Field Pilot Preparation, Resin Loading and Startup: Single-Use Ion Exchange Resin

Learn steps to help achieve the highest level of accuracy possible in a pilot-scale plant to best simulate the process of a full-scale treatment plant.

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Background

The purpose of a field pilot study is to simulate the process of a full-scale treatment plant. There are a few obstacles to overcome to achieve the highest degree of accuracy from the pilot-scale test.

The first challenge is the test column itself. A column is typically 2 to 4 inches (5 to 10 cm) in diameter and constructed of PVC. Columns less than 2 inches (5 cm) diameter may produce a friction coefficient at the wall surface, leading to the resin bed not representing the full-scale system.

The following steps will help achieve the highest level of accuracy possible in the pilot-scale plant.

PFAS field pilot startup

Preparation

1. Determine the amount of resin needed. Your Ecolab Technical Representative can assist you in scaling the pilot system to match your desired full-scale plant. Matching the pilot's resin height and linear velocity to that of the full-scale system is highly recommended as it allows simple scaling and more predictable performance.

    a. Match bed height by varying volume of resin

        i. Calculate the volume of resin needed by multiplying the desired height (e.g., 36 inches (91.4 cm)) by the cross-sectional area of the column. It is critical to use the internal diameter (ID) of the column rather than the nominal outer diameter (OD) in calculating the volume of resin. For example, the ID of a 2 inch column is 2.047 inches on a schedule 40 PVC column.

    b. Calculate the flow rate needed to achieve the same linear velocity as the full-scale column

2. Obtain the required amount of resin.

3. If intermittent sampling through the column is desired, for example, pulling samples at the 25% port for accelerated data collection, be aware that the resin shrinks as it converts from the chloride form into equilibrium with nitrate, sulfate, and alkalinity. It is advisable to use either a separate column or a separator plate between where the sample ports will be. That way, even with resin shrinkage, the resin volume will still be 25% of the bed volume. Figure 1 shows a pilot set up to pull samples at 25%, 50%, 75%, and 100%.

4. Leak-check the pilot skid. It is much easier to correct leaks before loading.

5. Sanitize the pilot system to prevent potential contamination, which could cause pressure drop or other pilot issues.

    a. This must be done before the resin is loaded.

    b. Remove all filters.

    c. Soak the pilot equipment with a 10–20 ppm free-chlorine solution for 30 minutes. If you are using another sanitizer, refer to the product directions for application.

    d. Flush the system until you have a zero-residual of free-chlorine or oxidant using the appropriate test method for the sanitizer used. Residual sanitizer left in the column and/or fittings will oxidize the resin when it is later installed and negatively impact the pilot test results. Even low concentrations of oxidants should be avoided as this can increase the potential for the formation of nitrosamines in the treated water, which are regulated at ppt levels in some states.

Loading the Resin

1. Use a graduated cylinder to accurately measure the volume of resin to be placed in each column. Static can be a major issue affecting the accuracy of resin volume measurement. It is highly recommended to use a glass cylinder at least two times the volume of the resin to be used to minimize these effects.
2. Add a volume of demineralized oxidant-free water to the cylinder equivalent to the volume of resin to be used.
3. Add the resin to the cylinder to the marking equal to the volume of resin to be used while gently shaking the cylinder to ensure even settling and accurate measurement.
4. Ensure the inside wall of the column is wet. This will reduce static and allow the resin to flow into the column better.
5. Pour the slurry mixture into the test column, rinsing the graduated cylinder with oxidant-free demineralized water as necessary to ensure all the resin is installed.
6. Close the top of the test column.
7. Repeat the above steps for each column on the pilot system.

Backwashing

If you are using a uniform particle size resin, it is not necessary to perform a backwash. However, if backwashing is desired or required, the following guide is recommended.

1. Ensure there is an upper resin retainer installed in the test column.
2. Refer to the backwash curve provided with your Ecolab resin for the proper flow for your water temperature.

CAUTION

Only oxidant-free, contaminant-free water should be used for the backwash step. Using process water can load the contaminants of concern onto resin located at the bottom end of the column. This can potentially result in an early or immediate breakthrough of one or more of the contaminants.

3. Backwash the column to achieve a 5-bed volume throughput based on the resin volume.

Starting the Test

1. Slowly apply pressure to the pilot system.
2. Vent each column to ensure it is free of air.
3. Establish the desired test flow.
4. Maintain 50 to 60 psig (344 to 413 kPa) on the system or as advised by your Ecolab Technical Representative.
5. It is highly recommended to wrap the columns to prevent exposure to sunlight. Aluminum foil can be used as a wrap. Sunlight can induce algae growth which can negatively impact the test results. Alternatively, the system can be located in a building with no sunlight.

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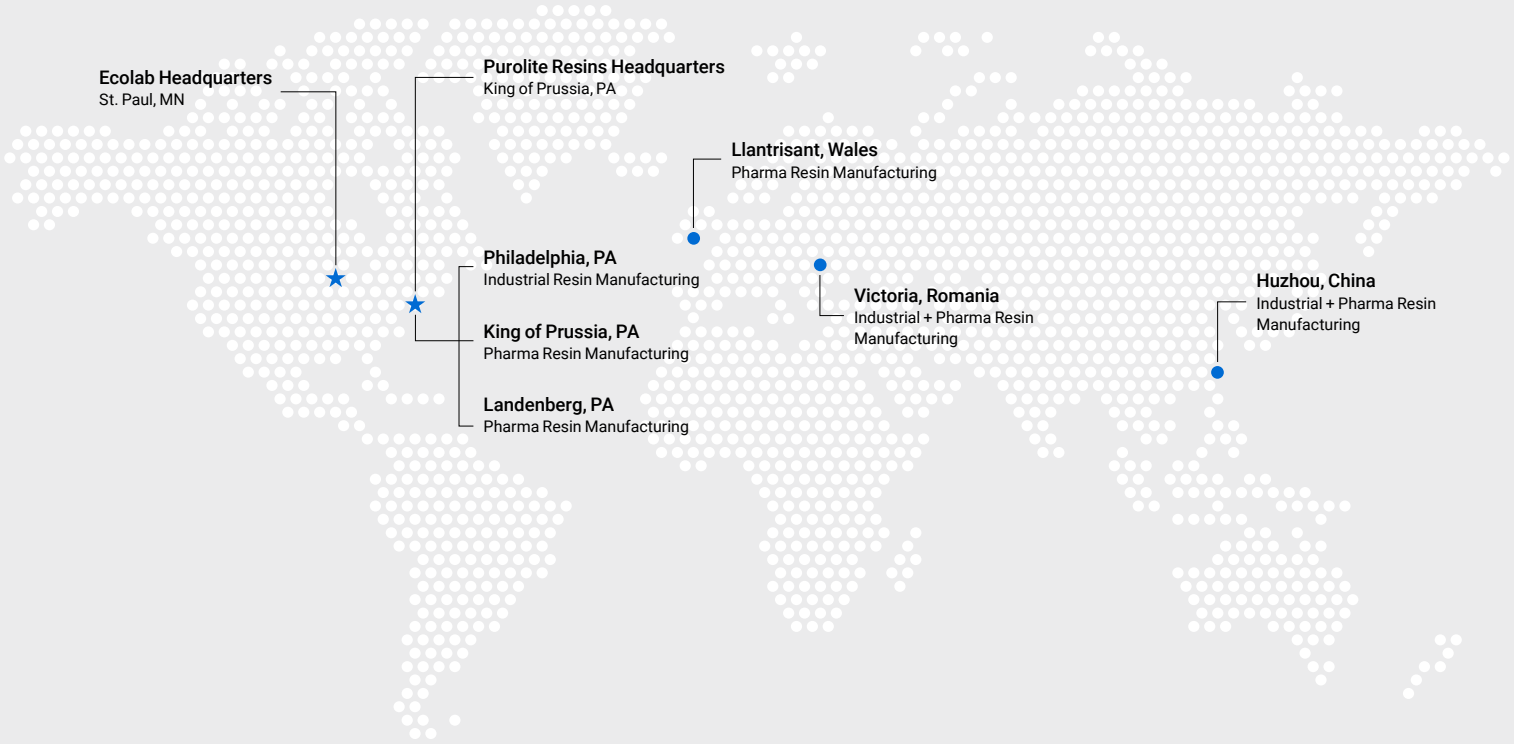

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