

CLEANING PROCEDURE FOR STRING

1. LEACHING PLASTICS

There are small plastic parts that need to be leached. Also, any bins that will be used for etching the copper and cleaning the stainless steel parts need to be leached. Tongs and stir rods will also be leached.

- DI = 15 M Ω -cm deionized water
 - The ACS nitric acid is 68% so the solution's ratio of nitric acid to DI should be 3.67 : 6.33 for a 6M solution. Each round of nitric acid baths will require 18.6 L of 6M nitric acid, meaning 6.8 L of concentrated ACS nitric acid for a total of 20.4 L of ACS nitric acid. (This does not include the leaching of any beakers.)
 - For this leaching we will be only using ACS grade nitric acid. In the future the first step of leaching will be done with ACS nitric acid and the second and third leaching will be done with optima nitric acid.
 - Also in the future three rounds of nitric acid leaching will need to be done.
 - And in the future beakers will need to be leached first. For now we will just clean them with isopropanol and DI water.
- (1) In the perforated pan, sonicate objects to be leached in a 2% Micro-90 solution with DI water for 60 minutes. All solutions will heat up during the sonication process so keep all solutions loosely covered to allow ventilation while limiting airborne contamination.
 - (2) Set sonicated items aside on a Kimwipe while you transfer the Micro-90 solution to a proper waste disposal container. Rinse the perforated pan and ultrasonic cleaner with DI water.
 - (3) Thoroughly rinse each object twice with DI water and place back in the perforated pan.
 - (4) Put all DI water used for rinsing in a proper waste disposal container.
 - (5) In the perforated pan, sonicate objects with (only) DI water for 60 minutes.
 - (6) Set sonicated items in a large bin (that has previously been wiped down with isopropanol and Kimwipes) in a hood and transfer the DI water to a proper waste disposal container.
 - (7) From now on, do everything in the hood until specified otherwise. Determine how much DI water and nitric acid you need in each bin to prepare a 6M nitric acid solution. Measure out the correct amount of DI water in a beaker and fill each bin with the water. Measure out the correct amount of ACS nitric acid in a beaker and fill each bin (slowly) with the acid. (You always want to add acid to water and not the other way around since the reaction is exothermic.)
 - (8) Leach items in the hood for at least 24 hours.
 - (9) Rinse each object twice with DI water.
 - (10) Transfer DI water and nitric acid solution to its proper waste disposal container.
 - (11) Determine how much DI water and nitric acid you need in each bin to prepare a 6M nitric acid solution. Measure out the correct amount of DI water in a beaker and fill each bin with the water. Measure out the correct amount of ACS nitric acid in a beaker and fill each bin (slowly) with the acid.
 - (12) Leach items in the hood for at least 24 hours.
 - (13) Rinse each object twice with DI water.
 - (14) Transfer DI water and nitric acid solution to its proper waste disposal container.
 - (15) From here on, things can be done outside of the hood. Dry parts with bottled nitrogen gas.
 - (16) Double bag small plastic parts, and any other leached items that will not be immediately used.

2. ETCHING COPPER PARTS

There are small to medium sized copper parts (some threaded) that need to be etched.

- (1) In the perforated pan, sonicate objects to be etched in a 2% Micro-90 solution with DI water for 60 minutes. All solutions will heat up during the sonication process so keep all solutions loosely covered to allow ventilation while limiting airborne contamination. The perforated pan allows us to place the objects that are to be sonicated directly in the ultrasonic cleaner, so no extra bins are needed in this step.
- (2) Thoroughly rinse each object twice with DI water. The rinsing should be done in a leached container. Once items are rinsed set them in a leached bin.
- (3) Transfer the Micro-90 solution to a proper waste disposal container. Rinse the perforated pan and ultrasonic cleaner with DI water.
- (4) Put all DI water used for rinsing in a proper waste disposal container.
- (5) Determine the amount of sulfuric acid, hydrogen peroxide and DI water you need for a sulfuric acid, hydrogen peroxide and DI solution. The ratio of sulfuric acid: hydrogen peroxide: DI water is 2:4:125.
- (6) Fill the bins first with water, then slowly add the correct amount of sulfuric acid, and finally add the hydrogen peroxide.
- (7) Let each copper item sit in the bath until effervescence stops (this should take about 5 minutes). Agitate the solution with a stir rod. If the item does not effervesce the sulfuric acid bath needs to be replaced.
- (8) Thoroughly rinse each object in a DI bath. Repeat in a new DI bath for a total of two rinses.
- (9) Transfer all sulfuric acid solution waste and DI water used for rinsing to a proper waste disposal container.
- (10) Prepare a citric acid solution with DI water, where the citric acid is 1% in weight. (For every liter of DI water, there should be 10 g of citric acid.) Let each copper item sit in the bath for 5-10 minutes.
- (11) Thoroughly rinse each object in a DI bath. Repeat in a new DI bath for a total of two rinses.
- (12) Transfer the citric acid solution to a proper waste disposal container. Transfer the DI water to a proper waste disposal container.
- (13) Submerge each copper part in 200 proof ethanol.
- (14) Put copper parts in a leached covered bin and let them dry for about 15 minutes under a light stream of nitrogen.
- (15) Transfer the ethanol to a proper waste disposal container.
- (16) Double bag each copper part.
 - If the copper parts aren't clean enough we can do this again with a stronger sulfuric acid-hydrogen peroxide solution; where the ratio of sulfuric acid to hydrogen peroxide to DI water would be 1:3:6. If they're still not clean, when the copper parts are in the sulfuric acid bath, that bath could be put in an ultrasonic cleaner.

3. CLEANING STAINLESS STEEL PARTS

There are small to medium sized stainless steel parts that need to be cleaned. These parts include the string assembly fixtures; in the future these parts will need to be etched.

- (1) In the perforated pan, sonicate objects to be cleaned in a 2% Micro-90 solution with DI water for 60 minutes. All solutions will heat up during the sonication process so keep all solutions loosely covered to allow ventilation while limiting airborne contamination. The perforated pan allows us to place the objects that are to be sonicated directly in the ultrasonic cleaner, so no extra bins are needed in this step.
- (2) Thoroughly rinse each object twice with DI water. Once items are rinsed set them in a bin large enough to hold all the stainless steel parts but small enough to fit in the ultrasonic cleaner.
- (3) Transfer the Micro-90 solution to a proper waste disposal container. Rinse the perforated pan and ultrasonic cleaner with DI water.
- (4) Put all DI water used for rinsing in a proper waste disposal container.

- (5) Place the bin that contains all the rinsed stainless steel parts in the perforated pan in the ultrasonic cleaner. Fill DI water up to the rim of the container in the ultrasonic cleaner.
- (6) Pour methanol in the bin containing the stainless steel parts so that all parts are covered in methanol.
- (7) Sonicate items for about 15 minutes
- (8) Thoroughly rinse each object twice with DI water.
- (9) Transfer the methanol to a proper waste disposal container. Transfer the DI water to a proper waste disposal container.
- (10) Dry each part with a Kimwipe and double bag each stainless steel part.