtration performance. Additionally, this study involved the personal construction of said system to reduce costs, improve accessibility, and increase feasibility for real-world applications. The system was constructed using repurposed and accessible materials, including silicone tubes from a fish tank kit, a small water pump made of a Kids WaterPik, and additional household items. A tea-based solution was used to simulate organic pollutants. Six trials were conducted at electric field strengths ranging from 0 to 33.3 V/cm while measuring variables including fouling ratio, fouled flux, membrane cleaning efficiency, and final flow rate. Results suggested that increasing electric field significantly reduced fouling ratio and increased both fouled flux and final flow rate. The largest improvements occurred at low to moderate field strengths, with performance leveling off at higher values. Although membrane cleaning efficiency wasn't found to be statistically significant ($p=0.12$), it implied that the system was more effective at preventing fouling than removing it after accumulation. These findings support the use of electric-field assisted filtration as a method to reduce membrane fouling and maintain system productivity. Additionally. this study demonstrates that electro-filtration can effectively be tested using a low-cost, accessible setup, suggesting potential for broader applications in water treatment and filtration systems.

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