

Development of a Low Toxicity Urine Pretreatment for Water Recovery in Space

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Wastewater stabilization was an essential component of the spacecraft water cycle. The purpose of stabilizing wastewater was two-fold. First, stabilization prevents the breakdown of urea into ammonia, a toxic gas at high concentrations. Second, it prevents the growth of microorganisms, thereby mitigating hardware and water quality issues due to biofilm and planktonic growth. Current stabilization techniques involve oxidizers and strong acids (pH=2) such as chromic and sulfuric acid, which are highly toxic and pose a risk to crew health. The purpose of this effort was to explore less toxic stabilization techniques, such as food-grade and commercial care preservatives. Additionally, certain preservatives were tested in the presence of a low-toxicity organic acid. Triplicate 300-mL volumes of urine were dosed with a predetermined quantity of stabilizer and stored for two weeks. During that time, pH, total organic carbon (TOC), ammonia, and turbidity were monitored. Those preservatives that showed the lowest visible microbial growth and stable pH were further tested in a six-month stability study. The results of the six-month study are also included in this paper. Additionally, the pretreatment formulations were tested to determine if the pretreated urine could be distilled to remove 85% of the water, as would occur on the ISS. The goal of the pretreatment was to produce no solids in the resulting brine at 85% water recovery.