Energy Optimization of Membrane Bioreactor Wastewater Treatment Systems

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In order to reduce the energy consumption and plant performance of wastewater treatment facilities using membrane bioreactor (MBR) systems, STREAMETRIC works to provide facilities with data on various metrics, such as transmembrane pressure, flux, temperature, pH, dissolved oxygen content, etc. The chosen approach to optimize energy consumption of plants was to minimize chemical cleaning cycles, a particularly energy-consumptive process. To ascertain necessary chemical cleaning cycles, the fouling rate of the membranes were determined; this was done by measuring the change in transmembrane pressure between hydraulic and chemical cleanings relative to the accumulated flux across the membrane. This can be used to extend the lifetime of a membrane and the duration between chemical cleanings, saving energy costs. Furthermore, using calculated fouling rates between chemical cleanings for the EGLV facility in German municipality, Huenxe, a temperature dependence for both reversible and irreversible fouling was discovered. This dependence was then quantified by the relationship $J(T) = J_n * 1.024^{(T - Tref)}$, where $J(T)$ is the temperature-corrected flux, J_n is the original flux metric, and $Tref$ is a reference temperature dependent on the treatment facility, as confirmed by existing literature. This relationship can be used to determine the seasonally optimum chemical cleaning cycles. Future directions for energy optimization in MBR systems are using dissolved oxygen from recycled waste for fueling oxygen-intensive processes, such as nitrification of influent wastewater, and optimization of aeration cycles based on flux downtime cycles.