July 2011

GUIDANCE

Pilot Study for Granular Activated Carbon (GAC) Filtration to Remove Volatile Organic Chemicals (VOCs)

Oklahoma Department of Environmental Quality

Guidance for Proposed Granular Activated Carbon (GAC) Filtration System for Volatile Organic Chemical (VOC) 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 granular activated carbon (GAC) filtration. Operating parameters for a site-specific, full-scale GAC filtration treatment should include at a minimum: backwash procedures and frequency, chemical dose (if used), and empty bed contact time (EBCT) to be established during the pilot study. 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 GAC filtration for VOC 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 GAC filtration system will produce water that meets Environmental Protection Agency (EPA) and Oklahoma Department of Environmental Quality (DEQ) drinking water standards.

BACKGROUND

GAC filtration can be used for removal of VOC.

Current DEQ regulations for GAC filtration do not have standards on use of GAC filters for VOC removal. Treatment for VOC removal with GAC filtration requires that a pilot study be conducted. DEQ guidelines for the GAC filtration 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, that 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 had reviewed and approved the engineering plans and specifications and a construction permit has been issued.

PILOT STUDY

The pilot study must provide all of the information that will be required in the pilot study report and by the engineer to design a site-specific, full-scale GAC filtration system installation. The following design information is required to be determined for GAC filters:

1. Adsorption isotherm of the contaminants to be removed.
2. Type, size and adsorptive characteristics of the GAC to be utilized in the adsorber.
3. Type, dimension and configuration of adsorbers, i.e. the number, sequence, and arrangement of the separate GAC contactors.
4. Location of the adsorbers in the water treatment process.
5. Superficial (approach) velocity.
6. Minimum EBCT for removal of contaminants to meet regulatory limits.
7. Bed depth of GAC in adsorbers.
8. Service time of adsorbers.

In addition to this information the pilot study will need to obtain the following information:

1. Filtration rates.
2. Backwash rates and frequencies.

A responsible official of the PWS 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.

A pilot study must be conducted for a period of at least 90 days during a season that represents adverse operating conditions for a full-scale water treatment system. Any level of pretreatment proposed for a pilot study must be equivalent to that which will be provided at the site-specific, full-scale GAC filtration system installed.

The following data must be collected during the pilot study to create data summary tables and graphs for the GAC filters tested in the final pilot study report.

1. During the pilot study, the following data must be collected at least once each day.
   a. Raw water temperature,
   b. Raw water turbidity,
   c. Raw water pH,
   d. Raw water alkalinity,
   e. Raw water iron and manganese,
   f. Filtered water turbidity,
   g. Filtered water pH,
   h. Filtered water alkalinity,
   i. Filtered water iron and manganese,
   j. All chemical dosage levels at application points, if used, and
   k. Head loss of filters.

2. During the pilot study, the following data must be collected at least once each week for each parameter.
   a. Total organic carbon (TOC) of the raw water from each source of water,
   b. TOC of the filtered water, and
   c. VOC, specifically the chemical(s) to be removed.

PILOT STUDY REPORT

A pilot study report must be prepared under the direction of a professional engineer, licensed in the State of Oklahoma. A submitted pilot study report must be accompanied by a cover letter that is signed, sealed and dated by the professional engineer representing the PWS system and having over-site of the pilot study to be conducted.

The DEQ staff member that is reviewing the pilot study report may request a meeting with the responsible official of the PWS and/or their engineer prior to issuing acceptance of the pilot study report.

The pilot study report contains the results of the pilot study and recommendations for the site-specific, full-scale design of the GAC filtration system for VOC removal. The report must include the following:

1. Summary of the pilot study results and recommendations.

2. General information about the site where the pilot study was conducted:
    a. The name of the PWS,
    b. The PWSID Number of the PWS,
    c. The name of the raw water source and the water rights allocated,
    d. A map showing the location of the raw water wells used in the pilot study, and
    e. A schematic of the pilot plant that shows chemical feed points (if any), pretreatment facilities (if any), pilot equipment, flow meters, and monitoring points.

3. A pilot study report must include a detailed description of the pilot study conducted on each GAC filter. The following information must be included in this description.
    a. A description of any preconditioning done to the GAC filter prior to the pilot study,
    b. A description of any equipment failures and any resulting time delays or time off line, and
    c. A description of any special tests conducted.

4. Data and results must be presented for the following items:
    a. Backwash duration,
    b. Backwash frequency,
    c. Backwash flow rate, and
    d. Raw water flow rate.

5. A 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.

6. A list of analytical procedures conducted at off-site laboratories must be included.

7. The pilot study must contain the following graphs for each GAC filter being considered for site-specific, full-scale installation.
    a. A plot showing the VOC levels (specifically of the chemical(s) to be removed) of the raw water and filtered water on the same graph,
    b. A plot showing the VOC removal (specifically of the chemical(s) to be removed) as a function of EBCT, and
    c. A plot showing the VOC removal (specifically of the chemical(s) to be removed) as a function of chemical dose (if a chemical is used with the treatment system).

8. The pilot study report must contain data summary tables that include all parameters measured during the pilot study.