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Technical Support

Released: March 2015

Application Note 001

Uptake rates for tube-type axial diffusive samplers

Introduction

The following tables provide uptake rates for tube-type axial diffusive samplers, for workplace and environmental applications.

Separate lists are given for values determined for periods and exposure concentrations typical of:

- Workplace applications – approx. 8 hours
- Environmental applications – 24 h, or 1, 2 or 4 weeks.

Users of the data are strongly advised to consult the relevant references to determine the level of confidence and range of applicability of the values.

Notes

This list of uptake rates is not intended to be exhaustive, and although every care has been taken in its preparation, no guarantee can be given of its accuracy. Nor does the list imply a preference for this type of sampler.

Units for uptake rates are ng ppm^{-1} min^{-1} unless otherwise stated.

Footnotes

[a] Sampler with membrane in diffusion cap.

[b] Preferred sorbent.

[c] A nickel disk, rather than the conventional stainless steel gauze, was used to support the Carbotrap sorbent material during method validation for these perfluorocarbon tracer gases. The uptake rates may not be applicable to samples using conventional steel gauzes.

[d] Rate varies predictably with exposure dose.

[e] Equivalent to Carbopack B.

[f] Sampling carried out for "1–2 weeks".

[g] Average of values obtained at two relative humidities.

[h] Average of values from three different locations.

[i] Average of values obtained on different test dates.

Levels

A = Validation equivalent to CEN level 1A.
B = Partial validation – see EN 482.
C = Calculated – ideal value.
D = Calculated from dynamic breakthrough volume.
E = Calculated from sorption isotherm.
F = Experimental observation.

We would be delighted to receive details of any uptake rates that have been measured and are being used in the field – please contact us.

Workplace applications

Alkanes and alkenes

Compound	Sorbent	Level	Uptake rate	Ref.
Butadiene	Carbopack X	B	1.64	3
	MolSieve 13X [a]	A	1.3	1
n-Pentane	Carbopack B [b]	B	1.77	1
	Chromosorb 106	A	1.46	1
n-Hexane	Chromosorb 106	A	1.77	1
Cyclohexane	Chromosorb 106	D	1.60	5
	Tenax TA	D	1.32	5
n-Heptane	Carbopack B	B	1.94	1
	Chromosorb 106	A	1.95	1
	Tenax TA	A	1.77	1
		F	1.57	6
2-Methylhexane	Chromosorb 106	D	1.79	5
	Tenax TA	D	1.48	5
3-Methylhexane	Chromosorb 106	D	1.80	5
	Tenax TA	D	1.48	5
Methylcyclohexane	Chromosorb 106	D	1.88	5
	Tenax TA	D	1.55	5
n-Octane	Chromosorb 106	A	2.13	1
	Tenax TA	A	2.00	1
		F	1.67	6
2-Methylheptane	Chromosorb 106	D	2.33	5
	Tenax TA	D	1.95	5
n-Nonane	Chromosorb 106	A	2.40	1
	Tenax TA	A	2.12	1
		F	1.75	6
n-Decane	Chromosorb 106	A	2.47	7
	Tenax TA	A	2.3	1
		F	1.96	6
$n\text{-}C_{11}H_{24}$	Tenax TA	F	1.97	6
$n\text{-}C_{12}H_{26}$	Tenax TA	F	2.08	6
$n\text{-}C_{13}H_{28}$	Tenax TA	F	2.33	6
$n\text{-}C_{14}H_{30}$	Tenax TA	F	2.41	6
$n\text{-}C_{15}H_{32}$	Tenax TA	F	2.19	6
$n\text{-}C_{16}H_{34}$	Tenax TA	F	2.36	6

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Aromatic hydrocarbons

Compound	Sorbent	Level	Uptake rate	Ref.
Benzene	Chromosorb 106	B	1.72	1
	PoraPak Q	A	1.37	1
	Tenax GR	B	1.81	1
	Tenax TA	A	1.3	1
Toluene	Carbopack B	B	2.06	1
	Chromosorb 106	B	1.94	1
	Tenax GR	B	2,12	1
	Tenax TA	B	1.67	1
Ethylbenzene	Chromosorb 106	B	1.9	1
	PoraPak Q	D	2.38	1
	Tenax GR	B	2.43	1
	Tenax TA	B	2.0	1
Xylene	Chromosorb 106	B	2.10	1
	Tenax GR	B	2.48	1
	Tenax TA	B	1.82	1
Styrene	Chromosorb 106	B	2.12	1
	Tenax TA	A	2.40	1
n-Propylbenzene	Chromosorb 106	C	2.37	1
	Tenax TA	C	2.37	1
Isopropylbenzene (Cumene)	Chromosorb 106	C	2.26	1
	PoraPak Q	C	2.26	1
	Tenax TA	D	2.5	1
Trimethylbenzene	Chromosorb 106	C	2.37	1
	Tenax TA	C	2.37	1
1,3-Dimethyl-4-ethylbenzene	Tenax TA	D	2.45	5
1,4-Diethylbenzene	Tenax TA	D	2.56	5
o-Ethyltoluene	Chromosorb 106	D	2.57	5
	Tenax TA	D	2.44	5
m-Ethyltoluene	Chromosorb 106	D	2.43	5
	Tenax TA	D	2.25	5
p-Ethyltoluene	Chromosorb 106	D	2.35	5
	Tenax TA	D	2.21	5
Naphthalene	Tenax TA	A	2.55	7
		F	2.14	8

Nitriles

Compound	Sorbent	Level	Uptake rate	Ref.
Acrylonitrile	Chromosorb 106	D	1.48	5
	PoraPak N	A	1.35	1
Acetonitrile	Chromosorb 106	A	1.48	7
	PoraPak N	A	1.0 (2 h), 0.8 (8 h)	1
Propionitrile	PoraPak N	A	1.4 (2 h), 1.3 (8 h)	1

Halogenated hydrocarbons

Compound	Sorbent	Level	Uptake rate	Ref.
Methyl chloride (chloromethane)	SpheroCarb/ UniCarb	B	1.3	1
Vinyl chloride (Chloroethene)	SpheroCarb/ UniCarb	B	2.0	1
1,1-Dichloroethene	SpheroCarb/ UniCarb	B	2.5	1
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon® 113)	Chromosorb 102	B	3.5	1
Chlorotrifluoromethane	Chromosorb 102	B	1.8	1
Dichloromethane	Chromosorb 102	B	1.56	1
	Chromosorb 106	B	1.56	1
1,2-Dichloroethane	Chromosorb 102	B	1.9	1
	Chromosorb 106	B	2.03	9
	Tenax GR	B	1.72	9
Halothane	Chromosorb 102	B	3.6	1
	Chromosorb 106	B	4.28	10
	Tenax TA	B	2.59	1
Enflurane	Chromosorb 106	D	2.8	5
		B	3.24	10
	Tenax TA	B	2.29	1
Sevoflurane	Chromosorb 106	B	3.09	10
Isoflurane	Chromosorb 106	D	2.51	5
		B	3.43	10
	Tenax TA	B	2.20	1
Bromoethane	Chromosorb 106	E	2.45	1
Bromobenzene	Chromosorb 106	D	3.59	5
	Tenax TA	D	3.31	5
Trichloromethane (Chloroform)	Chromosorb 102	B	2.35	1
	Chromosorb 106	B	2.47	9
	Tenax GR	B	2.18	1
Tetrachloromethane (Carbon tetrachloride)	Chromosorb 102	B	2.87	1
	Tenax GR	B	3.72	1
Trichloroethene	Chromosorb 102	B	2.3	1
	Chromosorb 106	B	2.66	1
1,1,1-Trichloroethane	Chromosorb 102	B	2.3	1
	Chromosorb 106	B	2.3	1
	Tenax GR	B	2.92	1
Tetrachloroethene	Chromosorb 102	B	2.6	1
	Chromosorb 106	B	3.1	1
	Tenax GR	B	2.9	9
	Tenax TA	B	2.8	1
Epichlorohydrin	Chromosorb 106	E	2.45	1
Allyl chloride	Chromosorb 106	D	1.75	5
Benzyl chloride	Tenax TA	D	2.72	5
Perfluorodimethylcyclobutane	Carbotrap [c]	B	15 mL h^{-1}	1
Perfluoromethylcyclopentane	Carbotrap [c]	B	15 mL h^{-1}	1
Perfluoromethylcyclohexane	Carbotrap [c]	B	15 mL h^{-1}	1
p-Dichlorobenzene	Tenax	C	3.23	11

Esters

Compound	Sorbent	Level	Uptake rate	Ref.
Methyl acetate	Chromosorb 106	A	1.74	7
Ethyl acetate	Chromosorb 106	B	2.0	1
	Tenax TA	B	1.6	1
n-Butyl acetate	Chromosorb 106	A	2.6	7
	Tenax GR	B	1.93	9
	Tenax TA	B	2.26	1
Isobutyl acetate	Chromosorb 106	D	2.17	5
	Tenax TA	D	1.91	5
sec-Butyl acetate	Chromosorb 106	D	2.29	5
	Tenax TA	D	1.90	5
tert-Butyl acetate	Chromosorb 106	D	2.26	5
	Tenax TA	D	1.79	5
Vinyl acetate	Chromosorb 106	D	1.93	5
Methyl methacrylate	Chromosorb 106	D	2.14	5
	PoraPak Q	B	2.0	1
	Tenax TA	D	1.77	5
Methyl acrylate	Chromosorb 106	D	1.96	5
	Tenax TA	D	1.50	5
Butyl acrylate	Chromosorb 106	D	2.11	12
	Tenax TA	B	2.6	1
Ethylhexyl acrylate	Tenax TA	D	2.99	5
2-Methoxyethyl acetate	Chromosorb 106	B	2.08	9
	PoraPak Q	A	2.8	1
	Tenax GR	B	1.81	9
	Tenax TA	B	1.64	9
2-Ethoxyethyl acetate	Chromosorb 106	B	2.3	1
	Tenax GR	B	2.08	9
	Tenax TA	B	2.1	1
Methoxypropyl acetate	Chromosorb 106	B	2.5	9
	Tenax GR	B	2.23	9
	Tenax TA	B	2.21	9
2-Butoxyethyl acetate	Tenax	A	2.8	4

Glycol ethers

Compound	Sorbent	Level	Uptake rate	Ref.
2-Methoxyethanol	Chromosorb 106	B	2.1	1
	PoraPak Q	A	1.5	1
2-Ethoxyethanol	Tenax TA	A	1.8	4
2-Propoxyethanol	Chromosorb 106	D	1.94	2
	Tenax TA	D	1.65	2
2-Butoxyethanol	Chromosorb 106	B	2.1	1
	Tenax TA	B	1.97	1
		B	1.9	4
1-Methoxypropan-2-ol	Chromosorb 106	B	1.88	13
	Tenax GR	B	1.55	9
	Tenax TA	B	1.56	13
2-Methoxypropan-2-ol	Chromosorb 106	B	1.85	1
	Tenax TA	B	1.52	1
1-Ethoxypropan-2-ol	Chromosorb 106	B	1.94	2
	Tenax GR	B	1.64	2
Dipropylene glycol methyl ether	Chromosorb 106	A	2.70	2

Aldehydes and ketones

Compound	Sorbent	Level	Uptake rate	Ref.
Butan-2-one	Chromosorb 106	B	1.72	9
	Tenax GR	B	1.37	9
	Tenax TA	B	1.34	9
2-Methylpentan-4-one (Methyl isobutyl ketone, MIBK)	Chromosorb 106	B	2.01	1
	Tenax GR	B	1.69	9
	Tenax TA	B	1.71	1
Cyclohexanone	Chromosorb 106	B	1.96	9, 14
	Tenax GR	B	1.78	9
	Tenax TA	D	2.3	1
2-Methylcyclohexanone	Tenax TA	D	2.31	5
3-Methylcyclohexanone	Tenax TA	D	2.22	5
4-Methylcyclohexanone	Tenax TA	D	2.14	5
Furfural	Tenax TA	A	2.5	4
Hexanal	Chromosorb 106	A	2.06	7
	Tenax TA	D	1.64	5
Decanal	Tenax TA	D	2.32	5

Alcohols

Compound	Sorbent	Level	Uptake rate	Ref.
Ethanol	Chromosorb 106	A	1.3	7
Propan-1-ol	Chromosorb 106	D	1.47	5
Propan-2-ol (Isopropanol)	Chromosorb 106	A	1.52	7
	Spherocarb/UniCarb	C	2.0	1
n-Butanol	Chromosorb 106	A	1.74	7
	Tenax	D	1.33	5
Isobutanol (2-Methylpropan-1-ol)	Chromosorb 106	A	1.61	2
	Tenax GR	C	1.26	2
	Tenax TA	D	1.26	2
Furfuryl alcohol	Tenax TA	D	2.50	5
Tetrahydrofurfuryl alcohol	Chromosorb 106	D	2.39	5
	Tenax TA	D	1.90	5

Other

Compound	Sorbent	Level	Uptake rate	Ref.
Allyl glycidyl ether	Chromosorb 106	D	2.40	5
	Tenax TA	D	1.83	5
Butyl glycidyl ether	Chromosorb 106	D	2.61	5
	Tenax TA	D	2.36	5
Carbon disulfide	Spherocarb/UniCarb	A	2.6	1
1,4-Dioxane	Spherocarb/UniCarb	C	3.0	1
Ethylene oxide	Spherocarb/UniCarb	B	1.6	1
N-Methylpyrrolidone	Chromosorb 106	A	2.41	7
	Tenax TA	C	1.83	5
Nitrous oxide [d]	Mol. Sieve 5 Å	B	1.25	15
α-Pinene	Chromosorb 106	A	2.56	7
	Tenax TA	D	2.35	5
Propylene oxide	Chromosorb 106	A	1.24	7
Tetrahydrofuran	Chromosorb 106	D	1.64	5
N-Vinylpyrrolidone	Tenax TA	A	2.51	7

Environmental applications – 24 h

Alkanes and alkenes

Compound	Sorbent	Level	Uptake rate	Ref.
Butadiene	Carbopack X	F	1.35	16

Aromatic hydrocarbons

Compound	Sorbent	Level	Uptake rate	Ref.
Benzene	Carbopack X	F	2.14	16
Toluene	Carbopack X	F	1.96	16
Xylene	Carbopack X	F	1.99	16
Styrene	Carbopack X	F	2.13	16
1,3,5-Trimethylbenzene	Carbopack X	F	2.01	16
p-Ethyltoluene	Carbopack X	F	2.01	16

Halogenated compounds

Compound	Sorbent	Level	Uptake rate	Ref.
Chlorobenzene	Carbopack X	F	2.11	16
3-Chloropropene	Carbopack X	F	1.59	16
o-/*m*-/*p*-Dichlorobenzene	Carbopack X	F	2.70	16
1,1-Dichloroethane	Carbopack X	F	2.30	16
1,2-Dichloroethane	Carbopack X	F	2.30	16
cis-1,2-Dichloroethene	Carbopack X	F	2.30	16
1,1-Dichloroethene	Carbopack X	F	2.30	16
1,2-Dichloropropane	Carbopack X	F	2.40	16
1,2-Dichlorotetrafluoroethane	Carbopack X	F	3.07	16
Tetrachloroethene	Carbopack X	F	3.25	16
Tetrachloromethane (Carbon tetrachloride)	Carbopack X	F	3.20	16
1,1,2-Trichloroethane	Carbopack X	F	2.67	16
1,1,1-Trichloroethane	Carbopack X	F	2.78	16
Trichloroethene	Carbopack X	F	2.68	16
Trichlorofluoromethane	Carbopack X	F	2.86	16
1,1,2-Trichloro-1,2,2-trifluoroethane	Carbopack X	F	3.52	16

Environmental applications – 1 week

Alkanes and alkenes

Compound	Sorbent	Level	Uptake rate	Ref.
Butadiene	Carbopack X	B	1.19	3
		F	1.21	17
Cyclohexane	Tenax TA	F	0.86	18
Methylcyclohexane	Tenax TA	F	0.80	18
n-Heptane	Tenax TA	F	1.06	18
n-Octane	Tenax TA	F	1.26	18
n-Nonane	Tenax TA	F	1.78	18
n-Dodecane	Tenax TA	F	1.81	18

Aromatic hydrocarbons

Compound	Sorbent	Level	Uptake rate	Ref.
Benzene	Carbograph 1TD or Carbopack B	A	2.14 [i]	19
	Chromosorb 106	A	1.52	19
	Tenax TA	A	1.45	19
Toluene	Carbograph 1TD or Carbopack B	A	2.16	1
	Chromosorb 106	A	2.05	1
Ethylbenzene	Carbopack B	F	2.04	20
	Tenax TA	F	1.52	18
Xylene	Carbograph 1TD or Carbopack B	A	2.37	1
	Chromosorb 106	A	2.42	1
Propylbenzene	Tenax TA	F	1.77	18
Styrene	Tenax TA	F	1.53	18

Halogenated compounds

Compound	Sorbent	Level	Uptake rate	Ref.
Tetrachloroethene	Tenax TA	F	1.90	18

Other

Compound	Sorbent	Level	Uptake rate	Ref.
Benzaldehyde	Tenax TA	F	1.78	18
Ethyl acetate	Tenax TA	F	0.83	18
Limonene	Tenax TA	F	1.50	18
Phenol	Tenax TA	F	1.65	18
α-Pinene	Tenax TA	F	1.11	18

Environmental applications – 2 weeks

Alkanes and alkenes

Compound	Sorbent	Level	Uptake rate	Ref.
Butadiene	Carbopack X	B	1.02	3
		F	0.99	17
n-Butane	Carbopack X	F	1.3 [g]	21
Isobutane	Carbopack X	F	0.80 [g]	21
n-Pentane	Carbopack B	F	1.34 [g]	21
	Carbopack X	F	1.8 [g]	21
Isopentane	Carbopack X	F	1.60 [g]	21
n-Hexane	Carbopack B	F	1.75 [g]	21
	Carbopack X	F	2.0 [g]	21

Aromatic hydrocarbons

Compound	Sorbent	Level	Uptake rate	Ref.
Benzene	Carbograph 1TD or Carbopack B	A	2.02	19
	Carbopack X	A	1.99	19
	Chromosorb 106	A	1.47	19
	Tenax TA	A	1.03	19
Toluene	Carbograph 1TD or Carbopack B	A	2.13 ± 0.24	1
	Carbopack X	B	2.23 ± 0.52	22
	Chromosorb 106	A	1.91 ± 0.18	1
	Tenax TA	B	1.22	1
Ethylbenzene	Chromosorb 106	B	2.31 ± 0.07	1
Xylene	Carbograph 1TD or Carbopack B	A	2.07 ± 0.21	1
	Carbopack X	F	2.1 [g]	21
	Chromosorb 106	A	2.09 ± 0.29	1
	Tenax TA	A	1.49	1
Trimethylbenzene	Carbopack B	A	2.3	1

Environmental applications – 4 weeks

Alkanes and alkenes

Compound	Sorbent	Level	Uptake rate	Ref.
n-Decane	Tenax TA	B	2.93	1
		F	2.96	23
n-Undecane	Tenax TA	B	3.34	1
		F	3.38	23
n-Dodecane	Tenax TA	C	3.75	–

Aromatic hydrocarbons

Compound	Sorbent	Level	Uptake rate	Ref.
Benzene	Carbograph 1TD or Carbopack B	A	1.85	19
	Chromosorb 106	A	1.28	19
	Tenax TA	A	0.70	19
Toluene	Carbograph 1TD or Carbopack B	A	2.07 ± 0.26	1
	Chromosorb 106	A	1.82 ± 0.18	1
	Tenax TA	A	1.03 ± 0.26	1
Ethylbenzene	Carbopack B	B	2.3	1
	Chromosorb 106	B	2.24	1
Xylene	Carbograph 1TD or Carbopack B	A	1.94 ± 0.29	1
	Chromosorb 106	A	1.91 ± 0.35	1
	Tenax TA	A	1.46 ± 0.67	1
Trimethylbenzene	Carbopack B	A	2.2	1
	Tenax TA	A	2.67	1

Halogenated compounds

Compound	Sorbent	Level	Uptake rate	Ref.
Tetrachlorobutadiene	Tenax TA	B	3.0	24
Pentachlorobutadiene	Tenax TA	B	3.4	24
Hexachlorobutadiene	Tenax TA	B	3.5	24
Hexachloroethane	Tenax TA	F	2.4	25

Trademarks

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