

Selecting Samples for Sieve Analyses in Filter Pack Design

Introduction

If one were to ask 10 ground water professionals how many samples of cuttings are needed to design a filter pack, it would not be surprising to get 20 opinions offered in response. Experience supports the observation that some designers subscribe to the notion that one should analyze almost as many samples as were collected. Hyperbole? Not really. Others (i.e., minimalists) more often only analyze samples that are representative of finest sediments within the zone(s) to be screened. Truth be told, everyone who designs filter packs has an approach to selecting the samples that they consider to be “representative”. The issue here is that one must be clear on the key objectives in filter pack design so as to properly select the samples most needed to design the pack and to do so in a way that facilitates the analytical testing.

This memorandum proffers the thought that the selection of samples for sieve analyses is a straightforward exercise that is anything but mysterious. It’s doable by anyone.

What is the Objective?

The two guiding principles originating with the soils engineering pioneer, Karl Terzhagi, are:

1. The characteristic particle size of the filter pack must exceed that of the formation to provide a significant increase in the filter permeability.
2. The ratio of the filter size to the finer segment of the formation must not be too large or some formation material will migrate to the pack.

Implicit in these criteria is the fact that one must identify the finest material within the aquifers that are to be stabilized. Therefore, when selecting samples from the borehole it is necessary to deliver to the laboratory a representative sample(s) of the finest formation material. Having done this, the results of the sieve analyses will be most meaningful to design the filter pack. Whether one follows Terzhagi’s patented criteria or not, it is still important to know the size of the finest sediments because it will be them that are most likely to migrate from the formation if not stabilized by the filter pack.

Which Samples and How Many?

In direct rotary drilling and reverse-circulation drilling, it is common for cuttings to be collected at depth intervals of 10 feet as they return to the surface with the circulating drilling fluid. So, it would not be unusual to have collected 100 to 150 samples in some boreholes. The basic procedure for sampling is well described by Roscoe Moss Company (1990). When the pilot borehole is completed, the depth intervals (i.e. zones) that are to be screened are identified by reviewing the lithologic log (or driller’s log) and by interpreting the downhole geophysical log(s). (It should be pointed out downhole geophysical surveys are not always performed.) It is at this point when the samples are selected for sieve analyses.

Since well screens are typically installed within the depth intervals of the aquifers, it is unnecessary (let’s say useless) to attempt to perform sieve analyses of aquitards and aquicludes because neither is a source of water. In fact, the particle sizes of both materials are smaller than the #200 U.S. sieve size. If there is doubt whether the sample is finer than the

#200 sieve, simply place the sample in a small plastic bag and squeeze it. If it feels soft and “mushy” like clay, it is clay. There’s no need to set it aside for a sieve analysis. It’s either sediment from an aquitard or aquiclude.

Having accepted that one need only perform sieve analyses on granular cuttings, the question then is how many samples should be sent to the laboratory. Again, this is a matter of personal preference; however, the typical and generally accepted approach is to send to the laboratory samples of the finest cuttings from the zones to be screened. There is no need to send dozens of samples; those most important are the finest because they need to be stabilized by the filter pack. Generally speaking, 3 to 6 samples would be normal for 1,000 to 2,000-foot deep wells.

Summary

It is easy to understand the concern of well designers who want to perform sieve analyses on multiple zones where screens are to be installed. However, by keeping in mind that only the finest of the granular sediments are likely to cause problems during pumping, one can simplify the laboratory testing program, shorten the turnaround time for the results, and expedite the completion of the final well design.

References

- Roscoe Moss Company, 1990, *Handbook of Ground Water Development*, John Wiley and Sons, New York, NY.
- Terzhagi, K., and R.B. Peck, 1948, *Soil Mechanics in Engineering Practice*, J. Wiley and Sons, New York.

About the Author

Robert Turnbull is the Chief Hydrogeologist of Roscoe Moss Company. In this capacity he provides technical support, as needed, to consultants, municipalities, and water districts to plan and design water supply wells. He can be contacted for such information or to answer inquires regarding this technical memorandum via email at rturnbull@roscoemoss.com. His website is www.blthydro.com. The corporate website for Roscoe Moss Company is www.roscoemoss.com.