Electronic Supplementary Material (ESI) for Environmental Science: Water Research & Technology.

SUPPLEMENTARY INFORMATION

Decontaminating Chemically Contaminated Residential Premise Plumbing Systems by Flushing

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Ten pages

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RESULTS AND DISCUSSION

Table SI-1. Physiochemical properties of contaminants where premise plumbing system contamination occurred

Contaminant	Sources	Vapor Pressure, mmHg	Water Solubility, mg/L	Log K_{ow}	Henry's Law Constant, atm-m^3/mol
2-Butoxyethanol[1]	Cleaning solutions, resin formulas, herbicides	0.88	Miscible	0.83	1.6×10^{-6}
Benzene[1]	Fuel	94.8	1,790	2.13	5.55×10^{-3}
Chlordane[1]	Pesticide: Agriculture, pest control	9.98×10^{-6}	0.01299	6.26	7.05×10^{-5}
Chlorpyrifos (Dursban main component)[1]	Pesticide	2.025×10^{-5}	1.12	4.96	2.93×10^{-6}
Creosote[2]	Preservative (wood), developed from distillation of tar	11.1	313	3.247	
Diesel fuel	Fuel	Various (0.465, 21˚C)	Various	Various	Various
Diazinon[1]	Pesticide	9.01×10^{-5}	40	3.81	1.13×10^{-7}
Ethylene glycol[1]	Antifreeze formulations - heating systems	9.2×10^{-2}	Miscible	-1.36	6×10^{-8}
Ethanol[1]	Fuel, cleaning solvent	59.26	Miscible	-0.31	5×10^{-6}
Heptachlor[1]	Pesticide: Agriculture, pest control	4×10^{-3}	0.18	6.1	2.94×10^{-4}
Malathion[1]	Pesticide	3.38×10^{-6}	143	2.36	4.89×10^{-9}
4-MCHM (Methylcyclohexane-methanol)[3]	Frothing agent (coal washing)	0.058	2,024	2.55	6.43×10^{-6}
Metribuzin (main component of Lexone DF)[1]	Herbicide	4.35×10^{-7} (20˚C)	1,050 (20˚C)	1.7 (20˚C)	1.17×10^{-10} (20˚C)
Petroleum (crude oil)[1]	Fuel	Various [14.052 reported]	Various [0.66 reported]	Various [5.18 reported]	Various [3.211 reported]
Phenolic compounds[1]	-	0.35	82,800	1.46	3.33×10^{-7}
Polychlorinated Biphenol (PCBs)[1]	Coolant fluids, heat transfer fluids, sealants	4.94×10^{-3}	0.7	7.1	4.15×10^{-3}
Propylene glycol phenyl ether (PPH)[1]	Carrier solvent, paint remover, coalescent	5.2×10^{-3}	11,000	1.52	2.05×10^{-8}
Toluene[1]	Fuel, solvent	28.4	526	2.73	6.64×10^{-3}
Trihalomethanes[1]	Refrigerants, solvents, byproduct of residual chlorine	7,252	2,770	1.08	4.06×10^{-2} (22˚C)
Trichloroethylene (TCE)[1]	Solvent	69	1,280	2.42	9.85×10^{-3}
Xylene[1]	Used in cutting oil	7.99	106	3.16	6.63×10^{-3}

Contaminant property values at 25˚C unless otherwise noted; Note, the abovementioned properties are all affected by water temperature. 1. Syracuse Research Corporation (SRC) Inc. Fate Pointer | SRC, Inc. 2015. http://esc.syrres.com/fatepointer/search.asp; 2. U.S. EPA. *Reregistration Eligibility Decision for Creosote.* 2008. 100 p. http://www.epa.gov/pesticides/reregistration/REDs/creosote_red.pdf; 3. A variety of chemicals present, but 4-MCHM only described above. Toxicology Data Network. *4-Methylcyclohexanemethanol.* National Library of Medicine HSDB Database. 2015.

http://toxnet.nlm.nih.gov/cgi-bin/sis/search/a?dbs+hsdb:@term+@DOCNO+8182 and *Environ. Sci. Techno.* 2015. **49** (2): 813–823.

Table SI-2. Two story single family home in West Virginia: Model simulation results identifying successes and failures for water heater decontamination

Home Characteristics		C_{in} (mg/L)									
		Date (Jan):	18	19	20	21	22	23	24	25	26
		0	0.319	0.172	0.023	0.183	0.117	0.017	0.063	0.043	0.268
Water Heater Size (gal) [L]	**Type**	**Exceed Centers for Disease Control and Prevention Screening Level? (Yes = 1, No = 0)**									
40 [151.4]	Legacy A	0	0	0	0	0	0	0	0	0	0
	Legacy B	0	0	0	0	0	0	0	0	0	0
	Renovated	0	0	0	0	0	0	0	0	0	0
	New	0	0	0	0	0	0	0	0	0	0
50 [189.3]	Legacy A	0	0	0	0	0	0	0	0	0	0
	Legacy B	0	0	0	0	0	0	0	0	0	0
	Renovated	0	0	0	0	0	0	0	0	0	0
	New	0	0	0	0	0	0	0	0	0	0
60 [227.1]	Legacy A	0	0	0	0	0	0	0	0	0	0
	Legacy B	0	0	0	0	0	0	0	0	0	0
	Renovated	0	0	0	0	0	0	0	0	0	0
	New	0	1	1	0	1	0	0	0	0	1
70 [265.0]	Legacy A	0	0	0	0	0	0	0	0	0	0
	Legacy B	0	0	0	0	0	0	0	0	0	0
	Renovated	0	0	0	0	0	0	0	0	0	0
	New	1	1	1	1	1	1	1	1	1	1
80 [302.8]	Legacy A	0	0	0	0	0	0	0	0	0	0
	Legacy B	0	0	0	0	0	0	0	0	0	0
	Renovated	0	0	0	0	0	0	0	0	0	0
	New	1	1	1	1	1	1	1	1	1	1

The CDC screening level was 1 mg/L; C_{in} values shown represent the maximum known 4-MCHM concentration in the water utility distribution system from January 18 – 26, 2014.

Table SI-3. Manufactured home in West Virginia: Model simulation results identifying successes and failures for water heater decontamination

Home Characteristics		C_{in} (mg/L)									
		Date (Jan):	18	19	20	21	22	23	24	25	26
		0	0.319	0.172	0.023	0.183	0.117	0.017	0.063	0.043	0.268
Water Heater Size (gal) [L]	**Type**	**Exceeded Centers for Disease Control and Prevention Screening Level? (Yes = 1, No = 0)**									
20 [75.7]	Legacy A	0	0	0	0	0	0	0	0	0	0
	Legacy B	0	0	0	0	0	0	0	0	0	0
	Renovated	0	0	0	0	0	0	0	0	0	0
	New	0	0	0	0	0	0	0	0	0	0
30 [113.6]	Legacy A	0	0	0	0	0	0	0	0	0	0
	Legacy B	0	0	0	0	0	0	0	0	0	0
	Renovated	0	0	0	0	0	0	0	0	0	0
	New	0	1	1	0	1	0	0	0	0	1
40 [151.4]	Legacy A	0	0	0	0	0	0	0	0	0	0
	Legacy B	0	0	0	0	0	0	0	0	0	0
	Renovated	0	0	0	0	0	0	0	0	0	0
	New	1	1	1	1	1	1	1	1	1	1

The CDC screening level was 1 mg/L; C_{in} values shown represent the maximum known 4-MCHM concentration in the water utility distribution system from January 18 – 26, 2014.

Table SI-4. Two story single family home in West Virginia: Predicted water heater 4-MCHM concentration after flushing

Home Characteristics		C_{in} (mg/L)									
		Date (Jan):	18	19	20	21	22	23	24	25	26
		0	0.319	0.172	0.023	0.183	0.117	0.017	0.063	0.043	0.268
Water Heater Size (gal) [L]	**Type**	**C_{out} (mg/L)**									
40 [151.4]	Legacy A	0.0002	0.3192	0.1722	0.0232	0.1832	0.1172	0.0172	0.0632	0.0432	0.2682
	Legacy B	0.0044	0.3230	0.1762	0.0274	0.1872	0.1213	0.0214	0.0673	0.0474	0.2721
	Renovated	0.0887	0.4002	0.2567	0.1112	0.2674	0.2030	0.1053	0.1503	0.1307	0.3504
	New	0.4450	0.7264	0.5967	0.4653	0.6064	0.5482	0.4600	0.5006	0.4830	0.6814
50 [189.3]	Legacy A	0.0015	0.3204	0.1735	0.0245	0.1845	0.1185	0.0185	0.0645	0.0445	0.2694
	Legacy B	0.0170	0.3346	0.1883	0.0399	0.1992	0.1335	0.0340	0.0798	0.0598	0.2838
	Renovated	0.1878	0.4910	0.3513	0.2097	0.3617	0.2990	0.2040	0.2477	0.2287	0.4425
	New	0.6824	0.9437	0.8233	0.7012	0.8323	0.7782	0.6963	0.7340	0.7176	0.9019
60 [227.1]	Legacy A	0.0057	0.3242	0.1774	0.0286	0.1884	0.1225	0.0226	0.0686	0.0486	0.2733
	Legacy B	0.0419	0.3574	0.2120	0.0647	0.2229	0.1576	0.0587	0.1042	0.0844	0.3069
	Renovated	0.3097	0.6025	0.4676	0.3308	0.4777	0.4171	0.3253	0.3675	0.3492	0.5557
	New	0.9074	1.1497	1.0381	0.9249	1.0464	0.9963	0.9203	0.9553	0.9401	1.1110
70 [265.0]	Legacy A	0.0144	0.3321	0.1857	0.0373	0.1967	0.1309	0.0313	0.0771	0.0572	0.2813
	Legacy B	0.0797	0.3920	0.2481	0.1022	0.2589	0.1942	0.0964	0.1414	0.1218	0.3421
	Renovated	0.4426	0.7242	0.5945	0.4629	0.6042	0.5459	0.4577	0.4983	0.4806	0.6792
	New	1.1123	1.3373	1.2336	1.1285	1.2414	1.1948	1.1243	1.1567	1.1426	1.3013
80 [302.8]	Legacy A	0.0288	0.3454	0.1995	0.0516	0.2104	0.1449	0.0457	0.0913	0.0715	0.2948
	Legacy B	0.1291	0.4372	0.2952	0.1513	0.3058	0.2421	0.1455	0.1899	0.1706	0.3879
	Renovated	0.5786	0.8487	0.7242	0.5981	0.7335	0.6777	0.5930	0.6319	0.6150	0.8055
	New	1.2958	1.5052	1.4087	1.3109	1.4159	1.3726	1.3070	1.3372	1.3240	1.4717

The CDC screening level was 1 mg/L; C_{in} values shown represent the maximum known 4-MCHM concentration in the water utility distribution system from January 18 – 26, 2014.

Table SI-5. Manufactured home in West Virginia: Predicted water heater 4-MCHM concentration after flushing

Home Characteristics		C_{in} (mg/L)									
		Date (Jan):	18	19	20	21	22	23	24	25	26
		0	0.319	0.172	0.023	0.183	0.117	0.017	0.063	0.043	0.268
Water Heater Size (gal) [L]	**Type**	C_{out} (mg/L)									
20 [75.7]	Legacy A	0.0002	0.3192	0.1722	0.0232	0.1832	0.1172	0.0172	0.0632	0.0432	0.2682
	Legacy B	0.0044	0.3230	0.1762	0.0274	0.1872	0.1213	0.0214	0.0673	0.0474	0.2721
	Renovated	0.0887	0.4002	0.2567	0.1112	0.2674	0.2030	0.1053	0.1503	0.1307	0.3504
	New	0.4450	0.7264	0.5967	0.4653	0.6064	0.5482	0.4600	0.5006	0.4830	0.6814
30 [113.6]	Legacy A	0.0057	0.3242	0.1774	0.0286	0.1884	0.1225	0.0226	0.0686	0.0486	0.2733
	Legacy B	0.0419	0.3574	0.2120	0.0647	0.2229	0.1576	0.0587	0.1042	0.0844	0.3069
	Renovated	0.3097	0.6025	0.4676	0.3308	0.4777	0.4171	0.3253	0.3675	0.3492	0.5557
	New	0.9074	1.1497	1.0381	0.9249	1.0464	0.9963	0.9203	0.9553	0.9401	1.1110
40 [151.4]	Legacy A	0.0288	0.3454	0.1995	0.0516	0.2104	0.1449	0.0457	0.0913	0.0715	0.2948
	Legacy B	0.1291	0.4372	0.2952	0.1513	0.3058	0.2421	0.1455	0.1899	0.1706	0.3879
	Renovated	0.5786	0.8487	0.7242	0.5981	0.7335	0.6777	0.5930	0.6319	0.6150	0.8055
	New	1.2958	1.5052	1.4087	1.3109	1.4159	1.3726	1.3070	1.3372	1.3240	1.4717

The CDC screening level was 1 mg/L; C_{in} values shown represent the maximum known 4-MCHM concentration in the water utility distribution system from January 18 – 26, 2014.

Table SI-6. Two story single family home in Montana: Model simulation results identifying final water heater benzene concentration

Water Heater Size (gal) [L]	Home Type	Exceeded EPA MCL? (Yes 1, No 0)	C_{out} (mg/L)
40 [151.4]	Legacy A	0	0.0000
	Legacy B	0	0.0000
	Renovated	0	0.0004
	New	0	0.0018
50 [189.3]	Legacy A	0	0.0000
	Legacy B	0	0.0001
	Renovated	0	0.0007
	New	0	0.0027
60 [227.1]	Legacy A	0	0.0000
	Legacy B	0	0.0002
	Renovated	0	0.0012
	New	0	0.0036
70 [265.0]	Legacy A	0	0.0001
	Legacy B	0	0.0003
	Renovated	0	0.0018
	New	0	0.0044
80 [302.8]	Legacy A	0	0.0001
	Legacy B	0	0.0005
	Renovated	0	0.0023
	New	1	0.0052

C_{in} for benzene was assumed to be 0 mg/L because no utility water distribution system or building tap water sampling was found after flushing.

Table SI-7. Manufactured home in Montana: Model simulation results identifying final water heater benzene concentration

Water Heater Size (gal) [L]	Home Type	Exceeded EPA MCL? (Yes 1, No 0)	C_{out} (mg/L)
20 [75.7]	Legacy A	0	0.0000
	Legacy B	0	0.0000
	Renovated	0	0.0004
	New	0	0.0018
30 [113.6]	Legacy A	0	0.0000
	Legacy B	0	0.0002
	Renovated	0	0.0012
	New	0	0.0036
40 [151.4]	Legacy A	0	0.0001
	Legacy B	0	0.0005
	Renovated	0	0.0023
	New	1	0.0052

C_{in} for benzene was assumed to be 0 mg/L because no utility water distribution system or building tap water sampling was found after flushing.

Table SI-8. Time needed to achieve 1-, 2-, and 3-log removal from a manufactured home water heater

Building Characteristics				Log removal time (min)		
Water Heater Size (gal) [L]	**Type**	**Faucet (gpm) [lpm]**	**Shower (gpm) [lpm]**	**1**	**2**	**3**
20 [75.7]	Legacy	2 [7.6]	5 [18.9]	5.1	10.2	15.4
		3 [11.4]	5 [18.9]	4.2	8.4	12.6
		4 [15.1]	5 [18.9]	3.5	7.1	10.6
	Renovated	1.5 [5.7]	2 [7.6]	9.2	18.4	27.6
	New Home	0.8 [3.0]	1.25 [4.7]	16.2	32.3	48.5
30 [113.6]	Legacy	2 [7.6]	5 [18.9]	7.7	15.4	23.0
		3 [11.4]	5 [18.9]	6.3	12.6	18.8
		4 [15.1]	5 [18.9]	5.3	10.6	15.9
	Renovated	1.5 [5.7]	2 [7.6]	13.8	27.6	41.5
	New Home	0.8 [3.0]	1.25 [4.7]	24.2	48.5	72.7
40 [151.4]	Legacy	2 [7.6]	5 [18.9]	10.2	20.5	30.7
		3 [11.4]	5 [18.9]	8.4	16.8	25.1
		4 [15.1]	5 [18.9]	7.1	14.2	21.3
	Renovated	1.5 [5.7]	2 [7.6]	18.4	36.8	55.3
	New Home	0.8 [3.0]	1.25 [4.7]	32.3	64.6	97.0

1-, 2-, and 3- log removal constitutes 90%, 99%, and 99.9% reduction of contaminant concentration