

Bench Test of the Dual Membrane Passive Diffusion Sampler for 1,4 Dioxane

Purpose:

Controlled laboratory tests were conducted to validate that samples acquired using the Dual Membrane Passive Diffusion Sampler (DMPDB) represent the concentrations of 1,4 Dioxane in the water surrounding the sampler after a designated residence time. Two tests were performed at different concentrations; one test was conducted at about 0.55ug/L and another at about 5 ug/L to demonstrate a range of response near the emerging action levels.

Test 1 Method:

1. The sampling tests were conducted in a controlled environment using a PVC test chamber filled with approximately 70.85 Liters of water and that was spiked with lab certified 1,4 Dioxane reference material to a target concentration of about 4 ug/L, and a range of commonly sampled VOCs. The total water volume for the samplers and the chamber was approximately 75.49 Liters. The water inside the samplers comprised about 6.2% of the total water volume.
2. The chamber water was allowed to stabilize for three hours after spiking.
3. Three hours after spiking, 6 DMPDB samplers were filled with 600ml each of DI water and installed in the chamber using EON's polypropylene suspension tether assemblies. One DMPDB sampler was located near the bottom of the water column, 4 DMPDBs were located in the middle of the water column and one DMPDB was located near the top of the water column. The chamber was capped and sealed from outside air.
4. A recirculating pump was activated at the rate of about 200ml per minute.
5. The samplers were left in place for 15 days residence to allow the concentration gradient to cause 1,4 Dioxane to diffuse from the chamber fluid, through the membranes, into the samplers and reach equilibrium.
6. At 15 days after sampler installation, a control sample of the chamber water was obtained through a port midway along the height of the chamber, and decanted into 250 ml lab supplied sample bottles.
7. The DMPDB samplers were then removed from the chamber, one at a time, and the contents decanted into lab supplied 250 ml bottles using the provided "Juice-Box Straw" to puncture the membrane and direct the flow into the lab bottles.
8. After all 6 samplers were removed and sampled, a second control sample was taken of the chamber water and decanted into 250 ml lab supplied bottles.
9. The samples above were sent to Eurofins TestAmerica and analyzed for 1,4 dioxane using method 522 to obtain low detection limits.

Test 2 Method:

1. A second test was conducted in a similar manner as Test 1, with 6 DMPDB samplers and a lower concentration mixture of 1,4 Dioxane targeted for about 0.5 ug/L.
2. The samplers were left in place for 21 days residence to allow the concentration gradient to cause 1,4 Dioxane to diffuse from the chamber fluid, through the membranes, into the samplers and reach equilibrium.
3. The samples above were sent to Eurofins TestAmerica and analyzed for 1,4 dioxane using method 522 to obtain low detection limits.

DMPDB Bench Test Data 1,4 Dioxane

Mid-range Concentration

1,4 Dioxane Method 522	Lab RL	Control1	Control2	DMPDB (Residence time: 15 days)					
Sample I.D.		2MC-12	2MC-22	2M4-12	2L4-12	2M4-22	2M4-32	2M4-42	2U4-12
ug/l	0.2	4.2	3.7	3.6	3.8	4.0	4.2	3.8	3.8

Low Concentration

1,4 Dioxane Method 522	Lab RL	Control1	Control2	DMPDB (Residence time: 21 days)					
Sample I.D.		7MC-12	7MC-22	7U4-12	7U4-22	7M4-12	7M4-22	7L4-12	7L4-22
ug/l	0.20	0.56	0.59	0.56	0.55	0.57	0.63	0.55	0.56

Discussion & Notes:

- Since the test objective was to determine if the sampler concentrations match the concentrations of the chamber water at a point in time, pre-test concentrations of 1,4 Dioxane in the chamber were not collected. Changes that may have occurred in the 1,4 Dioxane concentrations in the chamber were deemed irrelevant as long as the sampler results were similar to the chamber concentrations at each sample event.
- Two control samples were acquired at each sample event, one immediately before and one immediately after the samplers were removed from the chamber and sampled. This provided a way to gage repeatability and set a reference for test variability outside of the samplers.
- The control samples were acquired from a port midway along the height of the chamber in such a way that the control samples did not come in contact with any materials other than the test chamber and the sample bottles.
- The laboratory results from the two control samples taken at each sampler removal can be compared to the results from the sampler contents from that test to determine if the sampler produces results equivalent to the water surrounding the samplers.
- The results suggest that 21 days is adequate residence time to achieve low concentration results. Shorter durations may produce acceptable results however further study is necessary for documentation.
- Comparison of the DMPDB sampler results to the Control results suggest that 1,4 Dioxane readily diffuses from water surrounding the sampler, into and throughout the DMPDB samplers until equilibration is reached with the water surrounding the sampler.
- Comparison of the DMPDB sampler results to the Control results suggest that the DMPDB Passive Diffusion Sampler results have degree of correlation with Control samples and would perform well for sampling 1,4 Dioxane through a range of concentrations, including the low levels of emerging regulation.