Nitric Oxide

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Occupational Uses

- OSHA also says that nitric oxide can come from "Combustion products from gas furnaces and appliances; tobacco smoke, welding, and gas- and diesel-engine exhausts"[1].

Figure 1: Nitric Oxide cylinders [6]

Occupational Exposure

Nitric oxide can be an intermediate produced for industrial uses. Those that work in or near coal plants or those that live in areas with higher motor vehicle traffic are likely to be exposed to higher levels of nitric oxide.

Toxicological Data

Since Nitric oxide is a gas, its main route of exposure is inhalation. However, the ATSDR also notes, "exposure by any route can cause systemic effects"[2]. OSHA states that "*Acute health effects:* Eye, respiratory, and mucous membrane irritation"[1]. As for chronic health effects, there are several listed. These include cancers and pulmonary problems. In 1977 it was discovered that nitric oxide had harmful effects on the body.

Epidemiological Studies

- There are a lot of studies on nitric oxide, many of which have to do with its nutritional side. I did find a study that was titled, "Post-exposure persistence of nitric oxide upregulation in skin cells irradiated by UV-A "[2]. This study focuses on "Evidence suggests that exposure to UV-A radiation can liberate nitric oxide from skin cells eliciting vasodilation in-vivo"[2]. This study also talks about how this could be beneficial in some cases. While there is also a possible risk of having a prolonged release duration of Nitric Oxide.
- There are also some epidemiological studies about how nitric oxide can be nutritionally good for the body.

Sampling Methods

- For the collection device OSHA explains, "The sampling device consists of 1) Two glass tubes which contain triethanolamine-impregnated molecular sieve, 2) A middle tube which contains an oxidizer and 3) A personal sampling pump is used to draw a measured volume of air through the tubes"[3].
- This would technically be considered air sampling. OSHA does note that there have been other methods in the past but, this is the one they use now. This sampling would be done in the worker's breathing zone. OSHA also lists the recommended sampling rate at 0.025L/min and the recommended maximum air volume at 6L. [3]
- NIOSH for collection explains, "SAMPLER: PORTABLE DIRECT-READING INSTRUMENT (with filter, if required) FLOW RATE: ~0.1 L/min to ~20 L/min (system-dependent) VOL-MIN: Instrument dependent -MAX: None"[4].

Analytical Methods

- One journal says that the typical method of analytics is, "An analytical method to identify a nitrogen source for NO generation was developed using liquid chromatography with tandem mass spectrometry in combination with stable isotope labeling"[9].
- Gas chromatography could also be used.

Occupational Exposure Limits (OELs)

- NIOSH has a REL of 25 ppm.
- [4] OSHA's PEL is also 25 ppm [3].
- ACGIH has a TWA of 25 ppm.
- No action limit was identified.

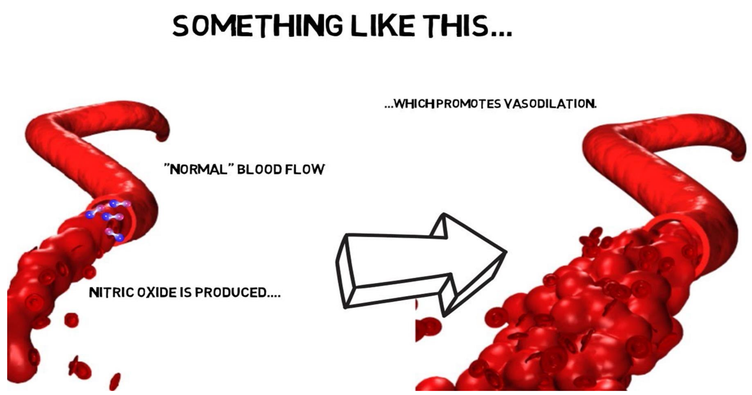

Figure 2. What happens to blood vessels when Nitric Oxide is produced [7]

Case Study

- Done by the U.S. Chemical and Safety Hazard Investigation Board
- Describes an explosion in a cryogenic nitric oxide (NO) distillation process at the Isotec facility in Miami Township, Ohio"[8].
- This event took place in 2003, many people had to be evacuated but, thankfully only one employee was injured.
- Nitric Oxide was mixed with air to become Nitrogen Dioxide. This was caused by a leak in the ventilation system. A reddish-brown cloud was able to be seen.
- About three hours later due to a combination of the leak and the pressure/heat an explosion occurred.
- There was a 1-mile radius evacuation zone.

Control Measures

- Engineering controls for nitric oxide could be something like a leak detection system to be notified if there has been a leak in the storage location. Another engineering control could be ventilation. A material safety data sheet recommends, "Local exhaust ventilation is preferred because it prevents dispersion of this gas into the workplace by eliminating it at its source "[5].
- Administrative controls can include things like worker rotation and limiting exposure to nitric oxide. Both of these would reduce the risk for workers. Specifically, "Nitric Oxide cylinders should be placed in a ventilated gas cabinet'[5]. This would be an effective administrative control to protect workers.
- PPE is personal protective equipment. These are things like masks and safety glasses that keep workers safe. PPE for nitric oxide includes work gloves/ neoprene gloves when working with it as well as chemical-resistant protective clothing.

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