**Making, deploying, and extracting mixed-bed resin bags**

The following details a methodology for creating, activating, deploying, and extracting resin bags. These bags interact with soil ion exchange dynamics and collect cations and anions over time. Resin bag deployment is useful toward quantifying plant-available ions such as nitrate, ammonium, and phosphate ions during a measurement, but can also collect other positive and negatively charged ions. It is possible to create resin bags to only collect anions or only cations by altering the type of resin put in the bags

**Reagent list**

1. **0.5 M HCl wash solution (Wash #1)**

In a 1L volumetric flask:

* + 1 L ultrapure water (from MilliQ)
  + 42 mL concentrated HCl (always add acid to water)

1. **2.0 M NaCl wash solution (Wash #2)**

In a 1L volumetric flask:

* + 116.88 g NaCl
  + 1 L ultrapure water

1. **2.0 M NaCl/0.1 M HCl extraction solution**

In a 1L volumetric flask:

* + 8.4 mL concentrated HCl
  + 116.88 g NaCl

**Constructing mixed-bed resin bags**

1. Cut nylon/lycra stocking material into 5-inch squares. Material can be found at Jo-Ann fabrics in the sportswear fabric section
2. Weigh out 5g of Dowex Marathon MR-3 and place in the center of each lycra square
3. Bundle corners and tie off resin bag with a zip tie
   1. To speed up process, partially zip a selection of zip ties prior to weighing out mixed bed resin so that you only need to tighten the tie around the top of the bag
   2. Once zip tie is over fabric edges, pull it tight and cut off the end

**Activating mixed-bed resin bags**

1. Prepare enough 0.5 M HCl solution to soak all resin bags. Place bags in 0.5 M HCl for 20 minutes
2. Remove bags from 0.5 M HCl solution and rinse with ultrapure water
3. Prepare enough 2.0 M NaCl solution to soak all resin bags. Place bags in 2.0 M NaCl solution until the pH of the solution stabilizes. This will take some time as you are exchanging off all the H+ you put on during the first acid wash
   1. A few NaCl changes over at least an 8 hour period should do the trick, although it may be better to leave them in the wash solution over night
4. Rinse bags again in ultrapure water and put them in individual Ziploc sandwich bags until ready for field deployment

**Deploying mixed-bed resin bags**

1. Use a trowel or shovel to dig a hole approximately 5-10cm below the soil surface. Be sure to clear any surface litter before digging
2. Place an individual bag in each hold and put down on the soil surface to close the opening
3. Be sure to mark the bags with flags and/or a GPS coordinate so that you can find them again. It is recommended to do both as flags can be moved by animals or can drift off in windy systems
4. Leave bags in the field for 1-2 months
5. Exercise caution when retrieving bags, as lycra is easy to tear. Dig a hole around the proximity of the bag and carefully extract each bag into an individual Ziploc bag

**Extracting mixed-bed resin bags (not an effective method for phosphorus extraction)**

1. Rinse each bag in ultrapure water and place in a labeled 250 mL Erlenmeyer flask. Be sure that you remove as much soil as possible from the bag. Murky extracts will skew anion/cation assays
2. Add 100 mL of 0.1 M HCl/2.0 M NaCl to each flask, cover with parafilm, and shake for 1 hour at medium speed
3. Pour resin extract into labeled Falcon tube and freeze until ready for assaying