

ESTCP Cost and Performance Report

(ER-9921)



Push-Pull Tests for Evaluating the Aerobic Cometabolism of Chlorinated Aliphatic Hydrocarbons

September 2006



ENVIRONMENTAL SECURITY
TECHNOLOGY CERTIFICATION PROGRAM

U.S. Department of Defense

ACKNOWLEDGEMENTS

We would like to acknowledge the personnel at McClellan Air Force Base (McAFB), especially Al Calise, Anteon Corporation for permitting us access to the site, and for the logistical support, with a special thanks to Dennis Debacker for his help in conducting the field tests. We would like also to thank our project officers, Marcia Kankelfrit, Erica Becvar, and Fricklen Holmes, at the Air Force Center for Environmental Excellence (ACFEE) for their help throughout the project. We acknowledge the help of Kyle Foster, Jesse Jones, Robert Laughman, and Brian Timmins from Oregon State University (OSU) for preparing field tests and sampling.

We would also like to thank Fort Lewis allowing us access to the wells on base, and special thanks to Kira Lynch of the U.S. Army Corps of Engineers for her logistical support.

Technical material contained in this report has been approved for public release.

This page left blank intentionally.

Table 4. Summary of Quantities of Injected and Extracted Solutes Mass, Percent Recovery, and Zero-Order Rate for Push-Pull Tests for MW2 and MW3.

Test Type	Quantities	Propane		Ethylene		Propylene		Br	
		MW2	MW3	MW2	MW3	MW2	MW3	MW2	MW3
Transport test	% recovery	104	105	99	99	103	105	99	98
	rate($\mu\text{mol/L/hr}$)	≈ 0	≈ 0	≈ 0	≈ 0	≈ 0	≈ 0	-	-
First propane activity test	% recovery	94	94	-	-	-	-	96	88
	rate ($\mu\text{mol/L/hr}$)	0.09	≈ 0	-	-	-	-	-	-
Second propane activity test	% recovery	31	7	-	-	-	-	107 ²	92
	rate ($\mu\text{mol/L/hr}$)	1.1	0.8	-	-	-	-	-	-
Ethylene activity test	% recovery	-	-	59 (3.1%) ¹	75 (3.8%) ¹	-	-	102	90
	rate ($\mu\text{mol/L/hr}$)	-	-	0.51	0.35	-	-	-	-
Third propane activity test	% recovery	44	17	-	-	-	-	99	90
	rate ($\mu\text{mol/L/hr}$)	1.0	1.8	-	-	-	-	-	-
Propylene activity test	% recovery	-	-	-	-	75 (2.3%) ¹	69 (0.45%) ¹	92	88
	rate ($\mu\text{mol/L/hr}$)	-	-	-	-	0.34	0.46	-	-
Fourth propane activity test	% recovery	-	40	-	60 (5.2%) ¹	-	-	-	107
	rate ($\mu\text{mol/L/hr}$)	-	0.82	-	1.2	-	-	-	-
Acetylene blocking test	% recovery	-	90	-	86 (0.12%) ¹	-	-	-	107
	rate ($\mu\text{mol/L/hr}$)	-	≈ 0	-	≈ 0	-	-	-	-

¹ Numbers in parenthesis indicate percentage of the oxide mass extracted to the mass of ethylene transformed.

² When bromide recovery is greater than 100%, a value of Rtracer in an equation is assumed as 1.00.

Table 5. Summary of Quantities of Injected and Extracted Solute Mass and Percent Recovery in Transport, Biostimulation, and Activity Tests Conducted at Fort Lewis.

Test	Quantities	Toluene	o-Cresol	Isobutene	Isobutene oxide	Cis-DCE	Trans-DCE	DO	NO ₃ ⁻ N	Br
Transport LC191-P1	Mass recovery (%)	30.1	NA ¹	36.5	NA	NA	NA	29.3	31.1	32.9
	Rate (μmol/L/hr)	0.35	NA	≈ 0	NA	NA	NA	--	--	--
Biostimulation LC191-P1	Mass recovery (%)	26.6	NA	NA	NA	NA	NA	26.3	21.6	33.1
	Rate (μmol/L/hr)	0.83	0.02	NA	NA	NA	NA	--	--	--
Isobutene activity LC191-P1	Mass recovery (%)	2.58	NA	21.0	NA	NA	NA	18.7	18.7	25.0
	Rate (μmol/L/hr)	0.81	NA	0.73	0.22	0.08	NA	--	--	--
Drift activity LC191-P1	Rate (μmol/L/hr)	1.27	NA	1.12	0.18	0.12	0.11	--	--	--
Inhibition LC191-P1	Rate (μmol/L/hr)	≈ 0	NA	≈ 0	NA	≈ 0	≈ 0	--	--	--

¹NA: Not applicable

This page left blank intentionally.

This page left blank intentionally.

This page left blank intentionally.

