

GUIDANCE

Pilot Study using Ion Exchange for Nitrate Removal

Oklahoma Department of Environmental Quality

Guidance for Proposed Ion Exchange System for Nitrate Removal Pilot Study Reports

PURPOSE

The purpose of the pilot study is to determine if the characteristics of the well water are conducive to treatment using ion exchange. Operating parameters for a site-specific, full-scale ion exchange treatment system should include at a minimum the backwash procedures and frequency and the resin used. The pilot study will also be used to demonstrate that the Public Water Supply (PWS) system has the technical capacity to operate and maintain the proposed system, as system operators will be expected to participate in the study and collect much of the required data.

This guidance is intended to facilitate consistent and timely review of pilot study reports submitted for ion exchange treatment systems for nitrate removal. This guidance will also be used to determine if the scope and nature of the pilot study report and resulting data are adequate and whether the proposed ion exchange treatment system will produce water that meets Environmental Protection Agency (EPA) and Oklahoma Department of Environmental Quality (DEQ) drinking water standards.

BACKGROUND

Ion exchange treatment systems can be used for removal of nitrates.

Current DEQ regulations for ion exchange do not have standards on use of ion exchange for nitrate removal. Treatment for nitrate removal with ion exchange requires that a pilot study be conducted. DEQ guidelines for the ion exchange pilot study are outlined below.

Approval, by the DEQ, of the pilot study protocol and pilot study report must precede the submittal of an engineering report. Be advised, approval of the pilot study report or the proposed site-specific, full-scale design criteria shall not be construed as approval for construction of a water treatment system. Construction of a water treatment facility may not begin until the DEQ has reviewed and approved the engineering plans and specifications and a construction permit has been issued.

PILOT STUDY

The pilot study report needs to contain all information necessary for the design of a site-specific, full-scale ion exchange system, by the PWS system's consulting engineer. The pilot study will provide all the necessary data to complete the pilot study report. Pilot studies involving the use of ion exchange should contain the following:

1. Testing of ion exchange on the target water in which ion exchange treatment system will be applied. The following factors need to be addressed when conducting the pilot study:
 - a. State treatment objectives,
 - b. Effects of ion exchange treatment on raw water
 - i. Effects on nitrate levels,
 - ii. Effects on hardness levels, and
 - c. Backwash and regeneration sequences to meet treatment objectives.

A responsible official of the PWS system or its engineer must notify the DEQ that a pilot study will be conducted at least 30 days prior to the start of the study and may request a meeting with DEQ staff prior to starting a pilot study. **The pilot study must be conducted for a period of at least 7 days.**

Prior to the beginning of the pilot study, a full analysis of the raw water must be conducted in order to determine constituents in the target water which may be affected by ion exchange. This analysis may include:

1. Nitrate,
2. pH,
3. Alkalinity,
4. Hardness,
5. Total dissolved solids,
6. Chloride, and
7. Sulfate.

During all stages of the pilot study, the following data must be recorded at the beginning and throughout a pilot run (a pilot run is considered to be in progress when water is flowing through the ion exchange columns for data collection):

The following data must be collected daily for the duration of the pilot:

1. Influent water flow rate,
2. Effluent water flow rate,
3. Backwash flow rate,
4. Raw water nitrate,
5. Raw water pH,
6. Raw water hardness,
7. Raw water alkalinity,
8. Finished water nitrate,
9. Finished water pH,
10. Finished water hardness, and
11. Finished water alkalinity.

The data collected must be used to create data summary tables and graphs for the effects of ion exchange based on the parameters mentioned above.

PILOT STUDY REPORT

The pilot study report must be prepared under the direction of the PWS system's consulting engineer. The submitted pilot study report must be accompanied by a cover letter that is signed, sealed and dated by the District's consulting engineer.

DEQ may request a meeting with the PWS system or the PWS system's consulting engineer prior to issuing acceptance of the pilot study report.

The pilot study report must contain the results of the pilot study and recommendations for the site-specific, full-scale design of an ion exchange system. In addition to the parameters mentioned above, the report must include the following:

1. State pilot study objectives to include at a minimum: efficiency of unit to remove nitrates and determination of resin regeneration setpoint in terms of number of gallons or bed volumes.
2. Summary of the pilot study results and recommendations.
3. General information about the site where the pilot study was conducted:
 - a. The name of the public water system (PWS),
 - b. The PWSID Number of the PWS,
 - c. The name of the raw water source and the water rights allocated, and
 - d. A schematic of the pilot plant that shows pilot equipment, flow meters and monitoring points.
4. The pilot study must contain the following information for the ion exchange system:
 - a. Ion exchange equipment manufacturer,
 - b. ETV/NSF certifications and verifications, and
 - c. Type of resin.
5. A pilot study report must include the following information.
 - a. A description of the ion exchange manufacturer's required preconditioning method (if any) that occurred prior to the pilot study,
 - b. A description of any equipment failures and any resulting time delays or time off line,
 - c. A list of the proposed site-specific, full-scale operating parameters for the ion exchange system with supporting data, and
 - d. A description of any special tests.
6. The pilot study report must include a list of the analytical methods and equipment used during the pilot study. All flow measuring devices, rate-of-flow controllers, and laboratory equipment must be calibrated as specified by the manufacturer prior to beginning data collection. A description of the calibration methods and frequency must be included for verification of data.
7. A list of analytical procedures conducted at off-site laboratories must be included.
8. The pilot study must contain the following graphs for site-specific, full-scale installation. The scale of each axis, and test periods must be clearly identified.
 - a. A breakthrough curve showing removal percentages of targeted contaminant(s) as a function of total bed volumes (e.g. removal of nitrate).
9. The pilot report must contain summary tables for all data collected during the pilot study. Each of the tables must contain the number of data points collected, the range of the data values (i.e. the maximum and minimum values), the average value, and the 95th percentile if more than 10 data points are collected.