Title

Biological effects of inhaled crude oil vapor. II. Automated oil vapor inhalation exposure system-Dataset

Introductory Information

In August 2020 there were over 186,000 employees in the oil and gas extraction industry in the United States (United States Department of Labor. Bureau of Labor Statistics, 2020). Many workers in the upstream oil extraction industry have potential risk of crude oil vapor (COV) inhalation. There are many current knowledge gaps regarding the health effects from inhalation of complex mixtures found in crude oil vapors. To aid research in filling these gaps, an automated system that could carefully deliver and control the COV concentration within an animal inhalation exposure chamber was needed. The objective of this project was to develop an automated computer-controlled system to expose small laboratory animals to precise concentrations of crude oil vapor (COV).

Methods Collection

- Heated crude oil (85 F) was fed to an atomizer by a syringe pump.
- Heated (85 F) dilution air (40 L/min) was mixed with the oil mist from the atomizer.
- To achieve constant relative humidity, custom software set the ratio of dilution air that passed over a heater water bath or bypassed it.
- The oil droplet air mixture was fed into a 1-inch diameter PTFE tube.
- Particle filters removed the droplets after the PTFE tube.
- Particle free COV entered the top of an exposure chamber and exited the bottom.
- The total volatile organic compounds (TVOC) gas concentration was measured inside the exposure chamber with continuous samples by a flame ionizing detector.
- Adjustments were made automatically to the oil injection flow entering the atomizer via custom control software.
- The TVOC monitor was calibrated using benzene, toluene, ethylbenzene and xylene (BTEX) gas as a standard.
- A GC-FID instrument was used to collected additional data on the gas mixture during inhalation exposures.
- Exposure chamber pressure was monitored with a pressure transducer.
- Exposure chamber pressure was automatically maintained at 0 by setting the amount of chamber exhaust air with a mass flow controller hooked to lab. vacuum.
- Exposure chamber temperature and relative humidity was monitored with a probe inside the chamber.
- Exposure chamber CO_2 was monitored with a probe placed in the exposure chamber's exhaust air.
- The custom software automatically controlled TVOC gas concentration, chamber pressure, relative humidity and exposure duration during exposure runs.
- Animal exposures lasting 1 day or 16 days were conducted at a target TVOC gas concentration of 300 PPM, with daily exposure runs lasting 6 hours.

Citations – Publications based on the dataset

Walter McKinney, Mark C. Jackson, Brandon Law & Jeffrey S. Fedan (2022): Automated crude oil vapor inhalation exposure system, Inhalation Toxicology, DOI:10.1080/08958378.2022.2114562

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