

Ethanol from Reed Diffusers and Hand Sanitizers: Why Should I Care?

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Products Designed for Home Use Containing Common VOCs

- **Ethanol / SD Alcohol 40**

- Cleaning Products
 - Laundry and dish detergent
 - Hand sanitizers
 - Wood cleaners
- Personal Care Products
 - Hair care products
 - Deodorant
 - Perfumes
- Air Fresheners
- Home Maintenance
 - Degreasers
 - Adhesives
 - Spray paints
- Insect Repellent

- **Isopropyl Alcohol**

- Rubbing Alcohol
- Personal Care Products
 - Nail products
 - Hair dyes
- Home Maintenance
 - Paints
 - Rubber cement
 - White lithium grease
 - Degreasers
- Glass Cleaning Products
- Ink Cartridges
- Leather Treatment
- Insect and Pesticide Sprays

Products Designed for Home Use Containing Common VOCs

- **Acetone**

- Personal care products
 - Nail polish remover
 - Nail enamel
- Home Maintenance
 - Car care products
 - Aerosol paints
 - Carburetor & brake cleaner
 - PVC cement
- Foggers and insecticide

- **Toluene**

- Home Maintenance
 - Paints & lacquers
 - Paint thinner
 - Polyurethane
 - Glues and adhesives
 - Degreasers
 - Carburetor cleaner
 - Caulk
 - Wood finish products
- Gasoline

Partition Coefficients

Chemical	Partition Coefficients Blood / Gas
Ethanol	2516
Isopropanol	1426
Methanol	2874
Methyl Ethyl Ketone	215
Acetone	330
1,1,1 Trichloroethane	38.6
Toluene	15.6
Benzene	7.8

Small Subset of Home VOC Measurements

TVOC (ng/L)	Ethanol (ng/L)	Acetone (ng/L)	Isopropanol (ng/L)	Toluene (ng/L)
240	20.0	4.8	0.0	4.0
470	221.0	7.5	3.3	6.0
5400	15.0	9.6	0.0	7.5
3300	1504.0	48.0	66.0	62.0
5400	3047.0	38.0	117.0	4.3
2900	1471.0	19.0	11.0	27.0
970	77.0	13.0	0.5	25.0
550	267.0	7.0	5.0	3.0
2400	999.0	23.0	52.0	6.0
2000	906.0	21.0	69.0	5.9
5000	955.0	47.4	8.9	125.0

Deep Lung Sampling

Breath Sampler

- **Collects deep lung air samples**
 - To evaluate blood/breath partitioning
- **Subject continuously exhales**
- **Collects last 150 mL of breath**



Deep Lung Sampling

Sample Transfer

- Breath tube removed
- Plunger attached
- Thermal desorption tube connected
- Sample pushed onto TDT
 - Loading rate onto TDT important
 - More study required to determine optimum delivery rate
 - All data collected are compared with room air samples on same configuration to reduce sampler contribution to analysis



ANALYTICAL RESULTS

Initial Results with Breath Sampler

Comparison of Tedlar Bag to Breath Sampler

- Sampler used as previously described
- VOC losses due to sampler
- Sampler wet from breath collection

	Tedlar Bag Transferred to TDT 0.8 L ng/L	Breath Sampler 0.150 L ng/L
Ethanol	1,600	110
Acetone	1,800	950
Isopropanol	11,000	16,000
Toluene	91	12

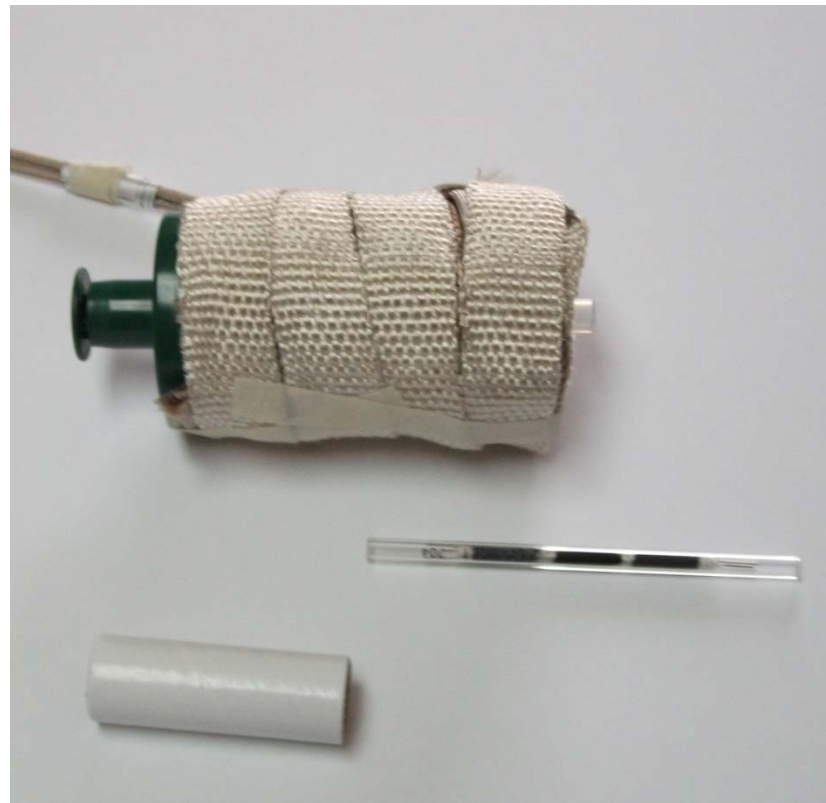
Issues with Deep Lung Sampling

Issues

- **Moisture can coat the sampler walls**
 - Moisture can then retain VOCs
- **150 mL sample may not be sufficient to monitor for certain gases**
- **Multiple sample collections exacerbates moisture issue**

Modification

- **Thermal jacket added**
 - To reduce moisture condensation
 - To increase retention of all VOCs
 - Allow for multiple breath samples



Results with Warmed Breath Sampler

Comparison of Breath Sampler (reduced variability)

- Sampler was dry before usage
- Post samples are after usage by subjects
- Results in ng/L (Ratio)

	Ambient Air 750 mL (pre)	Ambient Air 150 mL(post)	Ambient Air 750 mL(post)
Ethanol	190 (1.00)	110 (0.54)	140 (0.74)
Acetone	180 (1.00)	240 (1.29)	160 (0.89)
Isopropanol	730 (1.00)	610 (0.83)	530 (0.73)
Toluene	190 (1.00)	220 (1.20)	150 (0.83)

Results with Warmed Breath Sampler

5 Subjects Exposed to Airborne VOCs

- VOC levels respired after ~1 hour exposure (150 mL sample)
- Toluene showed greatest retention
- Acetone greater than baseline level

	Subject 1 ng/L (ratio)	Subject 2 ng/L (ratio)	Subject 3 ng/L (ratio)	Subject 4 ng/L (ratio)	Subject 5 ng/L (ratio)
Ethanol	160 (0.81)	150 (0.75)	140 (0.73)	44 (0.23)	43 (0.22)
Acetone	390 (2.12)	370 (2.03)	340 (1.81)	180 (0.96)	160 (0.87)
Isopropanol	390 (0.53)	440 (0.61)	280 (0.38)	300 (0.41)	75 (0.10)
Toluene	92 (0.49)	120 (0.64)	80 (0.43)	67 (0.36)	55 (0.29)

Results with Warmed Breath Sampler

4 Subjects Exposed to Higher Airborne VOCs

- VOC levels respired after ~1 hour exposure (750 mL sample)
- Ethanol still lowest retention (IPA greatest – toluene consistent)

	Ambient Air 750 mL (ratio)	Subject 2 ng/L (ratio)	Subject 3 ng/L (ratio)	Subject 4 ng/L (ratio)	Subject 5 ng/L (ratio)
Ethanol	940 (1.00)	750 (0.80)	610 (0.64)	580 (0.61)	220 (0.24)
Acetone	1000 (1.00)	250 (0.25)	610 (0.61)	200 (0.20)	550 (0.55)
Isopropanol	9600 (1.00)	1200 (0.12)	15 (0.16)	890 (0.09)	900 (0.09)
Toluene	100 (1.00)	26 (0.26)	39 (0.39)	33 (0.32)	37 (0.36)

Results with Warmed Breath Sampler

4 Subjects Exposed to Airborne VOCs (duplicate study later date)

- VOC levels respired after ~1 hour exposure (750 mL sample)
- Toluene very consistent
- Isopropanol best retention

	Ambient Air 750 mL (ratio)	Subject 4 ng/L (ratio)	Subject 5 ng/L (ratio)	Subject 6 ng/L (ratio)	Subject 7 ng/L (ratio)
Ethanol	230 (1.00)	86 (0.38)	220 (0.99)	75 (0.34)	1400 (6.30)
Acetone	190 (1.00)	120 (0.64)	320 (1.69)	120 (0.63)	160 (0.88)
Isopropanol	1600 (1.00)	370 (0.23)	450 (0.27)	170 (0.10)	1000 (0.62)
Toluene	33 (1.00)	14 (0.41)	15 (0.45)	15 (0.44)	16 (0.47)

Concluding Remarks

- **Collecting breath samples certainly has challenges**
 - Breath moisture complicates sampling
 - Sampler temperature critical to reliable data
 - Further sampling improvements might reduce variability of measurements
- **Results indicate different absorption than expected based on published partition coefficients**
- **The next step ... Exploration of the absorptive properties of the many VOCs found in home environments?**