ANL/CSE-13/10
Addendum

Addendum to UREX Flowsheet for Cleanup of a Spent 130 g-U/L Uranyl Sulfate SHINE Target Solution (March 29, 2012)

Chemical Science and Engineering Division

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prepared for
U.S. Department of Energy, National Nuclear Security Administration,
Office of Defense Nuclear Nonproliferation

May 18, 2012

ADDENDUM TO UREX FLOWSHEET FOR CLEANUP OF A SPENT 130 g-U/L URANYL SULFATE SHINE TARGET SOLUTION (MARCH 29, 2012)

The UREX flowsheet described in the original letter report was designed so that it could be used (with modifications in flow rates) for a variety of uranium feed concentrations and for either uranyl-nitrate or uranyl-sulfate SHINE target solutions. Because use of a uranyl-nitrate SHINE target solution (STS) is becoming a less and less probable option, the flowsheet was reevaluated.

For both sulfate and nitrate STSs, the UREX feed will be a uranyl-nitrate solution; however, the uranium-nitrate product solution will be treated in completely different ways. In the case of a nitrate STS, the uranium product (after Tc/I-removal and a diluent-wash steps) will only need to be concentrated and pH adjusted before return to the SHINE vessel. In the case of a sulfate STS, the solution will need to be thermally converted to an oxide and then dissolved in sulfuric acid.

A multistage scrub-section 2 is required for a nitrate STS, to scrub acetohydroxamic acid (AHA) from the U-loaded solvent entering the strip section, to assure that the concentration of AHA in the U product is essentially zero. However, for a sulfate STS, any process that destroys nitrate will also destroy AHA, so AHA removal from the U-loaded solvent is not important. This could call for the total elimination of the scrub-2 section, but this scrub does have a second purpose: to maintain a higher nitric-acid concentration in the scrub 1 section while keeping the acid concentration low in the scrub-1 feed. AHA is less stable to hydrolysis as the acid concentration increases; by keeping the acidity in the first scrub low (0.1 M), the destruction rate for AHA is low enough for a solution to be stable for 1–2 days.

Figure 1 shows the exponential effect of the number of stages in the scrub-2 section on the concentration of AHA in the U product. Every scrub-2 stage lowers the AHA in the U product by 14.2. Since with only one stage the AHA concentration in the U product is 5.2×10^{-5} M, the number of stages in the second scrub section was dropped to one.

Figure 2 is the new and improved 30-stage UREX process flowsheet developed using the Argonne Model for Universal Solvent Extraction (AMUSE).

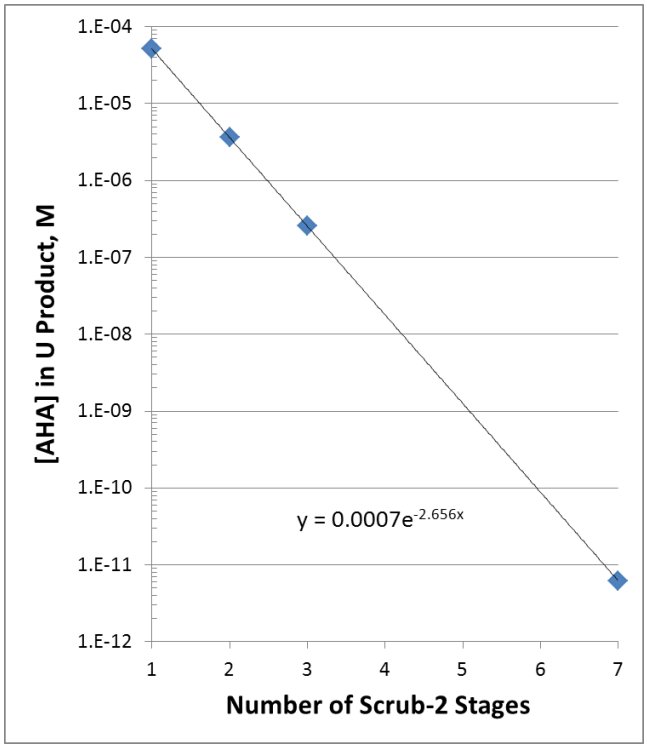

FIGURE 1 Effect of Number of Stages in the Second Scrub Section on the Concentration of Acetohydroxamic Acid in the Uranium Product from the UREX Flowsheet Described in Figure 2, which Shows the Second-Scrub Section with Only One Stage

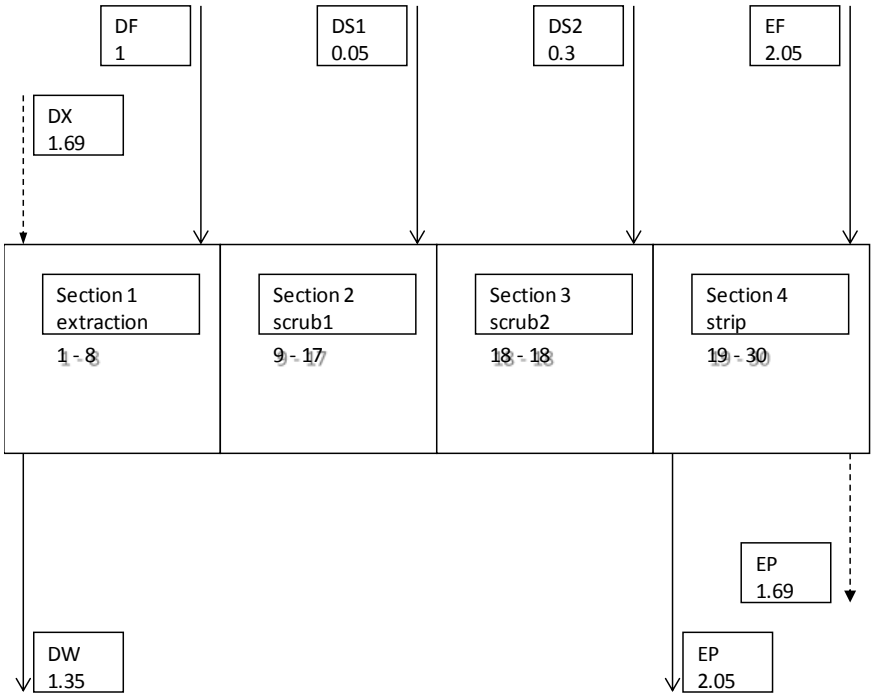

FIGURE 2 AMUSE-Generated Revised Flowsheet for Cleanup of a Sulfate STS

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