EHST 3700: Industrial Hygiene
Environmental Health Sciences Program
Department of Health Education and Promotion
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N-Octane

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Chemical Description

- Appears as a colorless liquid with a gasoline-like smell
- Hydrocarbon straight-chain alkane, 8 carbon chain with 18 hydrogen atoms.
- Exists as many isomers depending on branching in hydrocarbon chain
- Characterized by volatility and extreme flammability
- Also known as Octane

Figure 1. 3D Visualization of n-Octane
https://www.google.com/url?sa=i&url=https%3A%2F%2Fen.wikipedia.org%2Fwiki%2FOctane&psig=AOvVaw3_f584K6dxPBcw2n9QOpFE&ust=1712022850153000&source=images&cd=vfe&opi=89978449&ved=0CBIQjRxqFwoTCPiXya_0n4UDFQAAAAAdAAAAABAJ

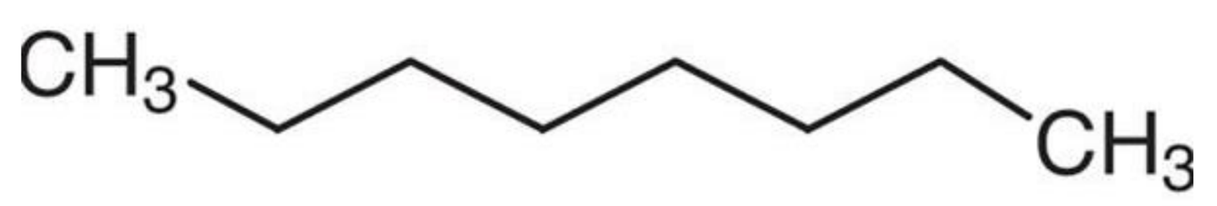


Figure 2.Structural Formula of n-Octane
https://labproinc.com/cdn/shop/products/o0151.jpg?v=1634117108

Occupational Uses

Primarily used as a gasoline additive:

- Reduces engine knock, or a mistimed and asymmetrical ignition by increasing required ignition pressure.
- Origin of the term "high octane fuel"

Also used as

- Industrial solvents
- Degreaser
- Rockets as a propellant
- Component in organic compound synthesis
- Component of adhesives for elastomers and plastics

Occupational Exposure

Workers in proximity to fossil fuels:

- Auto workers
- Truck drivers
- Gas station attendants, fuel refinery workers

Other types of workers

- Lab technicians
- Maintenance workers (cleaning and degreasing)
- Painting and Coating workers

Routes of Exposure:

- Inhalation (vapors), skin contact (poor hygiene), eye contact (vapors, poor hygiene, or splashes), ingestion (poor hygiene)

Figure 3. Mechanic working on an engine that may be exposed to n-Octane
https://www.military.com/off-duty/autos/auto-repair-major-engine-components.html

Toxicological Data

Health Effects

- Inhalation: Irritation of nose, throat, lungs, targets nervous system
- Skin and eye contact: irritation
- Prolonged skin exposure: cracking and drying of skin, redness and rash (dermatitis)
- Can be fatal if ingested, significantly more toxic
- Chemical pneumonitis
- Not carcinogenic
- No delineated fatal dose, estimated at 13,500PPM

Epidemiological Studies

A NIOSH study examined n-octane exposures in different occupations.

- More than 9000 workers in the US are potentially exposed to n-octane
- Most common exposure from occupations take place in auto shops, hydrocarbon refineries, and manufacturing requiring the vulcanization of rubber.
- Excess exposure can lead to headaches, dizziness, confusion, drowsiness, and unconsciousness, paralysis, convulsions, and death.
- Death from n-octane is from cardiac arrest, asphyxia, or respiratory paralysis (narcotic and anesthetic effects)

Occupational Exposure Limits (OELs)

- OSHA PEL (Permissible Exposure Limit)
  - 8 Hour TWA: 500PPM
- NIOSH REL (Recommendatory Exposure Limit)
  - 10 Hour TWA: 75PPM
  - 15 Minute Ceiling: 385PPM
- ACGIH TLV (Threshold Limit Value)
  - 8 Hour TWA: 300PPM
- OSHA Construction and Maritime PEL (Permissible Exposure Limit)
  - 8 Hour TWA: 400PPM

Sampling Methods

N-Octane sampling follows the methods of several other chemicals in the OSHA Organic Vapor Sampling Group 1 (OVSG-1). The method (#5000) involves the use of a coconut shell charcoal sorbent tube. The sampling train is composed of a sampling pump, flexible tubing. and the sorbent tube.

- 240 minutes at 50ml/minute.
- After sampling, the tubes must be capped and are refrigerated as a precaution.
- Before analysis, the samples are extracted from the tube by adding them to a solution of carbon disulfide.

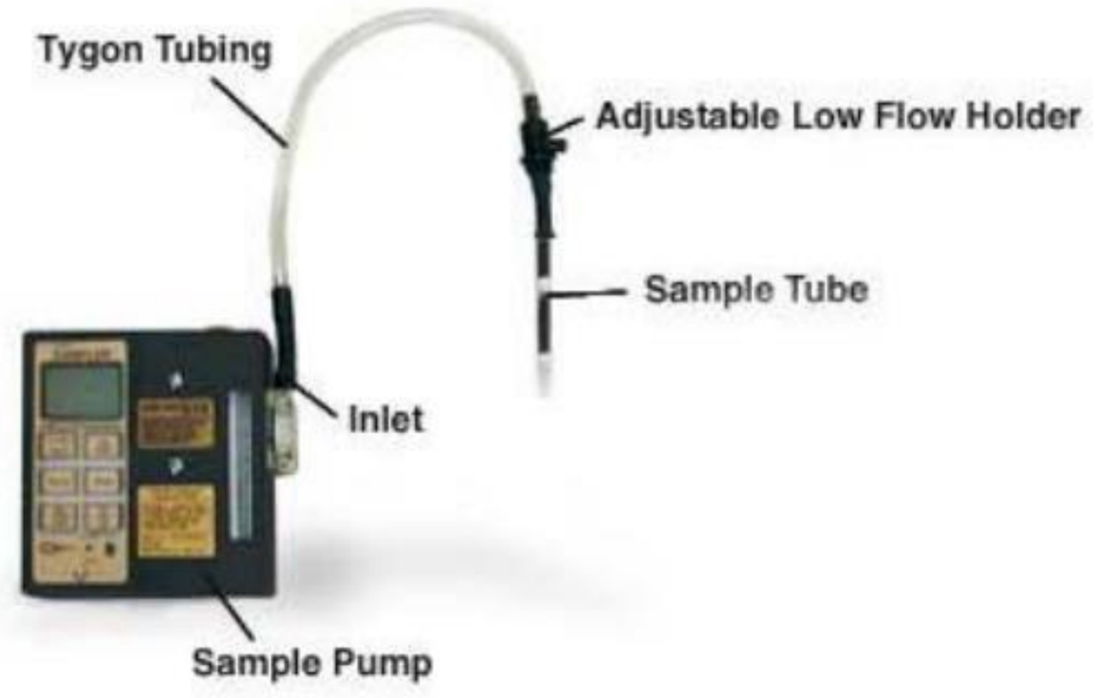


Figure 4. Sampling setup for n-Octane
https://www.google.com/url?sa=i&url=http%3A%2F%2Fwww.fortordcleanup.com%2Far_pdfs%2FAR-OE-0404Q%2FAppendixes%2FAPPENDIX_N.pdf&psig=AOvVaw3isX_YdH77eC1Slkjo6cEg&ust=1711588858476000&source=images&cd=vfe&opi=89978449&ved=0CBQQjhxqFwoTCKiH8sGjk4UDFQAAAAAdAAAAABAE

Analytical Methods

The primary instruments for analysis are gas chromatography with flame ionization detectors. They each have their own parameters for running the samples.

Gas Chromatography:

- Carrier Gas: Hydrogen
- Run time: 14.99 minutes
- Inlet temperature: 250 °C
- Retention time: 6.88 minutes

Flame Ionization Detector:

- Hydrogen Flow: 30mL/minute
- Air flow: 400mL/minute
- Detector temperature: 250°C
- Nitrogen make up flow: 25mL/minute

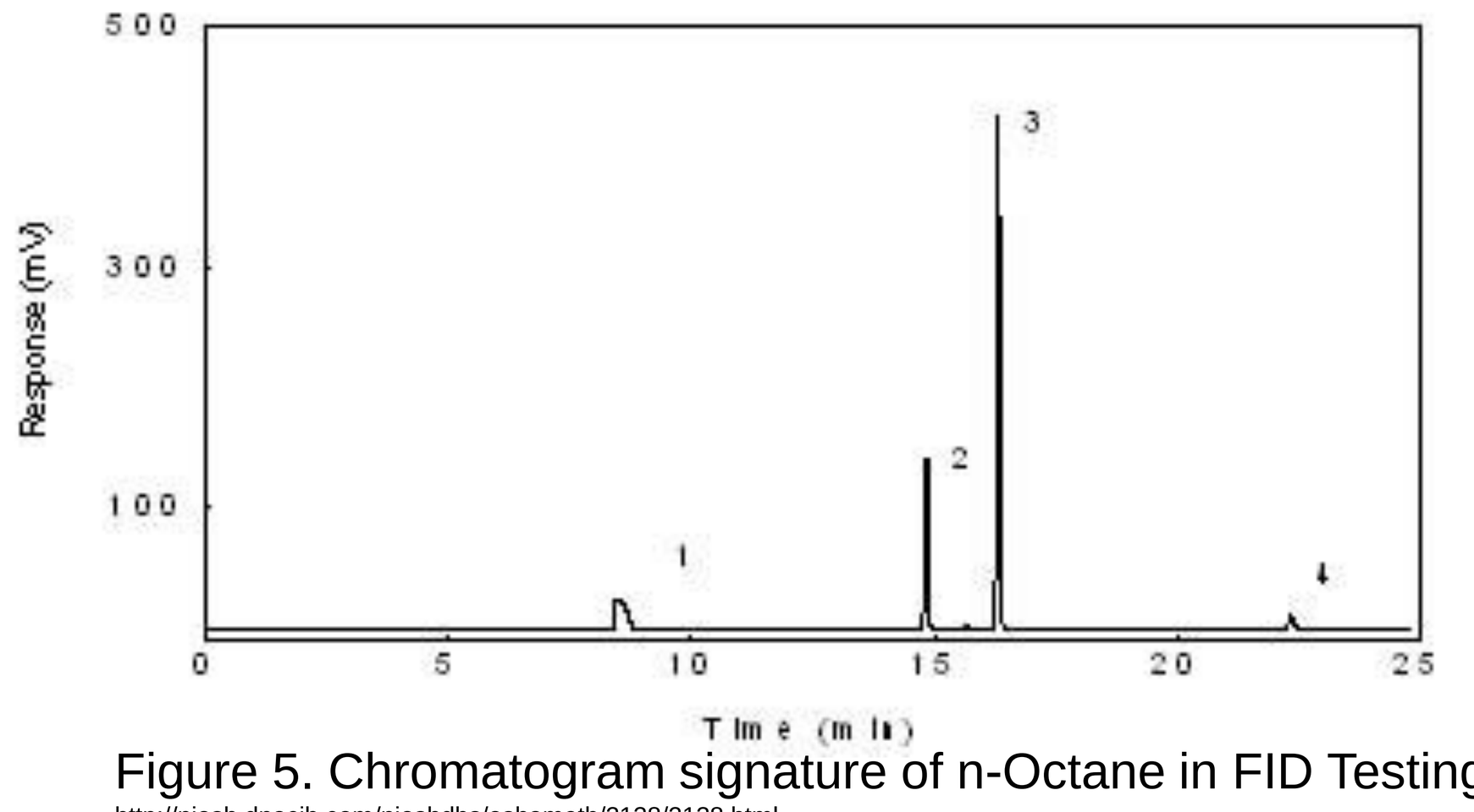


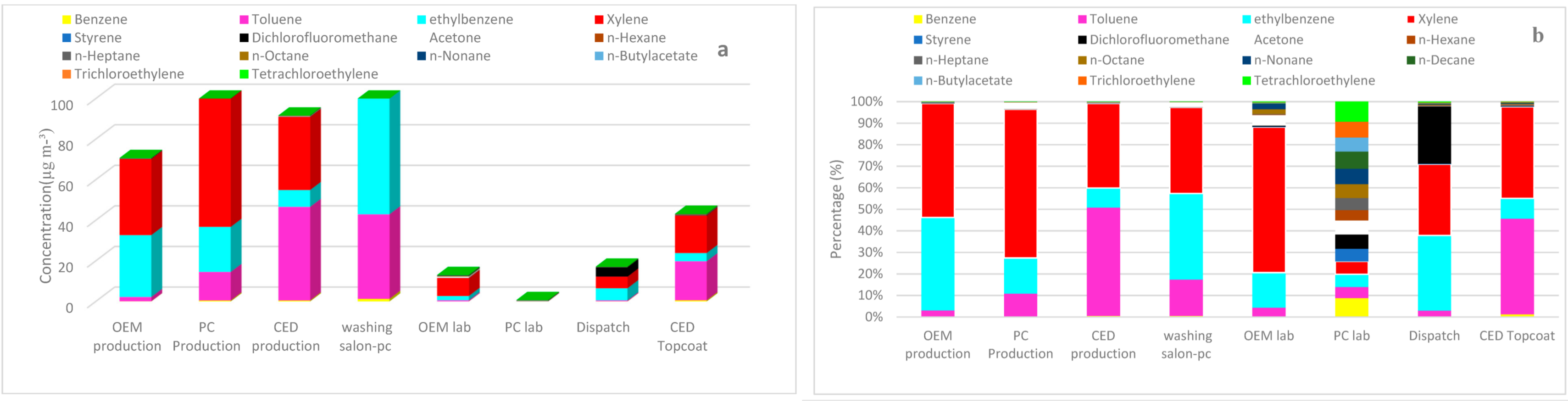
Figure 5. Chromatogram signature of n-Octane in FID Testing
http://niosh.dnacih.com/nioshdbs/oshameth/2138/2138.html

Case Study

A study was conducted at 2 different paint plants in Iran, many VOC's, including n-octane, are used as solvents in the process. Air sampling was conducted with activated carbon sorbent tubes.

- Contaminants included ethylbenzene, acetone, benzene, toluene, m,p-xylene, n-heptane, and others.
- Many exposures in parts of the factory were under carcinogenic limits, but the combined exposures may produce synergistic effects.
- Workers exposed throughout the day experienced decreased motivation and increased mental fatigue.
- Carcinogenic exposures were significantly above carcinogenic LTCR (lifetime cancer risk) values.
- Highlights the need to eliminate or reduce VOCs (like n-octane) from paint and it's manufacturing.

Figure 6a. Breakdown of exposure to n-octane and other VOC's in different sections of paint plant by concentration
Figure 6b. Distribution of VOC makeup in each section of the paint plant
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9961358/



Control Measures

- Engineering
  - Enclose processes involving n-octane
  - Use local exhaust and general ventilation
- Administrative
  - Train workers
  - Worker rotation
- PPE
  - Respirators
  - Eye protection (goggles)
  - Gloves

Figure 7. Chemical Fume Hood, a Local Exhaust Ventilation Method used as a control strategy
https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.sentryair.com%2Fblog%2Findustry-applications%2Fchemical-solvents%2Freducing-hazardous-exposure-to-organic-solvents%2F&psig=AOvVaw3OPTumUeRlQHvfV9j0htM7&ust=1711901008449000&source=images&cd=vfe&opi=89978449&ved=0CBQQjhxqFwoTCKDmw7GunIUDFQAAAAAdAAAAABAS

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- NJ Health Octane Hazardous Substance Fact Sheet https://nj.gov/health/eoh/rtkweb/documents/fs/1434.pdf
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