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The Utility of the New Drop-in-place *FLUTe* MLS

The FLUTe Cased Hole Sampler (CHS)

The Utility of the New Drop-in-place FLUTe MLS Called a FLUTe Cased Hole Sampler (CHS)

The device

Requests for typical FLUTe multi-level sampling systems (MLS) for use in very slender casing (2-3" diameter) are infrequent because everting a 2" liner with tubing into such a slender hole is difficult. However, a new construction and installation method makes that application not only possible, but quite inexpensive.

Called the FLUTe Cased Hole Sampler, CHS, this newly available FLUTe system is constructed in a different manner and is lowered, instead of being everted, into the borehole or casing. This description is to put the use of this method into context with the other options for multi-level sampling and to describe the significant advantages of the CHS.

Background

Cluster wells are expensive in that several boreholes must be drilled. Nested wells are relatively inexpensive but the backfill seal is uncertain and more than two wells per borehole are to be avoided. Multi-level sampling intervals in a single hole with 3 or more ports is especially efficient.

Several multi-level systems, MLS, exist for shallow boreholes and shallow water tables such as the CMT system and the Shallow Water FLUTe. The CMT hardware is inexpensive, but it requires construction in the field and then requires backfill with sand packs and sealing materials and is a permanent installation. CMT systems can be installed through driven casing in sediments (e.g. sonic casing) and backfilled as the casing is withdrawn.

Another option is that standard casing can be installed in the same manner with multiple screens at desired sampling intervals. The standard casing installation can be easily developed which is not practical in the small channels and ports of the CMT system. The open multi-screened well can be sampled with straddle packers, but the open casing is then allows cross connecting flow and is not recommended.

The multi-screened standard casing can be very effectively developed with surge blocks and the same piping of the surge block can be used to remove the sediment developed using air lift pumping.

The Shallow Water FLUTe, SWF, system can be installed by eversion in an open stable borehole without the expense, or uncertain seal, of a backfilling operation. The SWF draws the sample directly from the formation and can be purged and sampled simultaneously for optimum sample isolation and in minimum time. The borehole should be well developed before installing a SWF.

FLUTe has developed a new sealing liner MLS that is quickly and easily lowered into a 2" casing with multiple screens. The FLUTe CHS liner is then inflated with a water or heavy mud fill. The water sampling and head measurements can be done as for the SWF. The new FLUTe system has been named the FLUTe Cased Hole Sampler, CHS. The CHS seals the casing with the liner and the tubing draws water from the screened interval which has been well developed as described. The same simultaneous sampling system can be used as for the SWF. Head histories can be recorded with the compact ACT (air couple transducer) design with the transducer(s) located at the wellhead. A positive displacement version of the CHS is available for deeper water tables (>25 ft) or if peristaltic pumping is not an option.

A major advantage of the CHS is that it is very inexpensive and can be installed by anyone in 10-15 minutes. However, it may be more important that the screened interval can be thoroughly developed. It may even be reasonable with a coarse gravel pack to use the system in mud drilled holes as is done for common water wells with extensive development of each screened interval.

A summary of the advantages of the CHS

1. Thorough development of the screened intervals is possible.
2. Perhaps the least expensive of the MLS systems
3. Easy head measurement using the Vacuum Water Level Measurement system.
4. Fully removable
5. May even be useful in mud drilled holes depending on the mud used because of the development option.
6. Can be used in sediments where casing is necessary
7. Can be installed quickly by the customer from the shipping reel or coil.
8. No field assembly required prior to emplacement
9. The backfill around a straight casing is more reliable than for a curved tubing system
10. No stagnant casing water can contact the sample water
11. Allows the sampling intervals to be selected at the time of drilling the borehole
12. Can be purged and sampled simultaneously.

The geometry of the CHS

Figure 1 shows the system in place in a casing with sand packs at the screens. The weighted end seal allows the liner to be lowered into the casing. The top of the liner is attached to the tubing bundle. The tubes are threaded through the small end cap on the slender casing and the system is supported by the tubing. The central tag tube allows the liner water level to be measured with a slender electric tag line. The water level for each port is measured with the vacuum water level meter (VWLM) provide by FLUTe at no extra cost for more than 5 systems. The central tube is also used to add water to the liner. Deflating the liner by pumping water from the central tube allows the liner to be lifted out of the casing for reuse of the casing such as for remediation injections.

The sampling intervals can be predetermined so the system is available at the time of drilling the borehole or

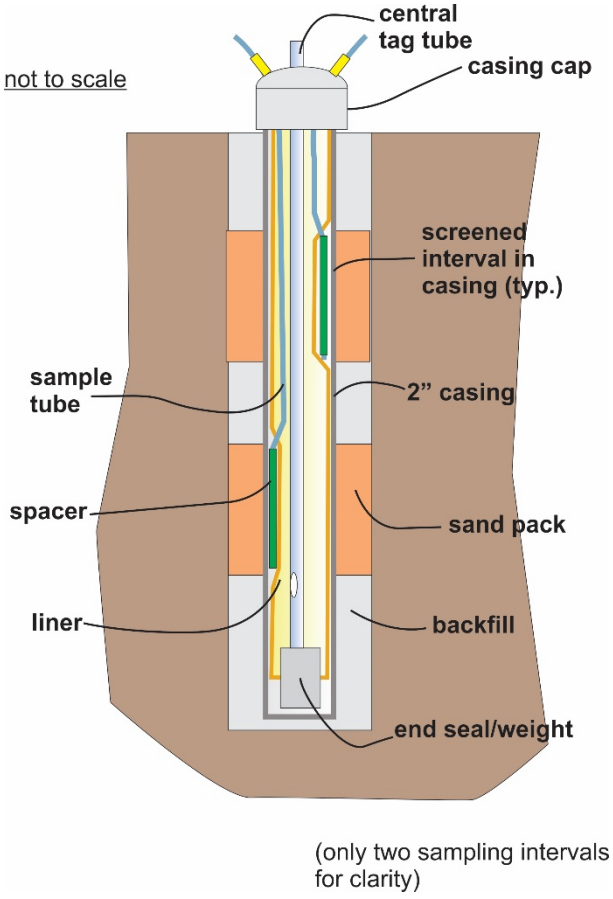

Figure 1. FLUTe Slender Sampler (CHS) in casing. Cylindrical spacers at each screen. CHS lowered into casing and inflated.

ordered from FLUTe with expedited delivery in a day or two after the casing is set in the borehole.

Whereas the most ports (8) are available using ¼"OD tubing, the use of 3/8" tubing allows a direct water level measurement with an electric water level meter and fewer ports in a 2 inch casing. A slightly larger casing (2.5-3") allows even more ports. The positive displacement pumping system uses the larger casing unless only 2-3 ports.

How does the VWLM work?

The VWLM (Fig. 2) applies a vacuum to the sample tube. The vacuum applied to each tube raises the water level into the sight glass above the surface. The valve is then closed. The height (H) of the meniscus above the ground surface is then measured. The value of H is subtracted from the vacuum reading (VAC) in the digital display. The result is the water table depth below the surface.

A system is available which uses duplicate sight glasses side side-by-side to allow the precise meniscus level difference (ΔH) to be measured for the precise head difference between the two ports. Dividing ΔH by the port port elevation difference determines the vertical gradient. A venturi vacuum pump or a peristaltic pump can be can be used to apply the vacuum.

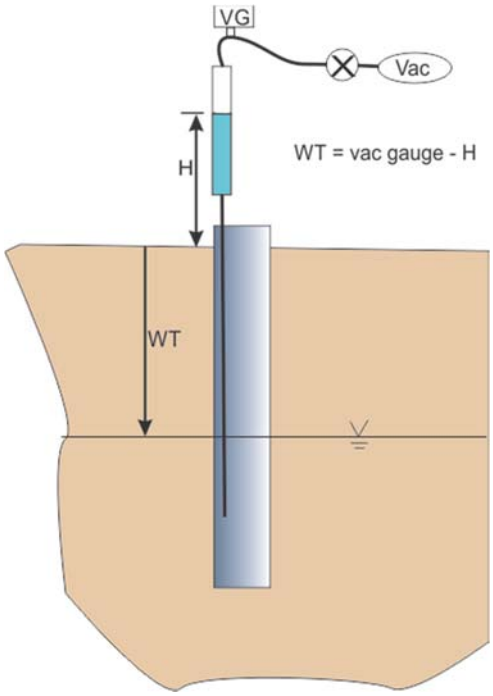

Figure 2. Vacuum Water Level Meter design. Water table can be measured through very slender tubes with a constant vacuum level and H.

If the water table is greater than ~30 ft., air can be injected into the sample tube to function as a bubbler tube (see the web site www.flut.com for the explanation of how a bubbler is used to measure the water table depth). Given the water table depth, the ACT system can record the water table history.

In conclusion

The CHS system* is inexpensive, light weight, compact for shipping, easily installed in minutes with no field construction and removable. The ability to develop the screened intervals is a major advantage for quality water samples. A variety of tubing materials are available.

*FLUTe patent pending.