HYDRASleeve
A No-Purge Groundwater Sampler for All Constituents

and Evaluation of its Use on DWR Projects

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US Patents 6,481,300 and 6,837,120
HydraSleeve - Background

- Developed in 1999 by Geologist Kent Cordry
- Kent also developed the first direct-push groundwater samplers, the HydroPunch I and II in mid to late 1980’s
- Kent is the president of GeoInsight, a company which performs its own R/D and sells direct-push equipment and environmental products in Las Cruces, New Mexico
- GeoInsight has six patents and several pending all related to direct push technology and the HydraSleeve
- I first learned about the HydraSleeve in March 2007 and immediately saw its potential applications and benefits to DWR
HydraSleeve Components

1. Expendable sample sleeve with top loading check valve
2. Reusable weight
3. Suspension tether
How Does It Work?

- HydraSleeve collects a water core sample from a defined interval within the well screen, then seals itself for recovery

  - *In empty and sealed*

  - *Out full and sealed*
HydraSleeve Assembly
HydraSleeve Placement
Well Equilibration

- All groundwater samplers or sampling methodologies attempt to collect a sample that is representative of formation-quality water adjacent to the well.

- Studies have shown that most wells receive groundwater flow through the screened interval of the well.

- This screened interval, considered in equilibrium with the adjacent formation water, can be sampled with passive samplers with little or no well-water agitation.
HydraSleeve Sample Collection (continuous pull)

Sample Interval: 1-1.5 times length of Sleeve
Deploy

Collect

Recover
HydraSleeve Sample Collection (Continuous Pull)

Top View

Well

Sample Radius

Sample Interval
Up-Down Cycle

Sample Interval
Recovered HydraSleeve
Sample Discharge
Vertical Profiling-Multiple Samplers
Why use the HydraSleeve?

- Collect a Formation Quality Sample for All Constituents
- Save Time and Money, typically 50-80%
Case Study-New England

- Landfill-Superfund Site
- 30 wells from ~30-200 feet deep
- Annual sampling event
- Original method - EPA Low Flow
- Replacement method - HydraSleeve
Case Study-New England

• Low Flow Sampling - Required 2 weeks with 4 people

• HydraSleeve - Required 4 days with 2 people
HydraSleeve Advantages

• No purge water
• Formation quality sample
• Simple and inexpensive to use
HydraSleeve Limitations

- **Limited sample volume.** One shot sample method
- Samples a defined vertical interval within the well
## ITRC Minimum Volume Requirements

**Hydrochloric acid Volatiles**  
- **8260**  
- See attached list  
- **140**  
- 20  
- 1  
- If separate 40-mL vials are used for each 20 mL aliquot, inert material is needed to occupy the remaining 20 mL. Approved inert material should be used. Alternatively, 20-mL vials can be used.

**Unpreserved (SVOCs) BNAs**  
- **8270**  
- See attached list  
- **1000**  
- 250  
- 1  
- Can use 100 mL, but RLS will be higher than AFCEE 3.1 QAPP

**Pesticides**  
- **8081**  
- See attached list  
- **1000**  
- 100  
- 1  

**PCBs (1016, 1221, 1232, 1242, 1248, 1254, & 1260)**  
- **8082**  
- 0.5 μg/L  
- **1000**  
- 100  
- 1  
- 100 mL extracted by separatory funnel (3510) and concentrated to 1.0 mL, 2 μL injection dual column GC/ECD analysis.

**Herbicides**  
- **8151**  
- See attached list  
- **1000**  
- 100  
- 1

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1 The sample volume in this column assumes that the analytical technique referenced will be employed with little or no modification, that the reporting limit will remain at the standard reporting limit, and that the cost of analysis would be essentially the same as the cost of the method performed using the SW-846 recommended preparation volume. If a modification is necessary to achieve the smaller sample volume, then the modification is of no or minor consequence to the performance of the method and would be "easily accepted" by almost all state and federal regulators that review environmental methods. Sample volumes even lower than those indicated in this column can be achieved through the use of other analytical techniques. However, regulatory approval might be necessary for non-standard technologies and methods and analysis pricing may be higher.

* Are not SW 846 methods and/or not in AFCEE QAPP 3.1, but are commonly requested groundwater tests for long-term monitoring projects.

** Stipulated in AFCEE QAPP 3.1 to be run by EPA Method 300.0.
Other Uses

- Low-yield wells
- Wells with brackish or saline water
- Vertically define contaminant concentrations in wells
- Sample crooked or damaged wells
- Collect samples from discrete intervals in surface water bodies and tanks
USACOE Demonstration Test

- Sampling completed in Summer of 2004
- Compared 6 no-purge samplers to low-flow and volume purge in the same wells
- Final report issued October 2005
Cost/Well:

- HydraSleeve
- Passive Diffusion
- Low Flow
- 3-Volume Purge

Cost does not include disposal of purge water.

Based on 2-person team.
USACOE Demonstration Test
Conclusions

- From a performance perspective, the report concluded that the HydraSleeve typically produced results most similar to the more conservative (i.e., higher-concentration) results obtained from the conventional and low-flow sampling methods.

- HydraSleeve was the least expensive sampler tested and simplest to deploy and retrieve, and it permits a larger volume of water to be collected than do some of the other passive samplers.

- HydraSleeve delivered viable samples for all of the analytes tested.

- The report concluded that the HydraSleeve appears to be a technically viable method for monitoring all of the compounds included in the demonstration.
Evaluation of the Use of the HydraSleeve on DWR Projects
Field Evaluation of HydraSleeve

• Eleven wells at four DWR multi-level well sites in the Sacramento Valley were sampled between June and October 2007

• Well depths ranged from 47 to 554 feet bgs

• Samples were analyzed at Bryte Lab for Major Ions, Minor Ions, Trace Ions, and Physical Parameters and Zymax Forensics for Stable Isotopes of O and H
Field Evaluation of HydraSleeve

- HS results were compared to results of samples collected through 3-5 casing volume purge methods using a submersible pump (Industry Standard)

- One well was sampled twice (one month apart) using the HS to evaluate data reproducibility and sampler precision

- Ion data pairs were graphed using X-Y scatterplots and correlation was evaluated using linear regression
HydraSleeve Data Evaluation

- The Coefficient of Determination commonly referred to as $R^2$ is a statistic that will give some information about the goodness of fit of a model to a dataset.

- In regression, the $R^2$ value is a statistical measure of how well the regression line approximates the real data points.

- An $R^2$ of 1.0 indicates that the regression line perfectly fits the data.
Major Ion Data Scatterplot

- Equation: $y = 1.0131x$
- $R^2 = 0.9903$
- $N = 71$ Data Pairs

Major Ions include:
- Calcium
- Magnesium
- Potassium
- Sodium
- Bicarbonate
- Chloride
- Sulfate
Minor Ion Data Scatterplot

$y = 0.9363x$

$R^2 = 0.9841$

$N = 37$ data pairs

Minor Ions include:
- Boron
- Bromide
- Carbonate
- Fluoride
- Hydroxide
- Iron
- Manganese
- Nitrate
Trace Ion Data Scatterplot

\[ y = 0.8875x \]
\[ R^2 = 0.9477 \]
\[ N = 21 \text{ Data pairs} \]

Trace ions include:
- Aluminum
- Antimony
- Arsenic
- Barium
- Beryllium
- Cadmium
- Chromium
- Copper
- Lead
- Mercury
- Nickel
- Selenium
- Silver
- Thallium
- Zinc
Physical Parameter Data Scatterplot

$y = 0.9865x$

$R^2 = 0.9901$

$N = 55$ Data pairs

Physical Parameters include:
- Hardness
- Total Alkalinity
- Total Dissolved Solids
- Conductance
- pH

Pump Sample Result (various units) vs. HydraSleeve Sample Result (various units)
Oxygen 18 Data Scatterplot

\[ y = 1.0118x \]

\[ R^2 = 0.8286 \]

\[ N = 13 \text{ Data pairs} \]
Deuterium Data Scatterplot

- $y = 1.0267x$
- $R^2 = 0.8644$
- $N = 13$ Data pairs
HydraSleeve Sample Data Reproducibility (Well HC-1)

$y = 0.9786x$

$R^2 = 0.9999$

$N = 24$ Data pairs

Major Ions = 7

Minor Ions = 6

Trace Ions = 6

Physical Parameters = 5
DWR Conclusions

• The HydraSleeve produced sample results that correlated well to industry standard 3-5 volume pump sample results indicating high accuracy.

• The HydraSleeve had excellent data reproducibility indicating high precision.

• The results of our evaluation are consistent with those obtained by USACOE in a trial of passive sampling devices at the former McClellan AFB.
DWR Conclusions

• The HydraSleeve requires minimal equipment and personnel

• The HydraSleeve is inexpensive and disposable

• The HydraSleeve is very quick and easy to use and generates no purge water
DWR Conclusions

• The use of the HydraSleeve following a standard procedure should produce highly accurate and reproducible data at both clean and contaminated water sites

• Use of the HydraSleeve will save DWR time and money

• The HydraSleeve should be seriously considered for use by DWR and our contractors on all future groundwater sampling projects where appropriate
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Online HydraSleeve References

- http://www.geoinsightonline.com
- http://www.hydrasleeve.com
- http://www.itrcweb.org