*Resumé *)*

FIELD COMPARISON OF GROUND-WATER SAMPLING DEVICES

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**) Contact BAT Geosystems AB for receipt of a copy of the complete report.*

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ABSTRACT

Most ground-water sampling methods require the investigator to purge a large quantity of stagnant water from a well prior to taking the sample. At hazardous waste sites, this can create problems with waste-water disposal and exposure of sampling personnel to hazardous materials. The use of *in situ* ground-water sampling devices which minimize or eliminate the need for purging would help to alleviate these problems. In this field comparison study, the performances of seven ground-water sampling devices were evaluated to determine if these devices would yield accurate, precise, and representative data. The sampling devices included a bladder pump, a bladder pump below a packer, a bailer, the Westbay® MP System, two *in situ* BAT devices, and a BAT well probe. The samplers were installed at a site contaminated by a benzene-chlorobenzene plume, and the comparison was based on the ability of the devices to recover representative concentrations of these volatile organic compounds. The results of the experiment indicate that the BAT® devices, which require only minimal purging, yielded samples containing levels of benzene and chlorobenzene as high as those collected with the bladder pump. Samples collected with the Westbay® MP System contained significantly lower levels of volatile organic compounds than those collected from all other devices. The pump/packer combination generally resulted in samples with lower yields of benzene and chlorobenzene than the BAT® devices and the other bladder pump, although higher than for the bailer or the Westbay® System.

DISCLAIMER

Although the research described in this article has been supported by the United States Environmental Protection Agency [through CR812713-01-7 to the Desert Research Institute], it has not been subjected to Agency review and therefore does not necessarily reflect the views of the Agency and no official endorsement should be inferred. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

devices may then be grouped accordingly by bracketing those devices which show no significant differences. Results of the analysis are shown below.

Benzene			Chlorobenzene		
Well	Device	$\bar{x}$	Well	Device	$\bar{x}$
3	Westbay®	114	3	Westbay®	651
1b	Bailer	179	1b	Bailer	1034
2	BAT® PTFE	199	5	BAT® HDPE	1383
6	Pump/Packer	205	6	Pump/Packer	1447
1p	Bladder Pump	279	2	BAT® PTFE	1448
4	BAT® Well Probe	329	1p	Bladder Pump	1463
5	BAT® HDPE	368	4	BAT® Well Probe	1704

The grouping of the sampling devices in this manner is useful in comparing the relative performance of pairs, or groups, of samplers. The results appear to confirm what may be interpreted from Figures 10 and 11. The Westbay® MP System consistently recovered the lowest concentrations of VOC's and the resulting mean differs significantly, at the 95% level, from all other sampling devices. In general, use of the BAT® sampling devices and the bladder pumps produced higher recoveries of both organic compounds, and in terms of chlorobenzene recovery, no significant differences exist between any of these devices. The bailer yielded higher concentrations than the Westbay® System, but differed significantly from the bladder pump, BAT® well probe, and BAT® HDPE in terms of benzene recovery, and from all of the devices in terms of chlorobenzene recovery.

DISCUSSION

The primary objectives of this study were to compare the accuracy and precision of the seven ground-water sampling devices and determine if either of the non-pumping sampling methods yield representative data. Because this is a field-orientated study, a true assessment of accuracy, and therefore "representativeness," is not possible. However, because of the physical and chemical properties of most volatile organic compounds, losses of VOC's from the system are much more likely than increases (Imbrigiotta *et al.*, 1986). Therefore, a relative approximation of accuracy may be made based on the concentrations of VOC's recovered during the sampling process (i.e. those devices which recover the highest levels of VOC's are considered the most accurate).

Based on the above assumption and the Tukey test results, it may be stated that the BAT® sampling devices and the bladder pump produced the most accurate results, while the bailer and the Westbay® MP System were the least accurate. In terms of precision (precision = $(s/\bar{x}) \times 100$), the bladder pump may be ranked highest, followed by the BAT® devices, pump/packer combination, Westbay®, and the bailer. The results of this study confirm some of the conclusions reached by previous studies regarding the consistency of the bladder pumps and the relative inconsistencies associated with the bailer (Barcelona *et al.*, 1984; Yeskis *et al.*, 1988). However, both of these devices require the purging of stagnant water from the well prior to sampling, thus producing the exposure and disposal problems discussed earlier. The results obtained from this study suggest that the BAT® samplers, which require only minimal purging, performed just as well as the bladder pump in terms of VOC recovery. Based on chlorobenzene recovery, the devices could not be distinguished at the 95% level of significance. In terms of benzene recovery, two of the BAT® devices (well probe, *in situ* HDPE) yielded as high or higher concentrations as the bladder pump. The possible effects

on sample chemistry of the materials making up the HDPE filter tip should be investigated.

The pump/packer combination was designed to minimize the amount of water purged from the well prior to sampling by isolating a column of stagnant water above the pump intake. Theoretically, the results should have been comparable to those obtained with the other bladder pump, and the chlorobenzene recoveries appear to back this up. However, benzene recoveries were significantly lower. The low precision associated with this device suggests a possible problem with the ability of the packer to seal off the stagnant water column from the pump intake. If the casing were cracked or leaking, the capabilities of the packer might be compromised. The possible effects of the Viton® packer bellows on sample integrity should also be evaluated.

The Westbay® MP System produced the lowest VOC recoveries, and a precision that was comparable only to the pump/packer and the bailer. The loss of volatiles may be due to orifice effects around the port and sampling probe valves, excessive vacuum applied to the sample vial holder, or well installation practices. Well development by airlifting may have had some long-term effects on sample chemistry in the monitoring zone around the measurement port. The vent needle in the VOA bottle holder may allow volatiles to escape into the interior of the container prior to removing the bottle. The seal in the VOA bottle caps may also have been compromised by the needle punctures, which would allow a pathway by which volatiles could escape prior to laboratory analysis.

CONCLUSIONS

In conclusion, the results of this field comparison appear to confirm the ability of at least one commercially-available *in situ* ground-water sampling device to collect accurate and representative data without the necessity of a pre-sampling purge of large quantities of stagnant well water. Both the *in situ* BAT® devices and the BAT® well probe recovered benzene and chlorobenzene with an accuracy and precision much greater than that of the bailer, and at levels rivaling those obtained with the bladder pump. The Westbay® MP System, on the other hand, produced samples which were much less accurate and at only a moderate level of precision.

The *in situ* devices allow samples to be collected quickly and with a minimal amount of exposure to sampling personnel. The devices are also relatively easy to operate and maintain. Further studies performed at a variety of sites and involving these and other commercially-available *in situ* sampling devices are needed to improve understanding of the applicability of these devices to a variety of monitoring situations.

REFERENCES CITED

Barcelona, M.J., Helfrich, J.A., Garske, E.E., and Gibb, J.P., 1984, A laboratory evaluation of ground water sampling mechanisms, Ground Water Monitoring Review, v. 4, no. 2, pp. 32-41.

Black, W.H., Smith, H.R., and Patton, F.D., 1986, Multiple-level ground water monitoring with the MP system, *in* Proceedings of the Surface and Borehole Geophysical Methods and Ground Water Instrumentation Conference and Exposition: Denver, Colorado, National Water Well Association, Water Well Journal Publishing Company, Dublin, OH, pp. 41-61.