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Kinetics of Urease Inactivation Using Hydrogen-Peroxide Producing Electrochemical Cells and the Stabilization of Source-Separated Urine to Recover Urea and Water

The practice of separating urine at a building-scale, rather than mixing with domestic wastewater to be treated at water resource recovery facilities allows for concentrated urine to be directly treated with the aim of resource recovery. However, source separation and treatment presents challenges during separation, storage, and transport. This study evaluated the use of hydrogen peroxide-producing electrochemical cells, which is a technology that uses electricity as an input, to stabilize urine to enable downstream water and nutrient recovery. The electrochemical cells have been previously shown to stabilize urine with electrochemically produced peroxide as an effective biocide that ceases biological activity in source-separated urine at concentrations in a few hundred to thousands of mg/L. Electrochemically treated urine with residual peroxide may be stable for a longer duration, thus allowing for processes for both water and urea recovery to follow. The kinetics of urease inactivation by the electrochemically produced peroxide are important to understand as it will form the basis for scaling up the technology and determining process operational parameters. The concentration of peroxide collected in urine is affected by: 1) the retention time of urine within the cell and 2) the magnitude of the current applied to the cathode, where peroxide is produced. Thus, the research evaluates the effect of these two conditions via systematic application of operational conditions to determine the effectiveness of peroxide at inactivating urease. These two conditions can then be tuned for a given concentration of urease in the urine using the kinetic data that I will present with the results.