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A COMPREHENSIVE VOC EMISSION DATABASE FOR COMMONLY-USED BUILDING MATERIALS

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ABSTRACT
A material emission database was developed for 48 building materials based on ASTM test methods. The database consists of model coefficients for the five to six most abundant volatile organic compounds (VOCs) emitted from each building material. A power-law model was used to describe the emissions from dry materials including particleboard, plywood, oriented strand board (OSB), solid wood, gypsum wallboard, acoustic ceiling tile, vinyl flooring, underpad, and carpet. The VOC emissions from wet materials were divided into three temporal regions with separate emission models including a vapor pressure and boundary layer model, an exponential decay model, and a power-law model. The wet materials include wood stain, polyurethane varnish, adhesive, caulking sealant, floor wax, and paint. Since the database is linked to a single-zone indoor air quality simulation program, it can be used to explore trade-offs between material selection and ventilation strategies.

INDEX TERMS
Building materials, VOCs, Emissions, Indoor air

INTRODUCTION
Source control followed by ventilation has been considered as one of the most effective strategies for controlling VOCs indoors. To apply this strategy it is necessary to have an indoor air quality simulation program and a comprehensive material emission database. In spite of the fact that emission tests conducted by most laboratories have followed the ASTM (American Society of Testing and Materials) Guide, details of test conditions and data analysis procedures can vary from laboratory to laboratory. As a result, these emission data are not suitable for the inclusion in a single database due to a lack of compatibility. To initiate the development of a comprehensive material emission database, a multi-year material emission project was launched in 1995. One main focus of the project was to develop testing protocols and standards for both dry and wet materials to guide the emission testing in a consistent manner and to provide other testing agencies with the standardized techniques required to generate data of sufficient quality to be included in the database (now and in the future). As an initial contribution to the database, material emission characteristics were determined for 48 commonly used building materials (from 16 different material types). This paper summarizes the contents of the database, i.e., model coefficients developed from laboratory experiments.

METHODS
Emission testing was conducted in accordance with the ASTM standard guide (ASTM, 1997). Test specimens of dry materials were collected at manufacturing sites. Others were purchased at local stores. The exhaust air of the test chamber was monitored over time. During the experimental period, the air exchange rate was 1.0 h^{-1} and the conditions inside the chamber were controlled at 23 ^{o}C, and 50% relative humidity. The air samples collected on sorbent

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tubes were analyzed with a thermal desorber and gas chromatograph/mass spectrometer (GC/MS). Emission models were fitted to emission factors estimated from the measured chamber air concentrations. Detailed information on the experimental method can be found in a report (National Research Council Canada,1999).

A power-law decay model (Eq. 3) was used to describe the emission characteristics of dry materials including particleboard (PB4, PB5, PB6), plywood (PLY1, PLY2, PLY3), oriented strand board (OSB1, OSB2, OSB3), solid wood (OAK1, PIN1, MPL1), gypsum wallboard (GB1, GB2, GB3), acoustic ceiling tile (ACT1, ACT2, ACT3), vinyl flooring (VIN1, VIN2, VIN3), underpad (UP1, UP2, UP3), and carpet (CRP1, CRP2, CRP3, CRP4, CRP5, CRP6). Data after 24 hours were used for the curve fitting for dry materials. For wet materials including wood stain (WS2, WS6, WS9), polyurethane varnish (UR3, UR5, UR8), adhesive (AD3, AD6, AD10), caulking sealant (CK2, CK5, CK9), floor wax (WX2, WX4, WX6), and paint (PT5, PT7, PT8), three different models were used: a vapor pressure and boundary layer model (Eq. 1) for $0<t<t_1$, an exponential decay model (Eq. 2) for $t_1<t<t_2$, and a power-law decay model (Eq. 3) for $t>t_2$.

$$E = K_m \left[\left(C_v \frac{M(t)}{M_{01}} - C(t) \right) \right] \qquad (0 < t < t_1) \tag{1}$$

$$E = E(t_1)\, e^{-k(t-t_1)} \qquad (t_1 < t < t_2) \tag{2}$$

$$E = a\, t^{-b} \qquad (t > t_2) \tag{3}$$

where E is the emission factor (mg m^{-2} h^{-1}); a and b are empirical constants, t is the elapsed time (h); K_m is the mass transfer coefficient (m h^{-1}); C_v is the initial vapor pressure at the surface (mg m^{-3}); $C(t)$ is the concentration in the air phase (mg m^{-3}); M_{01} is the initial mass at the surface available for evaporation (mg m^{-2}); $M(t)$ is the concentration in the material phase (mg m^{-2}); $E(t_1)$ is the emission factor (mg m^{-2} h^{-1}) at $t = t_1$; k is the emission decay constant (h^{-1}); t_1 is the time at which the transition period began (h); and t_2 is the time at which the diffusion controlled period began (h).

RESULTS & CONCLUSIONS

Tables 1 and 2 summarize the emission model coefficients for the 48 materials. The most abundant five to six VOCs emitted from each material were selected for the analysis. It should be noted that the value of b for several VOCs, in particular, aldehydes, is negative. Since the negative value of b can lead to the infinitely increasing emission rate, caution should be exercised when the results in Tables 1 and 2 are extrapolated beyond the experimental period. The monotonic increase of emission rates over time needs to be addressed in a future study.

The material emission database reported in this paper covers the most commonly used 48 building materials and five to six abundant VOCs emitted from them. A single-zone indoor air quality simulation program (MEDB-IAQ) was also included in the database for predicting the contribution of material off-gassing to the indoor air quality level in an enclosed space under different ventilation rates (Zhang *et al.* 1999). Work is underway to improve and expand the material emission database.

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Table 1. Model coefficients for dry building materials.

Model coeff.	***a***	***b***		***a***	***b***		***a***	***b***
PB4 (96 h)[1] Particleboard, 5/8", Industrial, Urea formaldehyde resin			**PB5** (96 h)[1] Particleboard, 5/8", Industrial, Urea formaldehyde resin			**PB6** (840 h)[1] Particleboard, 5/8", Industrial, Urea formaldehyde resin		
Hexanal	1.11	0.129	Hexanal	0.033	-0.054	Hexanal	3.71	0.266
α-Pinene	15.1	1.16	α-Pinene	45.8	1.07	α-Pinene	76.0	1.23
Camphene[4]	15.7	1.20	Camphene[4]	76.9	1.24	Camphene[4]	25.7	1.35
Limonene[4]	9.52	1.05	Limonene[4]	41.5	1.11	Limonene[4]	7.44	0.967
TVOC[3]	15.4	0.417	TVOC[3]	112	0.823	TVOC[3]	25.1	0.395
PLY1 (235 h)[1] Plywood, 3/4", Grade: G1S, Face/back: Douglas Fir, Resin: Phenol formaldehyde			**PLY2** (96 h)[1] Plywood, 5/8", Grade: CSP Sheathing			**PLY3** (96 h)[1] Plywood, 1/2", Grade: CSP Sheathing, Spruce, Phenolic resin		
α-Pinene	1.03	0.417	α-Pinene	0.155	0.348	α-Pinene	0.250	0.421
Camphene	0.260	0.616	Camphene	0.025	0.530	Camphene	0.016	0.208
3-Carene	0.328	0.321	3-Carene	0.019	0.161	3-Carene	0.142	0.291
p-Cymene	0.192	0.476	p-Cymene	0.010	0.329	p-Cymene	0.066	0.194
Limonene	0.709	0.675	Limonene	0.021	0.308	Limonene	0.076	0.219
TVOC[3]	2.41	0.428	TVOC[3]	0.391	0.176	TVOC[3]	1.50	0.250
OSB1 (96 h)[1] Wafferboard, 1/2", Grade R-1			**OSB2** (340 h)[1] Oriented Strand Board, 7/16", Grade O-2			**OSB3** (96 h)[1] Oriented Strand Board, 5/8", Grade O-2		
Pentanal	0.003	-0.453	Pentanal	0.002	-0.588	Pentanal	0.001	-1.28
Hexanal	0.022	-0.426	Hexanal	0.001	-1.19	Hexanal	0.171	-0.382
α-Pinene	0.024	0.351	α-Pinene	0.017	0.242	α-Pinene	0.012	-0.070
TVOC[3]	0.274	0.0125	2-PenFur[2,3]	0.221	0.268	TVOC[3]	0.309	-0.378
			TVOC[3]	1.51	0.320			
OAK1 (96 h)[1] Solid Red Oak, Tongue/Groove Flooring, 2-1/4" x 3/4" thick			**PIN1** (96 h)[1] Solid Pine, 2" x 10", Grade: 1-2			**MPL1** (123 h)[1] Solid Maple, 1x8", Select Grade		
Acetic acid[3]	0.085	0.032	α-Pinene	4.40	0.240	Hexanal	0.000	-0.334
Octanal	0.002	0.559	Camphene	0.856	0.200	Nonanal	0.007	-0.152
Nonanal	0.006	0.607	β-Pinene	2.24	0.170	Decanal	0.005	-0.0916
Decanal	0.013	0.800	p-Cymene	0.296	0.236	TVOC[3]	0.129	0.123
TVOC[3]	0.151	0.140	Limonene	0.752	0.185			
			TVOC[3]	9.34	0.224			
GB1 (97 h)[1] Gypsum Wallboard, 1/2", Plane sheetrock			**GB2** (264 h)[1] Gypsum Wallboard, 5/8", Fire-code			**GB3** (189 h)[1] Gypsum Wallboard, 1/2", Water-resistant		
α-Pinene	0.124	0.220	α-Pinene[3]	0.0433	0.125	α-Pinene[3]	0.0172	0.203
Limonene	0.0127	0.0845	1-COct[2,3]	0.137	0.531	1-COct[2,3]	0.234	1.01
1-CDec[2,3]	0.0497	0.515	1-CDec[2,3]	0.0048	-0.174	1-CDec[2,3]	0.0858	0.520
TVOC[3]	0.647	0.563	TVOC[3]	0.188	-0.0303	TVOC[3]	0.395	0.212

Table 1 (continued)

Coeff.	*a*	*b*		*a*	*b*		*a*	*b*
ACT1 (120 h)[1] Acoustical Ceiling Tile (suspended), Perlite, 24x48x1/2"			**ACT2** (120 h)[1] Acoustical Ceiling Tile (suspended), Vinyl-coated Fiberglass, 24x48x5/8"			**ACT3** (122 h)[1] Acoustical Ceiling Tile (nailed), Cellulose, 12x12x1/2"		
Toluene	1.49	1.98	Phenol[6]	0.0260	-0.0618	Hexanal	0.0026	-0.261
Hexanal	0.113	0.462	TetDec[2]	0.0808	1.08	Limonene	0.0003	-0.540
Tridecane	0.456	1.56	PenDec[2]	0.0515	0.911	Dodecane[7]	0.0111	0.0407
TetDec[2]	0.0152	0.708	TVOC[3]	0.277	0.413	Tridecane[7]	0.0705	0.651
TXIB[2,5]	0.196	0.405				TXIB[2]	0.0087	-0.240
TVOC[3]	0.726	0.524				TVOC[3]	0.116	-0.165
VIN1 (97 h)[1] Vinyl tile, No wax, Residential			**VIN2** (95 h)[1] Vinyl tile, 12" x 12" x 1/8", Commercial			**VIN3** (223 h)[1] Vinyl, Sheet, Residential		
IPAce[2,8]	0.0010	-0.587	1-Butanol	0.0019	-0.140	Dodecane	0.530	0.295
Octane	0.0001	-0.420	HMCTriSi[2,3]	0.0020	-0.0871	Tridecane	1.53	0.246
Undecane[7]	0.0032	0.060	Tridecane	0.0122	0.653	TetDec[2]	1.07	0.225
Dodecane[9]	0.0015	-0.108	TetDec[2,9]	0.0048	0.349	PAE[2,3]	1.27	0.253
TetDec[2,9]	0.0007	-0.259	PenDec[2,9]	0.0017	0.152	BPO[2,3]	0.182	0.289
TVOC[3]	0.0248	-0.230	TVOC[3]	0.470	0.341	TVOC[3]	8.84	0.250
UP1 (98 h)[1] Underpad, Foam chip, Moisture barrier			**UP2** (76 h)[1] Underpad, 10mm, Polyurethane foam			**UP3** (99 h)[1] Underpad, 10mm, Polyethylene foam		
124-TMB	0.248	1.27	Dodecane	0.483	1.62	Dodecane	0.153	1.43
Undecane	0.209	1.14	Tridecane	0.0619	0.532	Tridecane	0.858	1.18
Dodecane[10]	0.123	0.844	4-PC[2,3]	0.0576	1.12	4-PC[2,3]	0.050	0.642
Tridecane[10]	0.0238	0.233	TetDec[2]	0.0353	0.503	TetDec[2]	0.131	0.565
DBB[2,3]	0.541	0.989	HexDec[2]	0.0016	0.0434	HexDec[2]	0.0201	0.791
TVOC[3]	0.419	0.121	TVOC[3]	0.440	0.468	TVOC[3]	0.589	0.277
CRP1 (98 h)[1] Carpet, Nylon, Latex backing, Residential			**CRP2** (96 h)[1] Carpet, Nylon, Latex backing, Residential			**CRP3** (121 h)[1] Carpet, Nylon, Latex backing, Residential		
Heptane[11]	2.85	0.958	Styrene	0.0202	0.874	Styrene	0.146	1.19
p-Xylene	29.8	1.54	Dodecane[7]	0.0990	0.860	Dodecane[7]	0.545	0.831
Undecane	0.0070	-0.0910	4-PC[2]	0.0157	0.253	Tridecane[7]	0.723	0.542
4-PC[2,3]	0.0943	0.0768	CyDod[2]	0.0676	0.406	4-PC[2]	0.0221	0.391
CyDod[2,3]	0.325	0.150	TVOC[3]	2.22	0.771	TetDec[2,7]	0.353	0.443
TVOC[3]	7.93	0.433				TVOC[3]	2.10	0.525
CRP4 (96 h)[1] Carpet, Olefin, Woven synthetic, Latex laminate, Commercial Use			**CRP5** (96 h)[1] Carpet, Polypropylene, Woven polypopylene backing, Flame-resistant synthetic latex laminate, Commercial Use			**CRP6** (96 h)[1] Carpet, Nylon, Commercial Use		
Isooctane[7]	0.128	0.373	Isooctane[7]	0.0398	0.253	Isooctane[7]	0.0711	0.147
Dodecane[7]	0.0584	0.318	Styrene	0.0391	0.722	Styrene	8.55	1.90
Tridecane	0.0898	0.218	Tridecane[7]	0.0284	0.207	Undecane[7]	0.193	0.468
4-PC[2]	0.0297	0.0732	4-PC[2]	0.0134	-0.015	Tridecane[7]	0.252	0.336
CyDod[2,3]	0.0080	-0.167	TVOC[3]	0.544	0.248	4-PC[2]	0.0559	0.181
TVOC[3]	0.707	0.204				TVOC[3]	2.95	0.364

[1] The number in parentheses is the total period of an experiment.

[2] 1-CDec = 1-chlorodecane; 1-COct = 1-chlorooctane; 2-PenFur = 2-pentyl furan; 4-PC: 4-phenylcyclohexene; 124-TMB = 1,2,4-trimethyl benzene; BPO = Benzene, (propyloctyl); CyDod = cyclododecane; DBB = 2,6-di-t-butyl-1,4-benzoquinone; HexDec = hexadecane; HMCTriSi = hexamethyl-cyclotrisiloxane; IPAce = isopropyl acetate; PAE = Propanoic acid, alkyl…ester; PenDec = pentadecane; TetDec = tetradecane; TXIB = texanolisobutyrate-2,2,4-trimethyl-1,3-pentanediol diisobutyrate.

[3, 4, 5, 6, 7, 8, 9, 10, 11] The chemical was quantified against toluene, α-pinene, butyl acetate, butanol, decane, butyl propionate, tridecane, undecane, and nonane, respectively. Otherwise, the chemical was quantified against its own.

Table 2. Model coefficients for wet building materials.

	First Regime			Transition Regime					Third Regime	
	M_{01} (mg m^{-2})	K_m (m h^{-1})	C_v (mg m^{-3})	$E(t_1)$ (mg m^{-2} h^{-1})	$E(t_2)$ (mg m^{-2} h^{-1})	t_1 (h)	t_2 (h)	k (h^{-1})	a	b
WS2: Oil based wood stain (144 h) [1]										
Nonane	1615	1.16	1377	43.0	2.13	5	24	0.158	23493	2.93
Decane	6077	1.10	2547	154	16.2	8	24	0.141	8515	1.97
Undecane	3502	1.02	998	134	18.9	8	24	0.122	2689	1.56
Dodecane	223	0.943	48.8	9.68	4.73	8	24	0.0448	649	1.55
TVOC[3]	40794	1.13	18685	888	108	8	24	0.131	18429	1.62
WS6: oil based wood stain (144 h) [1]										
Nonane	820	1.16	1668	4.03	1.03	5	24	0.0718	9991	2.89
Decane	2714	1.10	2677	11.5	4.53	8	24	0.0583	13201	2.51
Undecane	1299	1.02	634	28.5	2.60	8	24	0.150	6134	2.44
Dodecane	96.6	0.943	37.8	2.30	0.208	8	24	0.167	30.1	1.57
TVOC[3]	20036	1.13	21590	63.4	43.7	8	24	0.0232	115577	2.48
WS9: oil based wood stain (120 h) [1]										
Nonane	4858	1.16	5172	88.1	24.6	5	24	0.0671	31236	2.25
Decane	3296	1.10	1902	49.9	31.1	8	24	0.0297	14793	1.94
Undecane	1680	1.02	575	56.1	21.7	8	24	0.0593	3441	1.59
Dodecane	225	0.943	46.6	9.84	4.12	8	24	0.0544	373	1.42
TVOC[3]	40146	1.13	27321	417	303	8	24	0.0200	111398	1.86
UR3: Oil based clear semi-gloss polyurethane, interior use (270 h) [1]										
EthylCHX[2]	55.0	1.23	135	0.177	0.0136	5	24	0.135	4.02	1.79
Nonane	693	1.16	1076	1.46	0.449	7	24	0.0692	120	1.76
PropCHX[2]	549	1.17	727	1.74	0.283	7	24	0.107	136	1.94
Decane	3870	1.10	2274	56.7	4.96	8	24	0.152	810	1.60
TVOC[3]	67203	1.13	41042	880	81.0	8	24	0.149	4869	1.29
UR5: Oil based polyurethane clear gloss, interior use (79 h) [1]										
Nonane	1815	1.16	2725	16.7	4.16	5	24	0.0730	939	1.69
PropCHX[2]	507	1.17	852	3.66	1.56	5	24	0.0447	512	1.82
Decane	2601	1.10	1781	27.7	5.69	8	24	0.0989	361	1.31
TVOC[3]	41256	1.13	34108	269	127	8	24	0.0469	10912	1.40
UR8: Oil based polyurethane clear gloss, interior use (103 h) [1]										
Nonane	1006	1.16	1520	9.12	3.17	5	24	0.0556	60.2	0.926
PropCHX[2]	384	1.17	456	5.63	1.08	5	24	0.0869	4.67	0.461
Decane	3503	1.10	2182	45.6	9.45	8	24	0.0984	340	1.13
TVOC[3]	38786	1.13	25337	441	128	8	24	0.0774	1160	0.694
PT5: 100% acrylic latex, stain blocker and primer sealer for interior use (97 h) [1]										
2-EH[2,4]	43.2	1.20	30.5	2.32	0.644	4	24	0.0640	22.2	1.11
PGly[2]	258	1.82	38.5	12.5	7.10	7	24	0.0332	266	1.14
TI2[2,5]	187	0.959	59.2	15.5	7.84	4	24	0.0340	124	0.868
TVOC	826	1.13	282	68.1	28.8	4	24	0.0431	611	0.962
PT7: Interior acrylic latex, Ultra pure white eggshell (97 h) [1]										
PGly[2]	417	1.82	45.9	20.2	14.6	7	24	0.0190	45.3	0.356
TI2[2,5]	191	0.959	54.1	13.1	9.95	5	24	0.0143	67.5	0.602
TVOC[3]	861	1.13	184	68.0	34.3	4	24	0.0343	165	0.494
PT8: Interior oil based, pure white (122 h) [1]										
p-Xylene	450.3	1.47	386	3.04	0.0968	7	24	0.0958	69.2	2.07
Nonane	1379	1.16	835	25.4	1.05	7	24	0.188	6432	2.74
Decane	3786	1.10	1233	156	5.16	7	24	0.201	4579	2.14
Undecane	2025	1.02	446	99.7	8.69	7	24	0.144	1873	1.69
TVOC[3]	113249	1.13	35316	4745	212	7	24	0.183	91034	1.91
CK2: Adhesive for bath and kitchen, clear (144 h) [1]										
Acetic acid[3]	NA	NA	NA	5438	5438	0	1	0	5438	0.923
OMCTetraSi[2,3]	NA	NA	NA	30.5	30.5	0	1	0	30.5	0.309
TVOC[3]	NA	NA	NA	4911	4911	0	1	0	4911	0.847

Table 2 (continued)

	First Regime		Transition Regime						Third Regime	
	M_{01} (mg m^{-2})	K_m (m h^{-1})	C_v (mg m^{-3})	$E(t_1)$ (mg m^{-2} h^{-1})	$E(t_2)$ (mg m^{-2} h^{-1})	t_1 (h)	t_2 (h)	k (h^{-1})	a	b
CK5: 100% silicon for door and window frames, white (223 h) [1]										
Nonane	NA	NA	NA	6031	6031	0	0.1	0	752	0.452
Decane	NA	NA	NA	5033	5033	0	0.1	0	1918	0.419
ButCHX[2]	NA	NA	NA	292	292	0	0.1	0	150	0.288
Undecane	NA	NA	NA	2316	2316	0	0.1	0	970	0.378
TVOC[3]	NA	NA	NA	393072	393072	0	0.1	0	393072	1.05
CK9: Thermoplastic caulking for exterior use (96 h) [1]										
Toluene	NA	NA	NA	668	668	0	0.1	0	177	0.577
EB + pXy [2]	NA	NA	NA	184358	184358	0	0.1	0	52779	0.543
o-xylene	NA	NA	NA	161984	161984	0	0.1	0	36014	0.653
124-TMB[2]	NA	NA	NA	53.9	53.9	0	1.0	0	53.9	0.284
TVOC[3]	NA	NA	NA	389614	389614	0	0.1	0	81402	0.680
WX2: Oil based floor wax (96 h) [1]										
p-Xylene	787	1.47	1327	2.62	0.722	5	24	0.0679	1100	2.31
Nonane	4702	1.16	3508	42.7	12.2	7	24	0.0737	43883	2.58
124-TMB[2]	2332	1.20	1606	24.3	7.27	7	24	0.0709	4478	2.02
Decane	26212	1.10	3181	135	25.6	7	24	0.0980	14065	1.99
Undecane	2933	1.02	957	119	12.4	7	24	0.133	2854	1.71
TVOC[3]	152653	1.13	91677	2370	477	7	24	0.0944	269479	1.99
WX4: Oil based floor wax (216 h) [1]										
Nonane	1237	1.16	2334	9.636	6.08	4	24	0.0230	82825	3.00
124-TMB[2]	20.9	1.20	39.0	0.160	0.0586	4	24	0.0502	42.7	2.07
Decane	2166	1.10	2560	47.5	12.1	4	24	0.0686	7272	2.02
Undecane	1183	1.02	924	11.4	5.06	7	24	0.0479	239	1.21
TVOC[3]	60000	1.13	86319	849	201	4	24	0.0719	29016	1.56
WX6: Acrylic floor polishing for regular and non-wax floor (97 h) [1]										
22-EEE[2,6]	973	1.30	120.0	92.4	83.6	1	24	0.0043	18812	1.70
Unknown ester[5]	41.6	1.2	32.0	0.416	0.132	7	24	0.0687	199	2.30
TVOC[3]	797	1.13	197	64.9	51.7	4	24	0.0114	10740	1.68
AD3: Non toxic, water proof adhesives for wet lumber or bridges. Gap up to 3/8 inch (271 h) [1]										
Tridecane	NA	NA	NA	NA	NA	NA	NA	NA	876	1.63
Tetradecane	NA	NA	NA	NA	NA	NA	NA	NA	127	0.454
Pentadecane	NA	NA	NA	NA	NA	NA	NA	NA	39.9	0.219
Hexadecane	NA	NA	NA	NA	NA	NA	NA	NA	20.1	0.041
TVOC[3]	NA	NA	NA	NA	NA	NA	NA	NA	5390	0.592
AD6: Board adhesive for both interior and exterior use (94 h) [1]										
22-DMB[2,7]	4772	1.20	7382	63.0	23.8	3	24	0.0457	1627	1.33
23-DMB[2,7]	14554	1.25	24461	84.8	42.1	3	24	0.0334	8948	1.69
2-MP[2,7]	53708	1.36	93251	271	44.2	3	24	0.0864	93251	2.53
3-MP[2,7]	21860	1.38	38272	106	31.8	3	24	0.0576	38068	2.23
TVOC[3]	154908	1.13	328120	406	211	3	24	0.0313	84642	1.89
AD10: Multi-purpose, residential flooring adhesive low odor, no solvent (121 h) [1]										
Toluene	0.543	1.52	0.319	0.0264	0.0243	4	24	0.0042	0.0793	0.372
Nonane	0.450	1.16	0.167	0.0362	0.0216	4	24	0.0258	0.167	0.0328
TVOC[3]	45.0	1.13	41.7	4.09	3.28	2.5	24	0.0104	41.7	40.2

[1] The number in parentheses is the total period of an experiment.

[2] 2-DMB = 2,2-Dimethyl butane; 2-EEE = 2-(2-etoxyethoxy) ethanol; 2-EH = 2-ethyl hexanol; 2-MP = 2-Methyl pentane; 3-MP = 3-Methyl pentane; 22-DMB = 2,2-dimethyl butane; 23-DMB = 2,3-dimethyl butane; 124-TMB = 1,2,4-trimethyl benzene; ButCHX = butyl cyclohexane; EB = ethyl benzene; EthylCHX = ethyl cyclohexane; OMCTetraSi = Octamethylcyclotetrasiloxane; NA = not applicable; PGly = Propylene glycol; PropCHX = propyl cyclohexane; TI2 = Texanol isomer II; pXy = p-xylene

[3, 4, 5, 6, 7] The chemical was quantified against toluene, 2-methyl-2-propanol, TXIB, methoxyethanol, and hexane, respectively. Otherwise, the chemical was quantified against its own.