Nebraska Department of Environment and Energy
Standard Operating Procedure (SOP)

Water Quality Division
Water Quality Assessment Section – GW

SOP Number: GW-080
Title: Field Filtration of Groundwater Samples
Written Date: July 2024

Purpose: To filter sediments and other foreign materials out of ground water samples, for determination of dissolved metals (Ca, K, Na) during laboratory analysis.

The decision to filter samples and what filter to use: Whether to filter groundwater samples has been debated since at least the mid-1970's.

Things to consider:
Why to Filter: Sediment is often present in monitoring wells. The particulate portion of the water column is often readily visible. Metals sorb to soil particles, particularly clays. Sampling particulates can result in erroneous, high metal results. This is particularly true if the sample is to be acidified; the addition of the acid will cause much of the normally immobile metals attached to the particulates to dissolve. USEPA has defined dissolved constituents as those particles small enough to pass through a 0.45 □m filter.[3] Taking both a 0.45 □m filtered and an unfiltered sample may provide an estimate of the total and dissolved portions of the sample parameter.

The arguments not to filter include: Proper well construction and development and using low flow purging and sampling methods may minimize the sample particulates. "Filtration" can "not compensate for inadequate" well "construction or sampling procedures."[1] The common use of a size 0.45 □m filter is arbitrary. Colloidal particles can have some mobility, particularly in porous media. Colloidal particles "are generally considered as particles up to 10 □m." and would therefore, in part, be filtered out with the standard 0.45 □m filter). Studies indicate "colloidal particles in the range 0.1 to 1.0 micron may be most mobile in a sandy, porous medium."[1] and larger colloidal particles maybe mobile in gravels and in areas with fracture flow.

Ultimately, the decision to filter and what filter to use should be based on the data needs of the user.

Hand filtering:

1. Filtration funnel. 2. Magnetic base with rubber stopper 3. Vacuum flask
4. Tubing 5. Hand vacuum pump with pressure gauge (Nalgene or equivalent)[2]

Equipment/Materials Needed:

- Filters, 0.45 µm flat disk filter mesh or other selected filter size, 47 mm diameter
- Tweezers/tongs/or forceps
- Squirt bottle filled w/ deionized water
- Filtration funnel w/ magnetic base and rubber stopper
- Hand pump (Nalgene or equivalent)
- Flask, 1000 ml (Nalgene or equivalent w/ tubing port)
- Clear plastic tubing to fit flask port, approximately 2'
- Temporary sample container to be filled with sample water
- Sample container with label
- Preservative as required

Procedures:

1. Complete the purging protocol, minimizing well disturbance.

2. Collect the water sample in the temporary sample container, minimizing well disturbance.

3. If a filter disc has been left on the screen from the previous sample location, remove it. Rinse the filter funnel and flask with deionized water.

4. Separate the funnel into its top and bottom portions. In a wind-free environment, use the tweezers or filter forceps to separate a filter disc (white) from its wrapper and protector (blue) and place the filter on the bottom portion of the magnetic funnel. Do not touch the filter with your fingers; fingers can impart oil, dirt, or other contaminants to the filter. A drop of rinse water on the funnel screen (on the bottom portion of the funnel) will help keep the filter in place. Reconnect the top and bottom portion of the funnel.

5. Connect the funnel to the flask by inserting the rubber stopper on the bottom portion of the funnel into the flask neck.

6. Connect the hand pump and tubing to the flask tubing port.

7. Pour a small amount (50-100 ml) of sample water into the filter funnel.

8. Squeeze the hand pump until the sample water is pulled through the filter.

9. Rinse the flask by swirling the filtered water all around the inside of the flask.

10. Discard the rinse water.

11. Fill the funnel with sample water and squeeze the hand pump until the sample water is pulled through the filter. Continue adding sample water until all of it has been filtered. Use the minimum vacuum necessary to collect the sample.

12. Rinse the labeled sample container by transferring a small amount of filtered water to the sample container. Place the cap on the container, swirl the water all around the inside of the sample container and discard the water. If the acid is pre-added to the container, do not rinse, simply proceed to step 13.

13. Transfer the sample water from the flask into the sample container.

14. Preserve and store the sample as per SOPs.

15. Take the filtration funnel apart and observe the used filter paper. Note on the field sheet the presence of any sediment or other contaminants. Leave the filter disc in place until the next sample location.

16. Prepare and secure all equipment for transport to the next sampling site.

Filtering using a pump and cartridge filter:

Disposable cartridge filter example
(Image from Waterra website)

Equipment/Materials Needed:

- Cartridge/ capsule filters, 0.45 µm filter or other selected filter size
- Pump (submersible or peristaltic, preferably with variable speed control) with tubing
- Power source, such as electrical generator and electrical cord, as needed
- Tubing size adapter, as needed
- Y or T shut-off valve with approximately 2'clear of plastic tubing to connect from Y or T shut-off valve (optional, to adjust and re-direct the flow though the filter, if needed)
- Squirt bottle filled w/ deionized water
- Sample container with label
- Preservative as required

Procedures:

1. Complete the purging protocol, minimizing well disturbance.

2. Carefully remove the cartridge filter from the packaging, without touching either end of the filter.

3. Note the arrow on the cartridge indicating the required direction of flow. Attach the cartridge to tubing from the pump, with tubing adaptor as needed; or attach to about 2 ft. of sample tubing after a Y or T shut off.

4. The sampling pump pressure is used to push water through the filter. Adjust the pump or the shut off valve to provide a low but steady water flow though the filter. Discard approximately 3 filter volumes of water.

5. Rinse the labeled sample container by transferring a small amount of filtered water to the sample container. Place the cap on the container, swirl the water all around the inside of the sample container and discard the water. If the acid is pre-added to the container, do not rinse, simply proceed to step 6.

6. Direct the flow from the filter to fill the sample container.

7. Preserve and store the sample as per SOPs.

8. Note on the field sheet the presence of any observable sediment or other contaminants within the used filter (This may not be possible with opaque filters).

9. Prepare and secure all equipment for transport to the next sampling site.

References:

1. Ground Water Sampling for Metals Analysis, Superfund Groundwater Issue, Rober Puls and Michael Barcelona, USEPA EPA/540/4-89/001, March 1989 pages 1-6

2. Environmental DNA Sampling Protocol—Filtering Water to Capture DNA from Aquatic Organisms, Book 2, Collection of Environmental Data, Chapter 13, USGS in cooperation with Washington State University, by Matthew B. Laramie, David S. Pilliod, Caren S. Goldberg, and Katherine M. Strickler, 2015, pages 1-15

3. The Complete Ground-Water Sampling Field Course, Sept. 19-21, 2011, Lincoln, NE. The Nielson Environmental Field School. Instructed by David Nielson and Gillian Nielson.