

The applications of the Cased Hole Sampler and its variations

The original version

The simple cased hole sampler (CHS) was designed to allow the installation of a multi-level sampling and head measurement device in cased and screened wells. Preferably the screens extend over discrete intervals of the cased hole. This design allows a relatively inexpensive method for multi-level sampling (MLS) in sediments where the boreholes are not stable. The simple liner system is lowered down the interior of the casing from the shipping container requiring no construction in the field. The customer provides the desired sampling intervals to FLUTE for immediate fabrication and shipping.

A particular advantage of the CHS is that it can be installed in casings as small as 2 inch diameter. Another advantage is that the sampling liner is lowered into the hole and independent of the water table depth or permeability of the formation. The complete installation is possible in 15 minutes by relatively untrained individuals after the driller has installed the casing.

The CHS spacer defining the sampling interval is usually positioned adjacent to the screen interval, but can be less for a sand packed screen and will draw the sample from the sand packed interval.

The CHS in its least expensive version uses peristaltic pumping of sample water from 1/4" OD tubing. The water table can be measured in the 1/4" tube using a FLUTE VWLM (vacuum water level meter) which draws the water to the surface with a measured vacuum and uses the height of the water level above the surface, with the vacuum measurement, to calculate the water table depth (see the VWLM description attached).

The CHS can be installed in any size multi-level screened casing. The larger the casing the more ports possible with 6 ports in a 2" casing and more in 3, 4 and 5" casings.

The Water table must be less than 25 ft. for peristaltic sampling and water table measurements.

All CHS systems can purge all ports simultaneously which is a substantial advantage in continuously screened wells.

The 3/8" tube version

By using larger tubing to the port, the water level can be measured with a slender electric water level meter. The number of ports for a 2" casing is reduced to 4 for the 3/8" OD tube version.

The system is still limited to peristaltic pumping.

The positive displacement pumping system version (pdCHS)

By extending the tubing of each port to the bottom of the hole and adding a tube from the bottom of the borehole/casing to the surface, plus a check valve at the port, one can use a positive displacement gas driven pumping system. The pumping method is the same as used for the Water FLUTE system which has been in use for nearly 20 years at 23 super fund sites.

One can also use the Water FLUTE manifold and pump all the ports simultaneously for purging. The photo shows the simultaneous flow of all ports. Because of the same total tube length for each port,

there is no concern about aeration of the sample water after purging of the prescribed volume. The simultaneous purging procedure assures optimum spatial isolation of the sampled formation volume.

For 2" cased wells, the tubing is ¼" OD and produces about 700ml per stroke of the system for 100 ft of saturated interval of the borehole. The number of ports in a 2" cased borehole for positive displacement pumping and ¼" tubing is 4 ports. A "stroke" is defined as the expulsion of the tube water volume with a single pressure application prior to the venting of the pressure for the refill of the tubing.



If 3/8" inch tubing is used to the bottom of the borehole, the pumping volume is greater, but the casing size must be larger, 3-4 inch diameter)

The CHS design used in uncased boreholes

Due to the less expensive fabrication, the advantages of the CHS can be extended to uncased stable boreholes. (another version of the CHS is in development for installation in driven casing drilling systems such as core or sonic drilling)

When provided with a suitable protective flexible sheath, the CHS system can be lowered into an uncased stable borehole. The sheath is then removed and the liner is dilated by water or mud addition to the interior of the liner through a central tube. This procedure has substantial advantages such as the installation is still easy and quick by untrained individuals.

However, for deep boreholes and many ports, the Water FLUTE system is preferred.

All of the CHS systems can use the air coupled transducer system for recording the head history at each port. That intended use must be indicated at the time of ordering for the pdCHS.

The use in continuously screened wells

If the well screen is continuous with a sand pack or in a collapsing formation such as mud or sugar sand, it is often assumed one cannot get vertical profiles of transmissivity or of contaminants. However with simultaneous sampling in a lined casing with the same draw down on each port, the pressure ridge between ports provides enhanced isolation. The continuous liner seal of the casing prevents vertical flow inside the casing. The open casing interior is the major perturbation of vertical resolution. Obviously straddle packers are easily bypassed in the filter pack, but simultaneous purging sampling with the same drawdown at each port allows reasonable, if imperfect, vertical isolation. Furthermore, if one has N sampling intervals equally spaced and you can deflate the liner raising it half the sampling interval separation. This provides N more sampling intervals in the same cased well. The advantage is not only higher spatial resolution, but lower cost of the liner and very many sampling elevations. If the vertical gradient is modest, a fine grained filter pack has much higher vertical impedance to flow than for horizontal flow through the filter pack to the screen to the sample port.

The discretely screened or continuously screened casing can be emplaced in several ways in sediments in alluvial plains or lake beds. The FLUTE methods of CHS, pdCHS, NAPL FLUTE, FACT and T profile can all be used in screened casing. It is not advised to slide a FLUTE liner upward in an uncased borehole because of the liner abrasion possible.