

Preventing Precipitation in the ISS Urine Processor

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The ISS Urine Processor Assembly (UPA) was initially designed to achieve 85% recovery of water from pretreated urine on ISS. Pretreated urine is comprised of crew urine treated with flush water, an oxidant (chromium trioxide), and an inorganic acid (sulfuric acid) to control microbial growth and inhibit precipitation. Unfortunately, initial operation of the UPA on ISS resulted in the precipitation of calcium sulfate at 85% recovery. This occurred because the calcium concentration in the crew urine was elevated in microgravity due to bone loss. The higher calcium concentration precipitated with sulfate from the pretreatment acid, resulting in a failure of the UPA due to the accumulation of solids in the Distillation Assembly. Since this failure, the UPA has been limited to a reduced recovery of water from urine to prevent calcium sulfate from reaching the solubility limit. NASA personnel have worked to identify a solution that would allow the UPA to return to a nominal recovery rate of 85%. This effort has culminated with the development of a pretreatment based on phosphoric acid instead of sulfuric acid. By eliminating the sulfate associated with the pretreatment, the brine can be concentrated to a much higher concentration before calcium sulfate reach the solubility limit. This paper summarizes the development of this pretreatment and the testing performed to verify its implementation on ISS.