A168 Odor Availability and Its Effect on Canine Detection of Explosives

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The goal of the presentation is to familiarize the audience with the canine detection of explosives by discussing the available odor of explosives and the factors that govern the amount of explosive vapor.

This presentation will impact the forensic science community by improving knowledge about explosives-detecting canines so that canine trainers and handlers can more effectively train, evaluate, and utilize these assets.

Trained canines are commonly used as biological detectors for explosives; however there are some areas of uncertainty that have led to difficulties in training and canine testing. The odor available to canines depends upon multiple factors which include explosive vapor pressure, the rate with which the explosive vapor is transported from its source, the extent to which the explosive degrades into more (or less) volatile substances and the degree to which the explosive is confined. To better understand odor availability, experiments with varying amounts of pure nitroalkanes (nitromethane, nitroethane and nitropropane) was completed by simple headspace GC/MS. The results demonstrated that once the headspace of the container is saturated any subsequent increase in sample volume will not result in the release of more vapor. This was predicted by the ideal gas law and the vapor pressure and densities of the nitroalkanes can be used as a predictive model for odor availability. For example, the minimum amount of nitromethane needed to saturate a 20 mL volume is only 2.3 µL. This model can also be used for other compounds in containers used for canine training and testing (e.g., two ounce sniffer tins as well as quart size and gallon size tin cans). The effect of temperature was also explored showing that increased temperature resulted in an increase of vapor within the headspace of a container.

Additional experiments were completed with the use of the container within a container method utilized for testing canines, in which a two ounce tin can is placed inside a quart size can and then placed inside a gallon sized paint can. The two ounce tin can had a perforated lid and this perforation was varied to demonstrate how confinement affected the amount of vapor released. This was completed by the measurement of mass loss with an analytical balance. The mass loss recorded over time aided in the determination of the evaporation rate and the subsequent flux of the nitroalkane's vapor. Preliminary results indicated that confinement directly affected the amount of odor available. The mass loss was measured and recorded, over a period of time, directly from a quart size can which aided in the determination of the concentration of vapor present. Analysis via headspace GC/MS was completed to complement the gravimetric measurements. As stated above, the minimum amount of a pure liquid needed to saturate the headspace is easily determined with different sized containers and the subsequent increase of volume will result in the same amount of vapor released at room temperature.

Further experimentation with solutions of nitroalkanes in water via simple headspace GC/MS was conducted. This study demonstrated the effect of sample volume (and hence phase ratio (β)) on headspace concentrations. It was predicted that since nitromethane is volatile it will be more abundant in the headspace with increasing sample volume as opposed to nitroethane and nitropropane, which will diminish in relative abundance. The effect of temperature was also analyzed with nitroalkane solutions and it was predicted that the semi-volatile nitroethane and nitropropane will increase in relative abundance with increase of temperature.

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