

Air Quality Trends in Residential Locations

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Introduction

- State of residential air quality
- EPA 5-10 times worse than outdoor air quality
 - Tighter homes
 - Low air exchange rate
 - More time spent indoors
 - More products/materials in homes
 - Not yet characterized

Methodology

- Sample collection
 - Active sampling @ 0.2 L/min
 - Custom multi-matrix sorbent tube
- Sample analysis
 - Thermal desorption
 - GC-MS optimized for VOCs
 - Methods NIOSH 2549 and EPA TO17



Total VOCs

- GC-MS chromatographic area of ~3-15 carbons
 - Not sum of individual compounds
- Good general air quality indicator
 - Allows comparison of multiple samples with each other or with target levels
 - US Green Building Council recommends 500 ng/L
 - Some European countries have adopted 300 ng/L
 - Chemical composition important



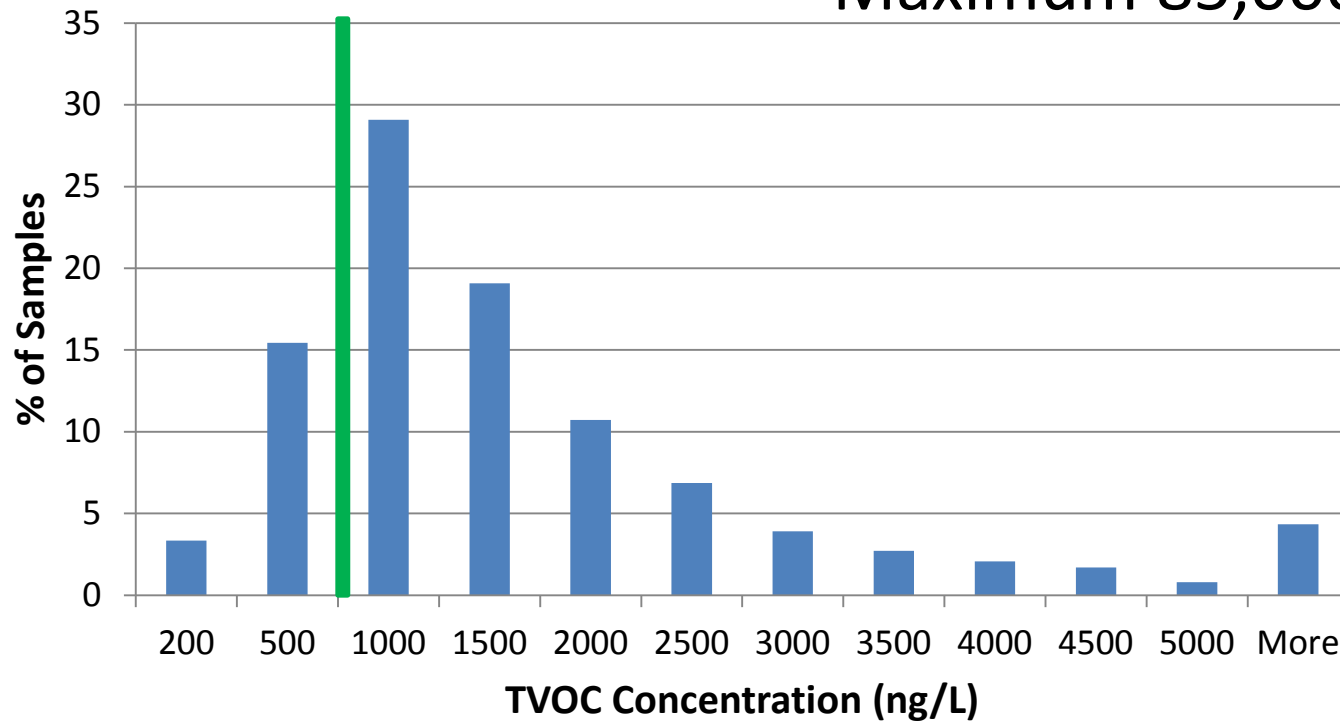
Translation to Health Effects

- TVOC < 500 ng/L
 - Acceptable for most individuals
- TVOC 500 – 1,500 ng/L
 - Marginal; some effects possible
- TVOC 1,500- 3,000 ng/L
 - Action level; some effects probable
- TVOC > 3,000 ng/L
 - Immediate action level; effects probable
- Chemically sensitive individuals require lower levels



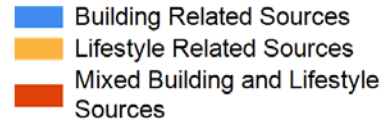
TVOC Distribution

- ~4,200 samples
- Only 22% below 500 ng/L
- Median 1,100 ng/L
- Mean 1,800 ng/L
- Maximum 85,000



Product Categories

Contamination Index Source Groups



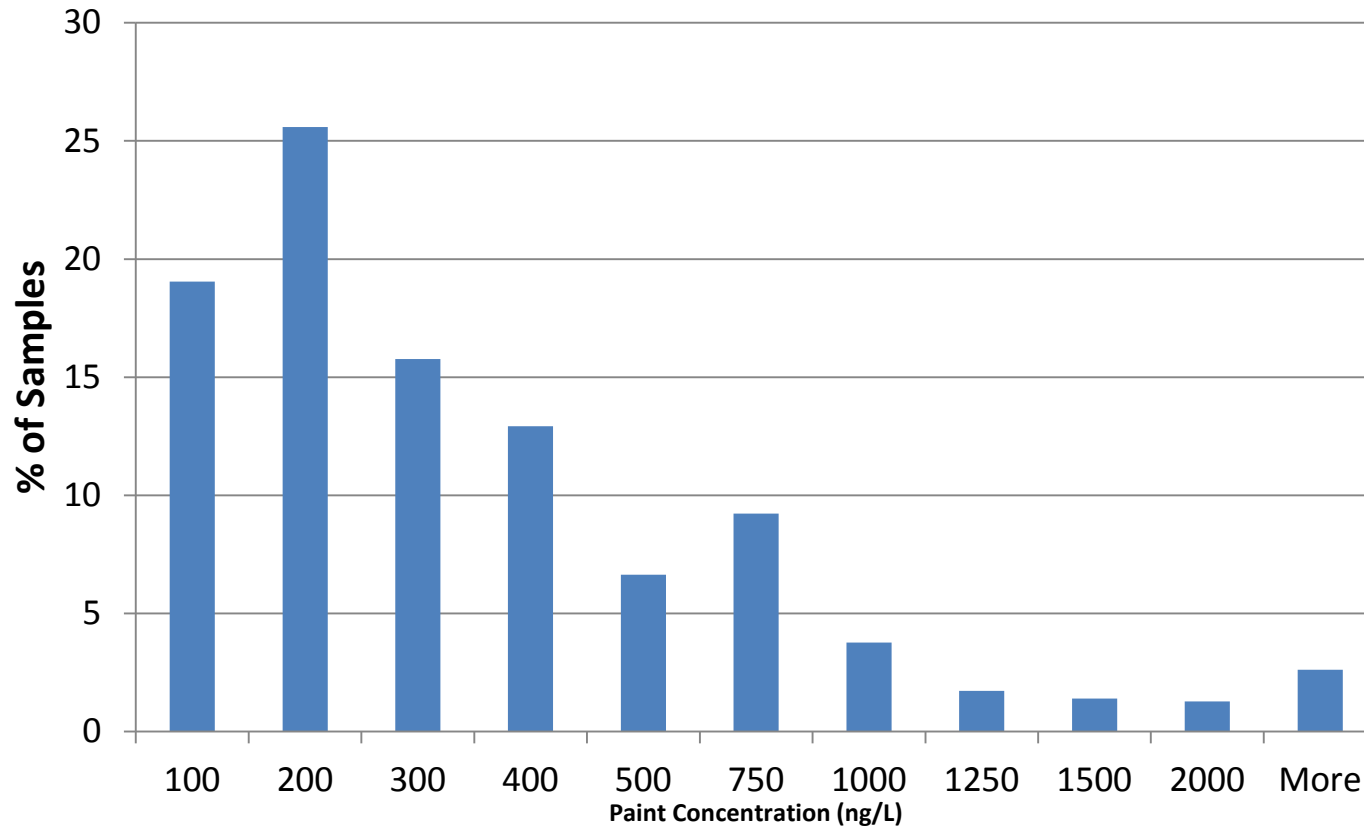
- Building
 - Part of the structure of home
- Lifestyle
 - Occupants bring into home
- Mixed Building and Lifestyle
 - Could belong to either Building or Lifestyle categories

Building – Paints and Coatings

- Complex mixture
 - Many formulations
 - Chemical composition not fully available (proprietary)
- Present in almost every structure
 - Applied on a surface
 - Stored in containers
- Can linger for months to years

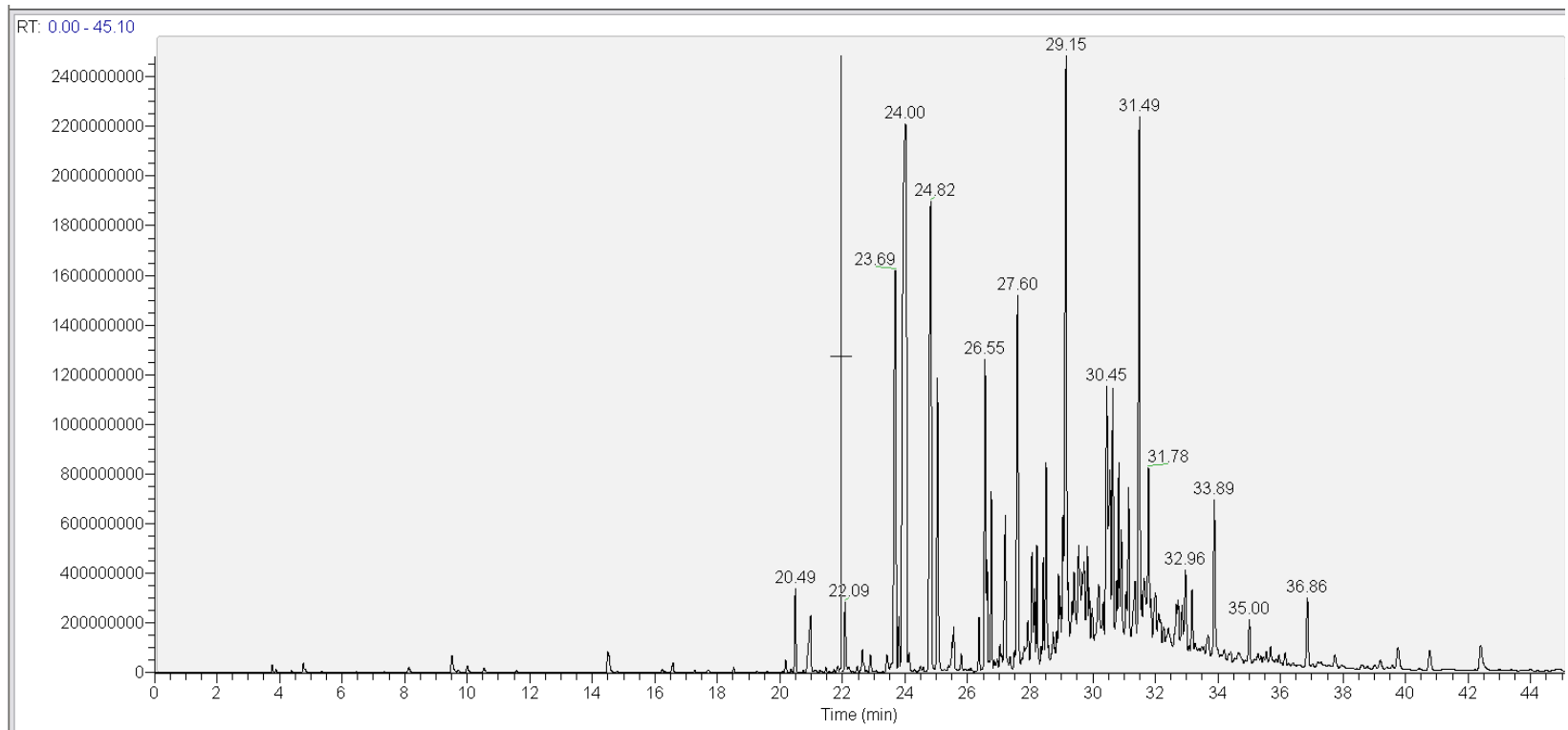
Building – Paints and Coatings

- Median 230 ng/L
- Mean 500 ng/L



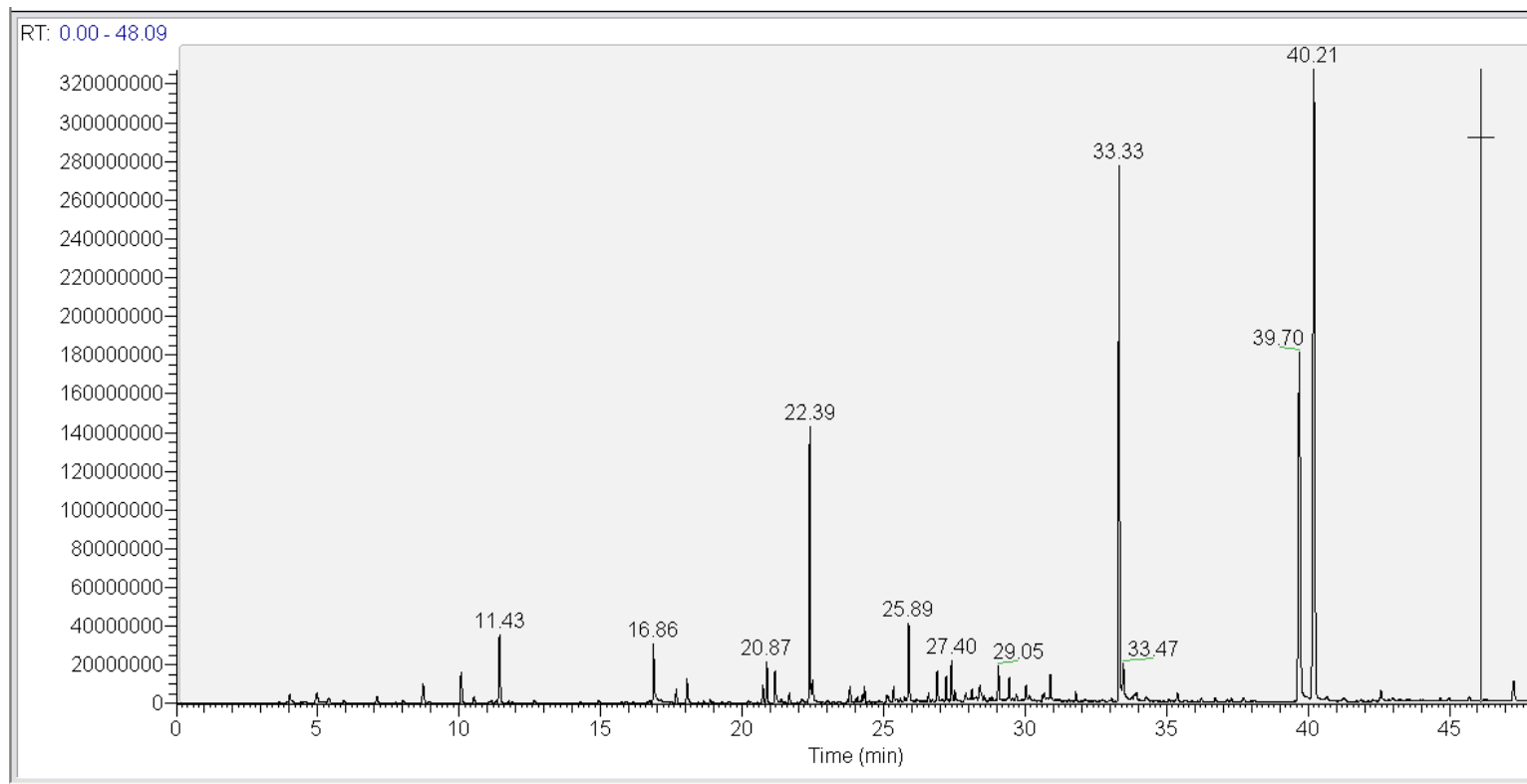
Paints and Coatings

Traditional Paint



Paints and Coatings

Low or No VOC Paint



Lifestyle – Personal Care

- Complex mixture
 - Ethanol, isopropanol, acetone
- Sources
 - Soap, deodorant, lotions, perfumes and colognes, hair care and coloring products, nail care products, oral hygiene products, etc.



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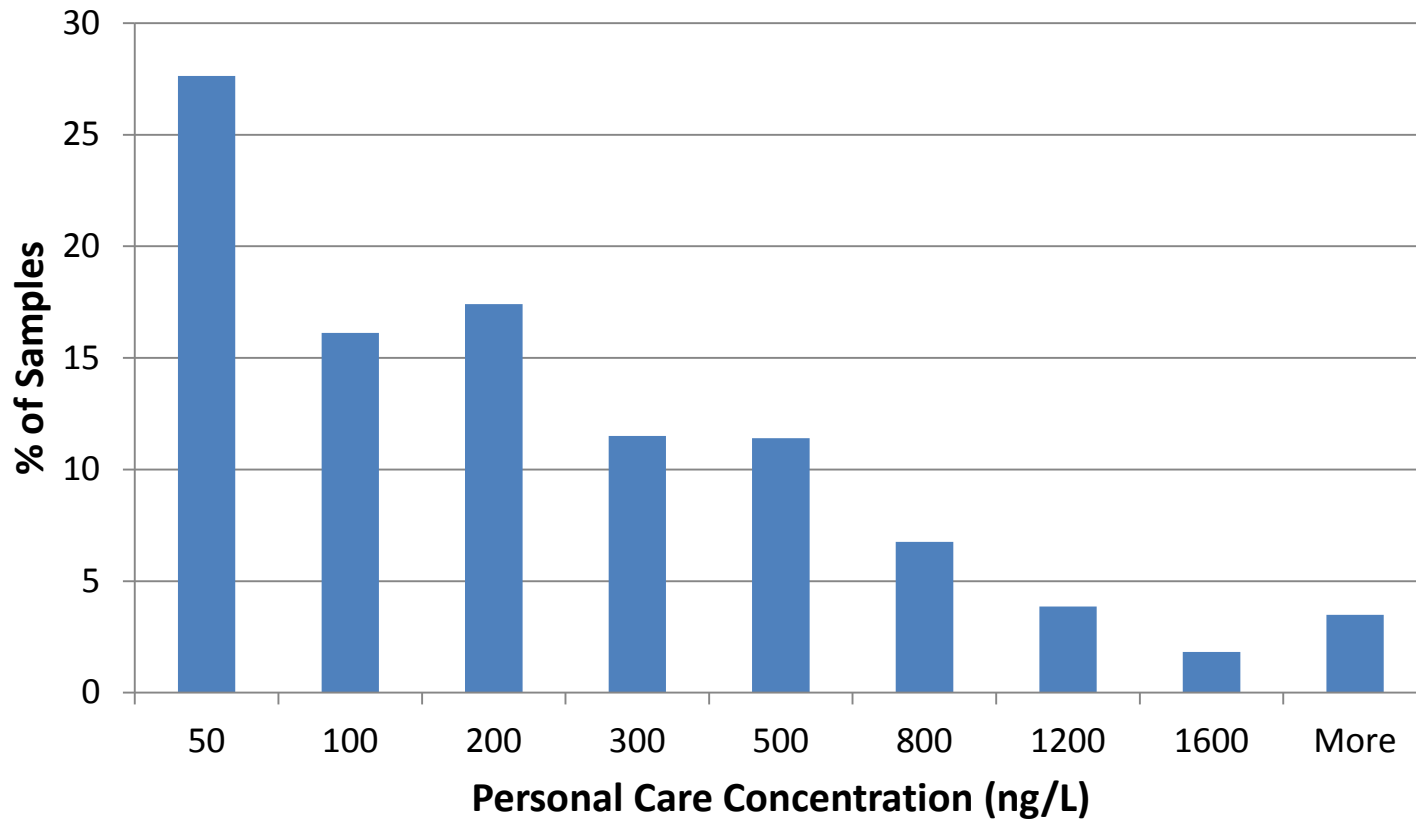
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Lifestyle – Personal Care

- Median 130 ng/L
- Mean 350 ng/L



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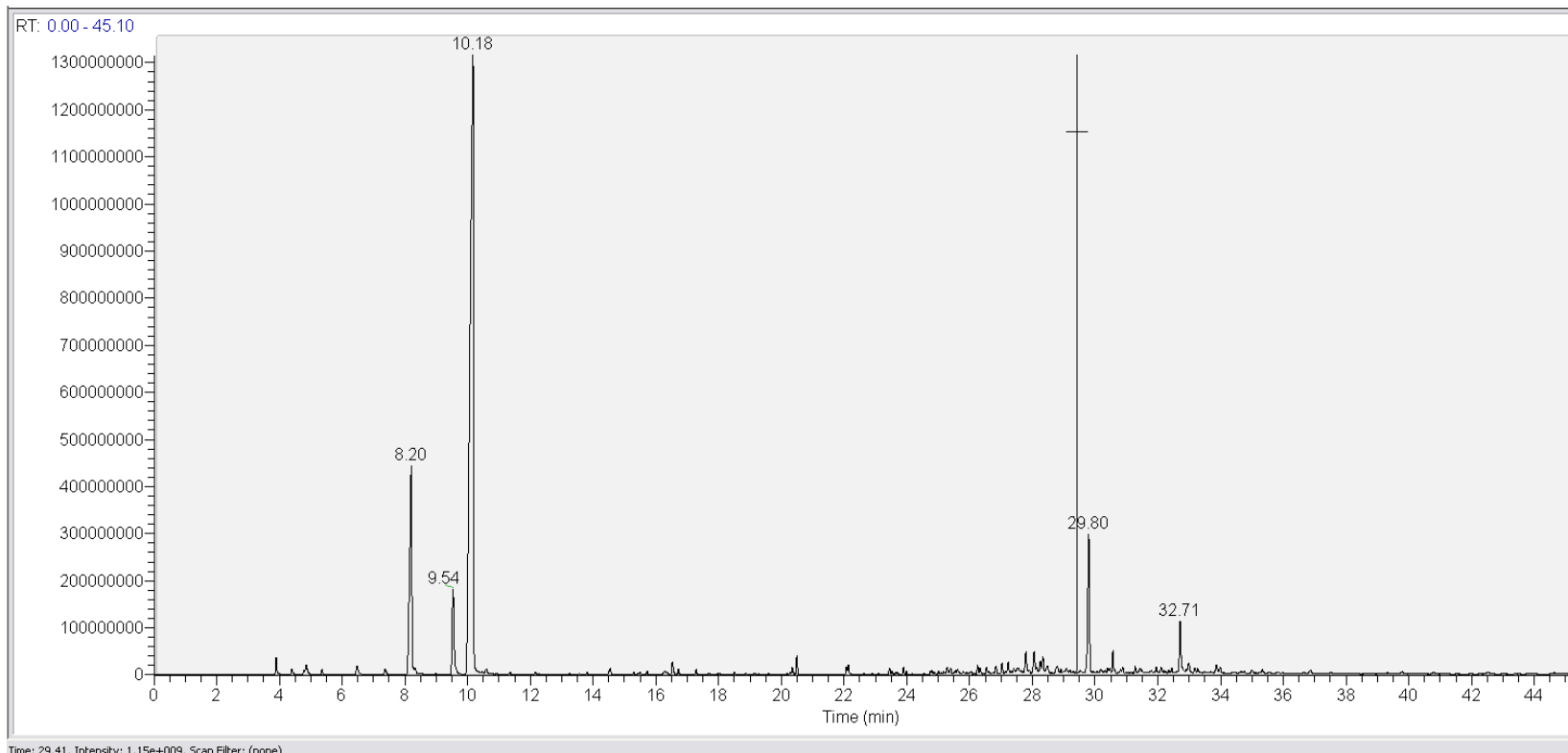
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Lifestyle – Personal Care

Ethanol, Isopropanol, Acetone



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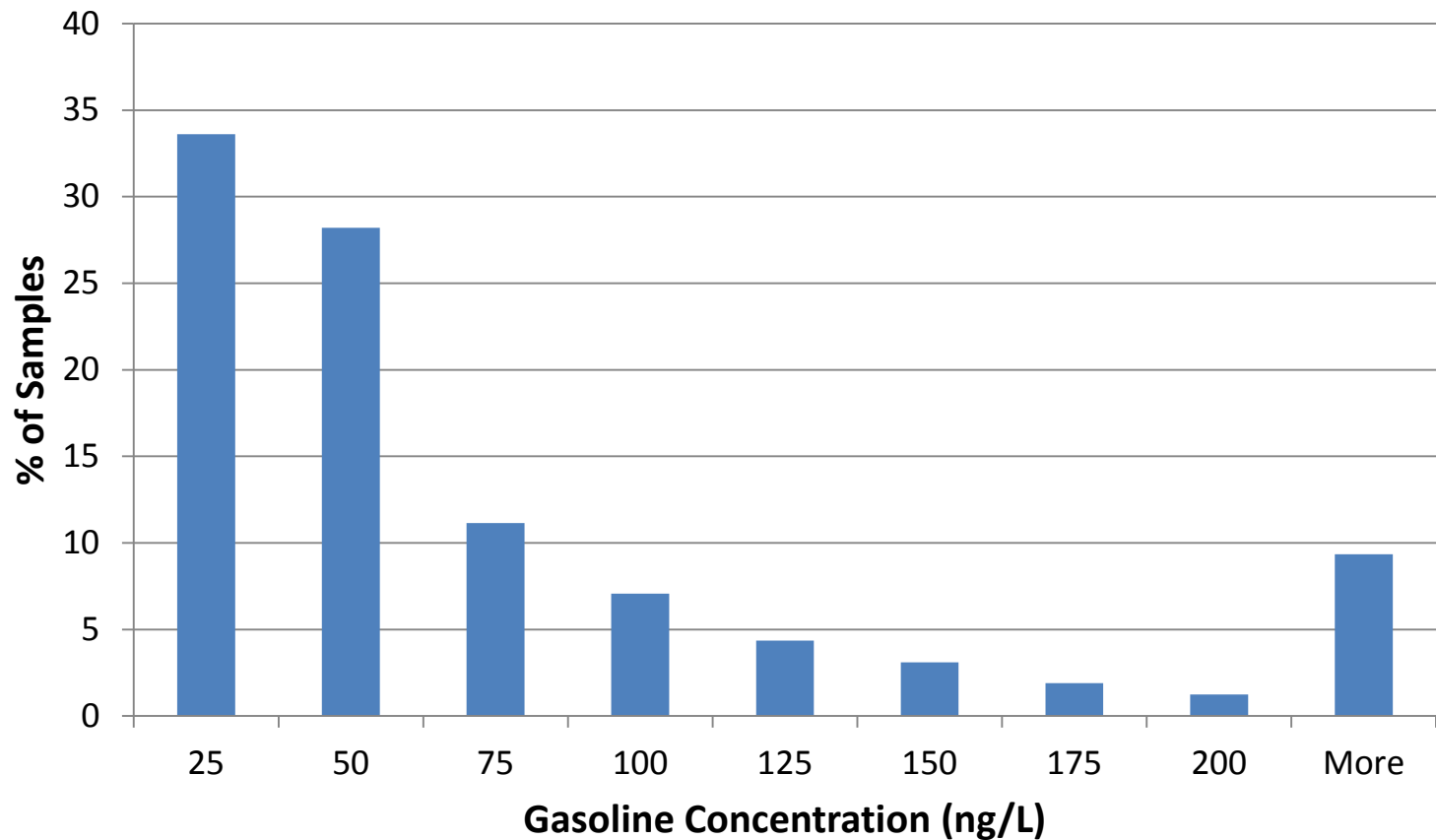
Mixed – Gasoline

- Complex mixture
 - Aromatics (benzene, toluene, xylenes),
 - Hydrocarbons (C3-C7)
- Sources
 - Non-automobile vehicles (lawnmowers, lawn equipment, snow blowers, ATVs, etc.)
 - Gas containers
 - Spills

Mixed – Gasoline

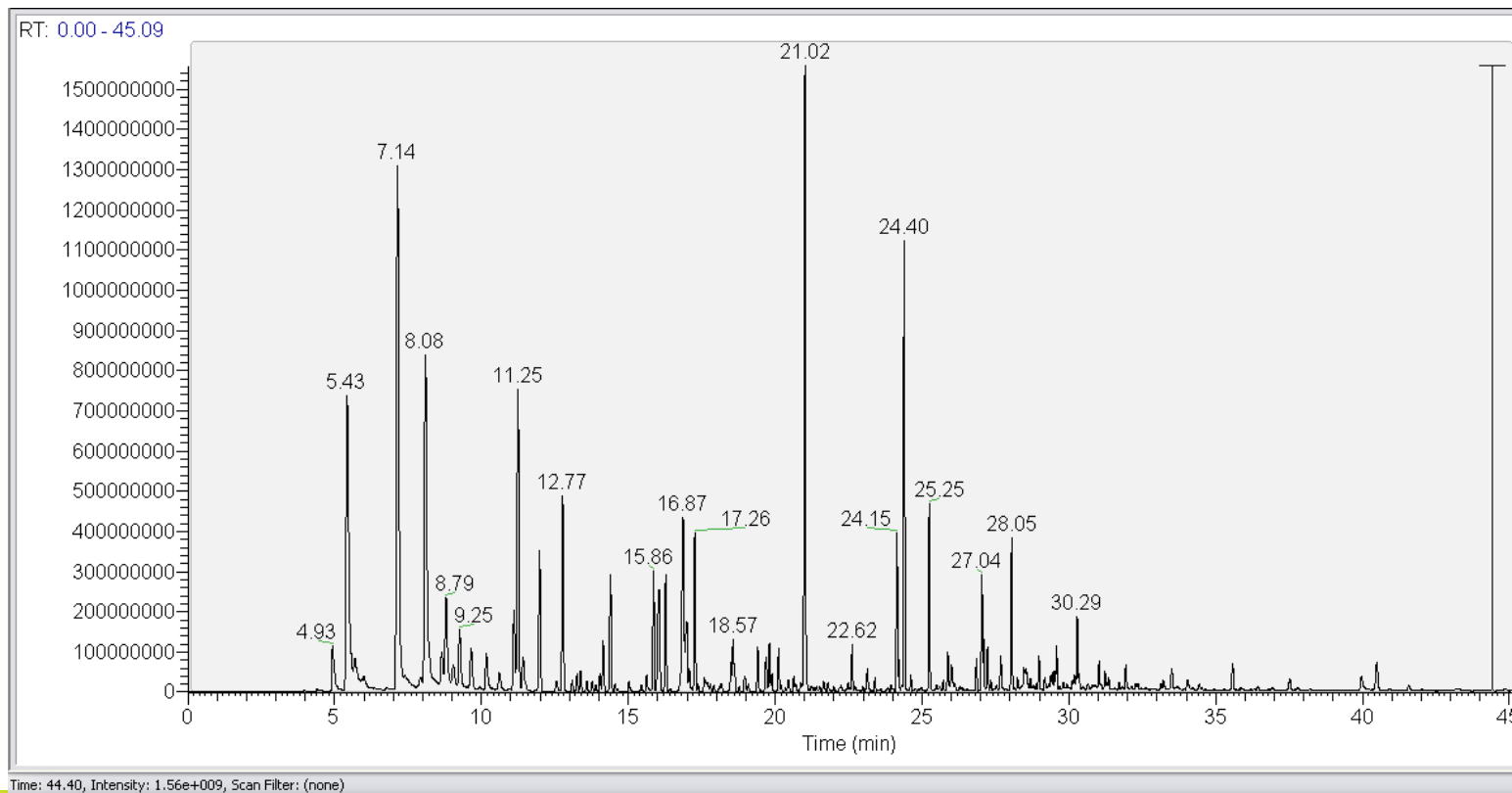
- Median 36 ng/L

- Mean 89 ng/L



Mixed – Gasoline

- Aromatics (benzene, toluene, xylenes),
- Hydrocarbons (C3-C7)



'Green' Products

- No official definition of 'green' products relating to their chemical ingredients
 - Virtually all chemical compounds could cause a problem
 - Typically have less toxic or irritating chemical compounds
 - Sometimes less effective than the more conventional products



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Emerging Issues

- Spray foam insulation
 - Curing/setting variables
 - Indicator compounds
 - Pentafluoropropane, trans-1,2-dichloroethene, amines, alcohols
- Fire residue
 - Indicators for odors and cleanup
- Tobacco smoke
 - More smoke-free environments
- Materials emissions
 - Focus on connecting materials/products to air quality



Conclusions

- Most residential TVOC above recommended 500 ng/L
 - Range < 200 to 85,000 ng/L
- VOC sources, new products, low air exchange, tighter homes
- Variety of sources/activities
- Highest Concentration Sources
 - Paints/coatings, personal care, cleaning, odorants/fragrances, light hydrocarbons and solvents
- Common sources
 - Gasoline, adhesives, PVC cement, dry cleaning, medicinal ointments/creams, moth balls/crystals, fuel oil/diesel, Freons™
- New issues

References

- L. Molhave, Volatile Organic Compounds, Indoor Air Quality and Health, Vol. 5, International Indoor Air Quality Conference, Toronto, Canada, 1990, p. 22 ff.
- European Collaborative Action: Indoor Air Quality and its Impact on Man (ECA-IAQ), Report No 19 Total Volatile Organic Compounds (TVOC) in Indoor Air Quality Investigations, 1997. (from L. Molhave et al., Total Volatile Organic Compound (TVOC) in Indoor Air Quality Investigation, Indoor Air 1997; 225-240.)
- T. Salthammer, Critical evaluation of approaches in setting indoor air quality guidelines and reference values, Chemosphere 82, 2011, 1507-1517.
- EPA Indoor Air Quality, <http://www.epa.gov/iaq/>
- Health Canada Indoor Air Quality, <http://www.hc-sc.gc.ca/ewh-semt/air/in/index-eng.php>

