

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



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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



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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



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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



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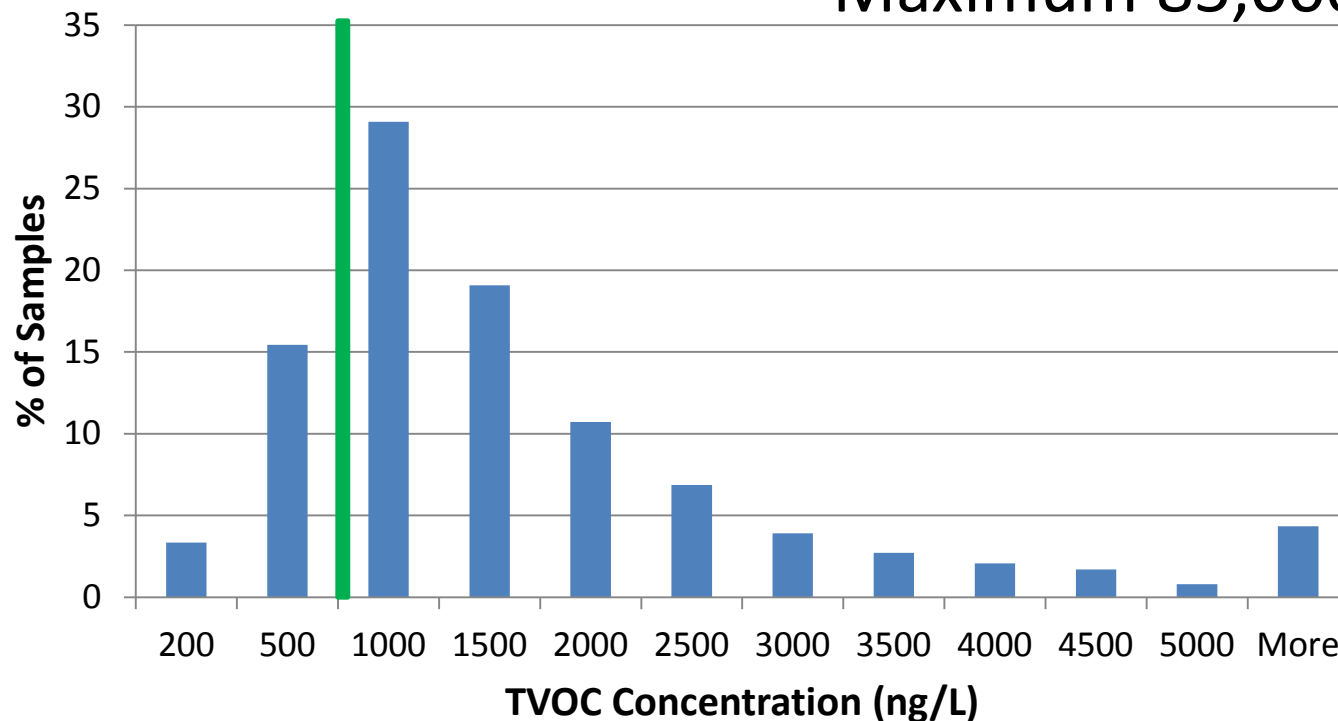
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TVOC Distribution

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



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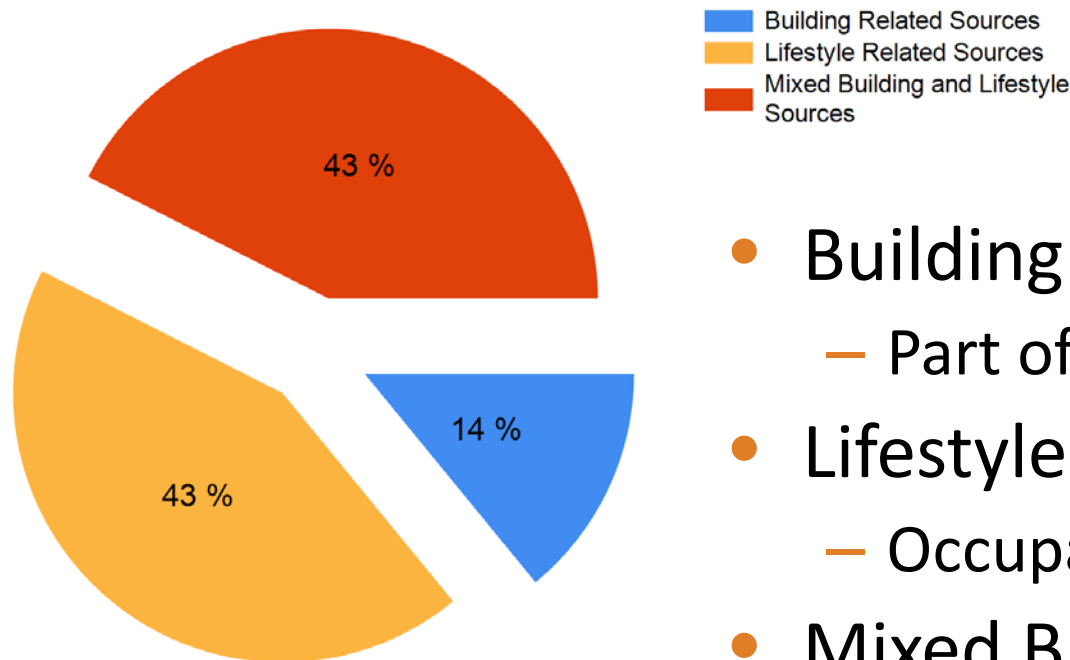
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Product Categories

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



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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



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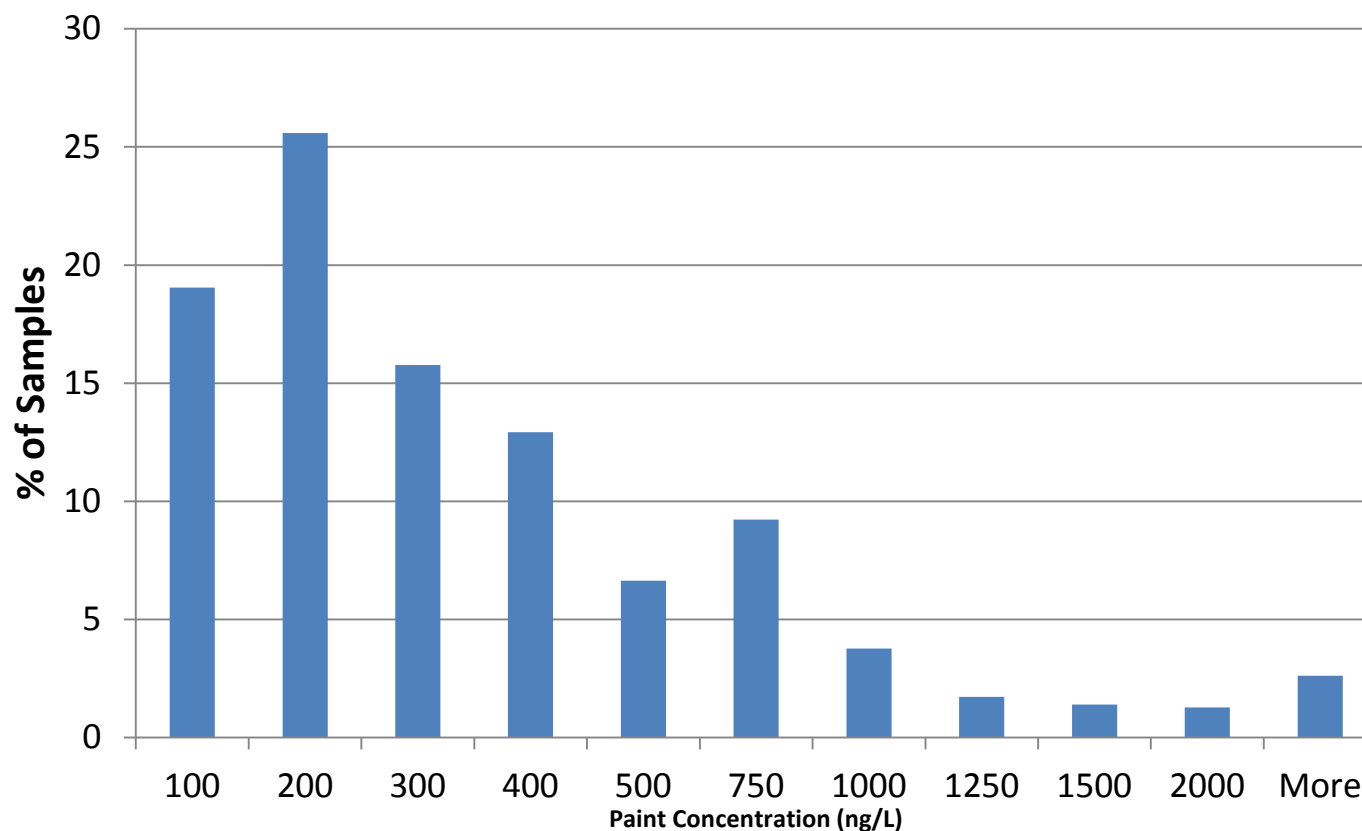
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Building – Paints and Coatings

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



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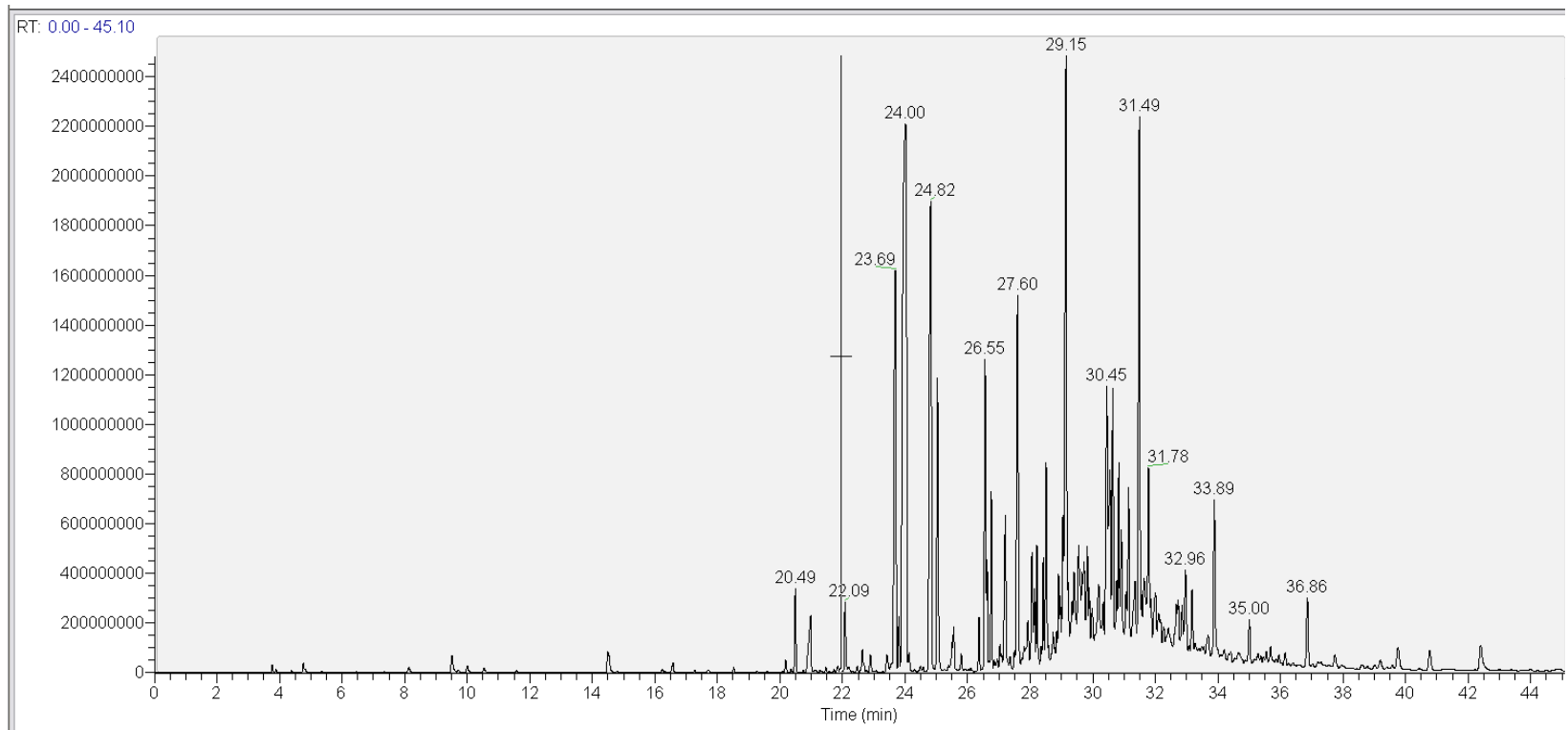
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Paints and Coatings

Traditional Paint



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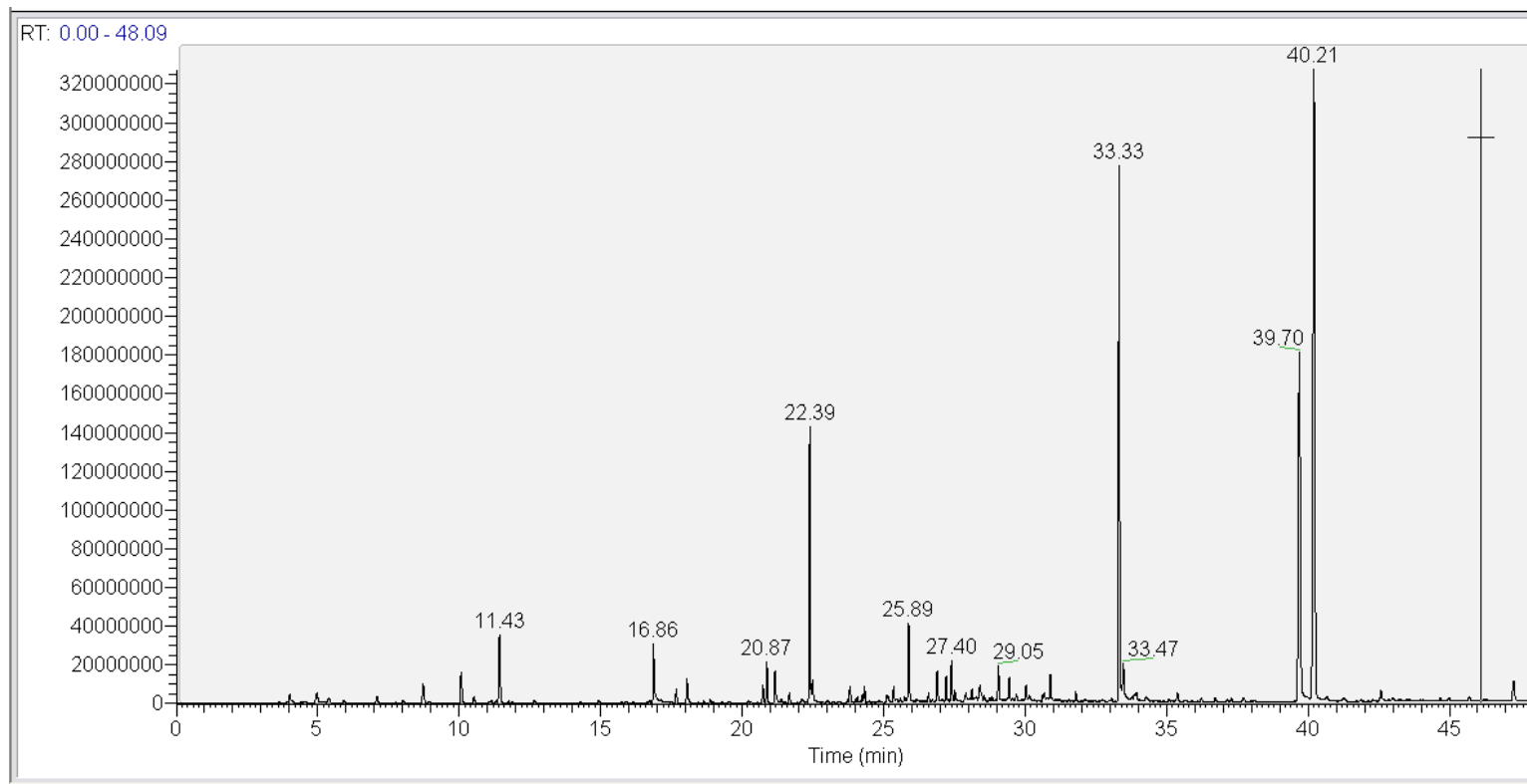
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Paints and Coatings

Low or No VOC Paint



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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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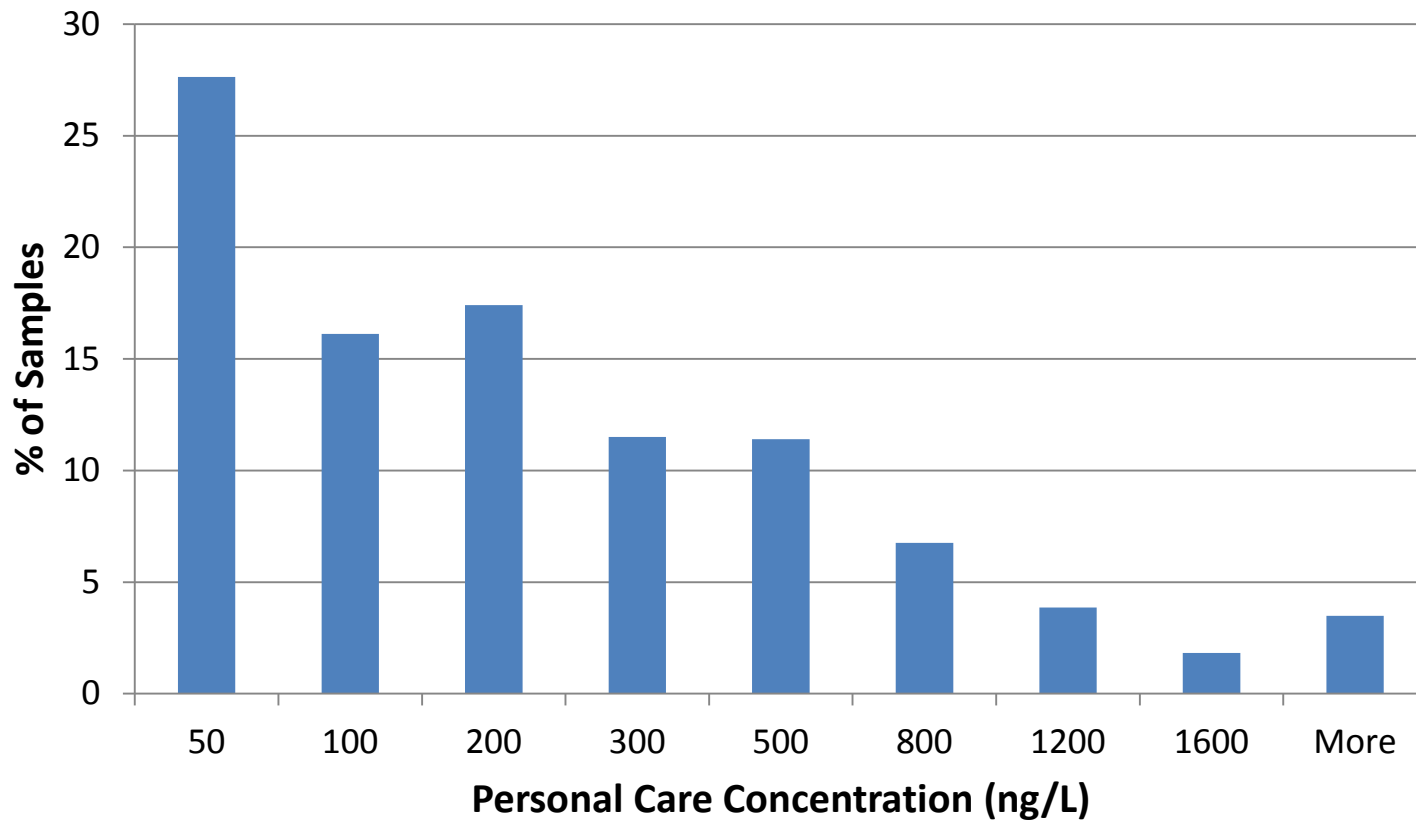
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Lifestyle – Personal Care

- Median 130 ng/L

- Mean 350 ng/L



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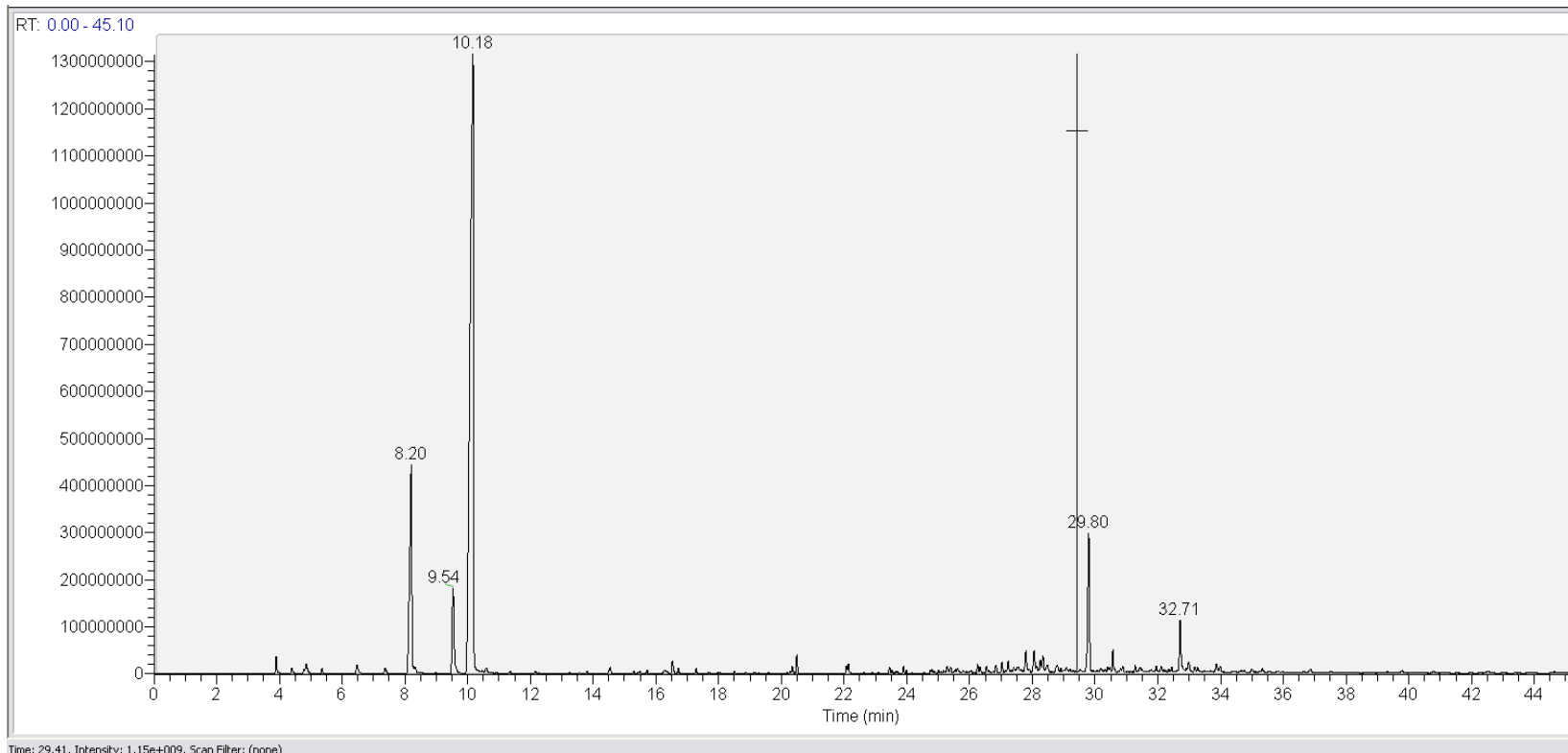
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Lifestyle – Personal Care

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



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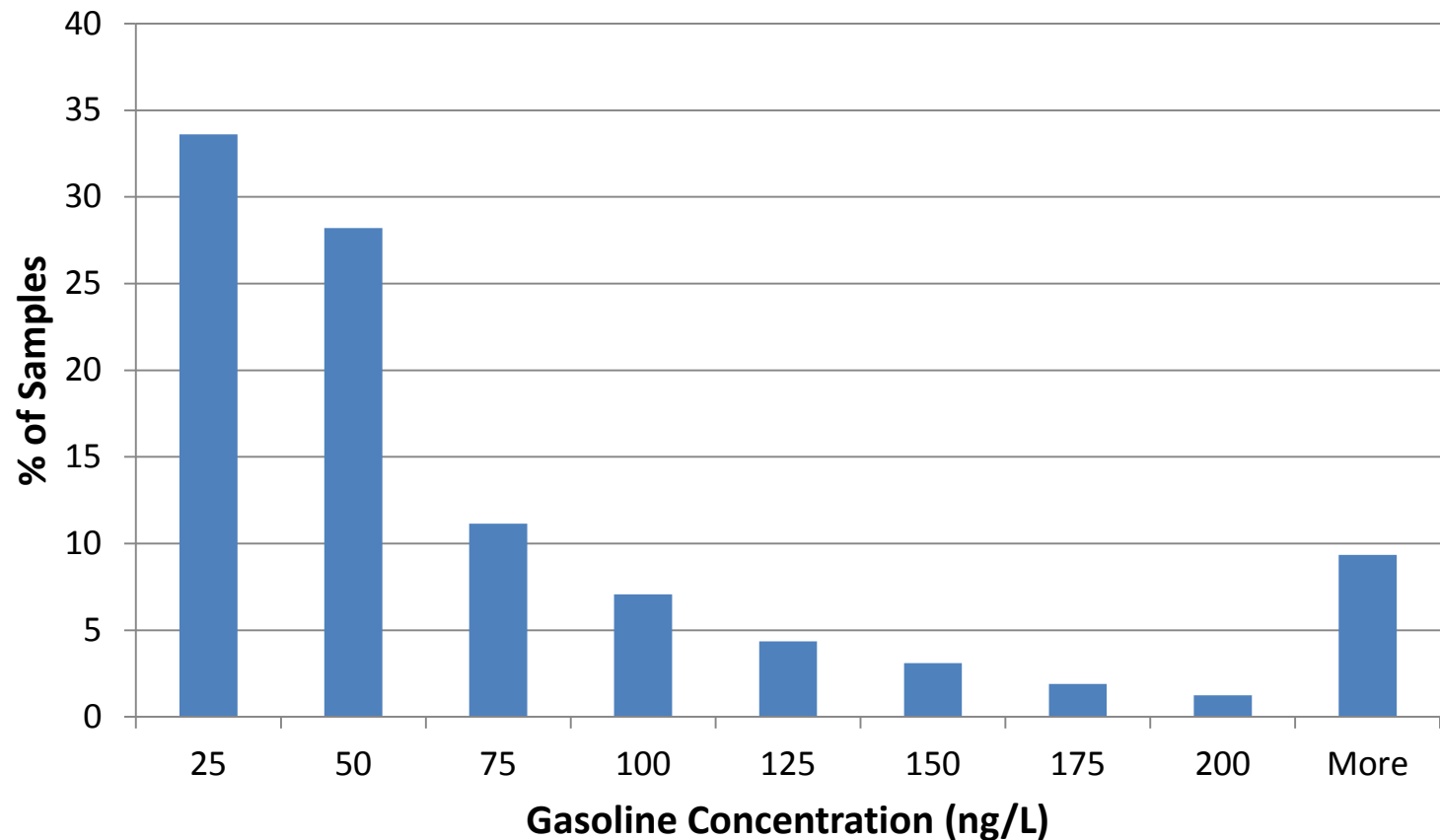
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Mixed – Gasoline

- Median 36 ng/L

- Mean 89 ng/L



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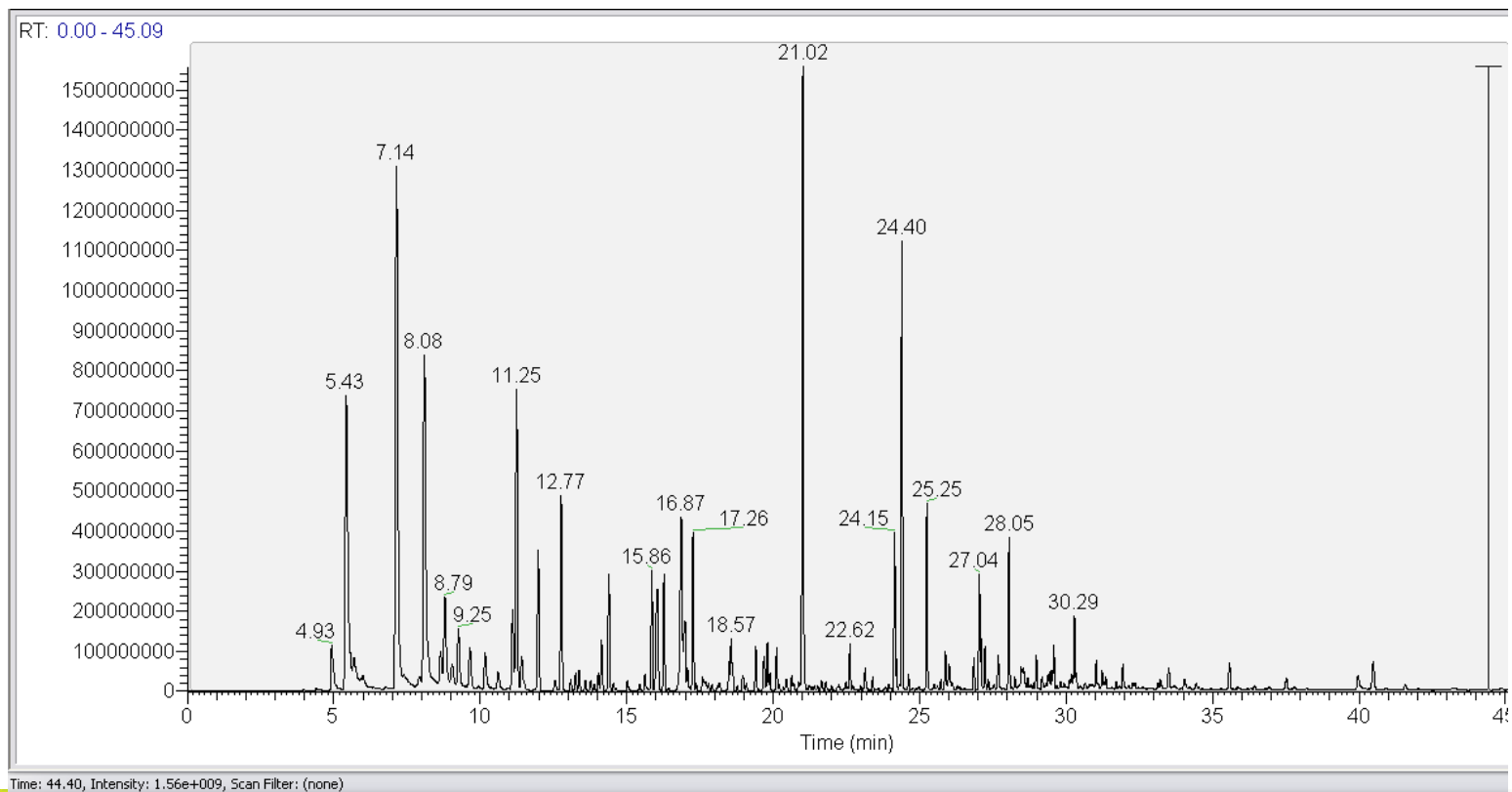
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Mixed – Gasoline

- 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



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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



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References

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