Method for Controlled Odor Delivery in Canine Olfactory Testing

Kelvin J. Frank*[1], Kenneth G. Furton[1], Howard K. Holness[1]

Alison G. Simon[2]

Kimberly Peranich[3]

Lauryn E. DeGreeff[4]

[1]*Florida International University Chemistry Department, Miami, FL*

[2]*Former National Research Council Postdoctoral fellow, Washington, D.C.*

[3]*Naval Surface Warfare Center, Indian Head EOD Technology Division, Indian Head, MD*

[4]*Chemistry Division, U.S. Naval Research Laboratory, Washington, D.C.*

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Research Motivation

- A major limitation in canine olfactory research is the lack of current methods for controlling odor availability during canine research trials or operational testing.
- Permeation tubes are often used in laboratory settings to release constant, quantifiable amounts of a vapor for analytical purposes.
  - Requires closely controlled airflow and temperature
  - Not practical for canine olfactory field testing
- A controlled, field adaptable and portable system is desirable

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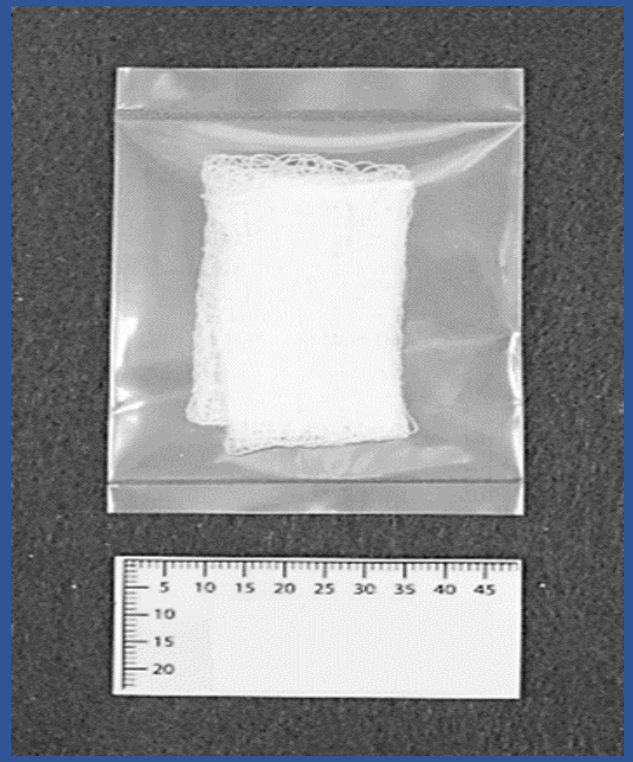
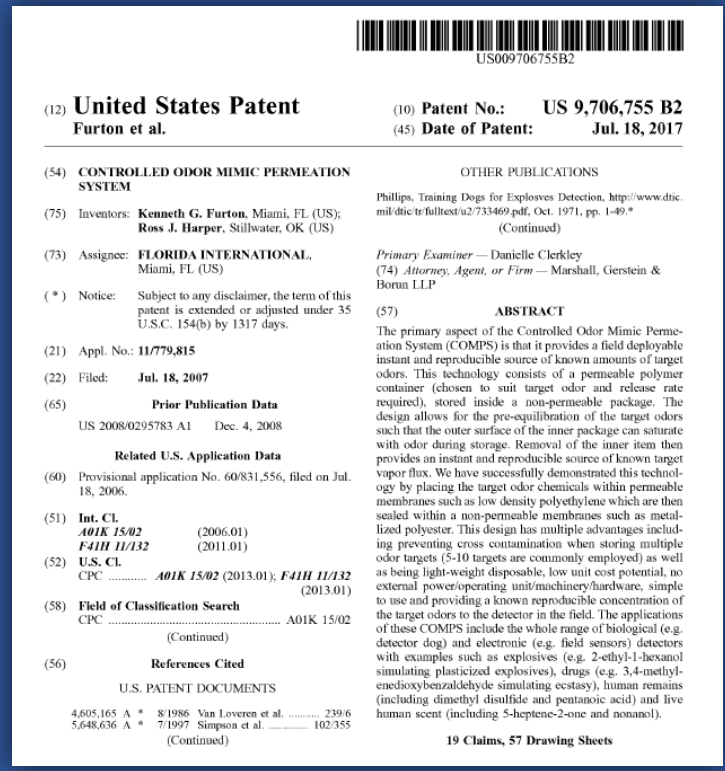
Controlled Odor Mimic Permeation System (COMPS)



Simon, Alison G., et al. "A method for controlled odor delivery in olfactory field-testing." *Chemical senses* (2019).

- Analyte of interest spiked onto sorbent material sealed within a permeable polymer bag
- Permeable bag thickness can be adjusted to control odor concentration delivered
- Delivers known amount of odor at controllable and reproducible levels
- Can be used over multiple training sessions yielding consistent levels of odor
- Other benefits: simple design, disposable, inexpensive



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Furton et al.

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(45) **Date of Patent: Jul. 18, 2017**

(54) **CONTROLLED ODOR MIMIC PERMEATION SYSTEM**

(75) Inventors: **Kenneth G. Furton**, Miami, FL (US); **Ross J. Harper**, Stillwater, OK (US)

(73) Assignee: **FLORIDA INTERNATIONAL**, Miami, FL (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 1317 days.

(21) Appl. No.: **11/779,815**

(22) Filed: **Jul. 18, 2007**

(65) **Prior Publication Data**

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Related U.S. Application Data

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A01K 15/02 (2006.01)
F41H 11/132 (2011.01)

(52) **U.S. Cl.**
CPC ***A01K 15/02*** (2013.01); ***F41H 11/132*** (2013.01)

(58) **Field of Classification Search**
CPC A01K 15/02
(Continued)

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,605,165 A * 8/1986 Van Loveren et al. 239/6
5,648,636 A * 7/1997 Simpson et al. 102/355
(Continued)

OTHER PUBLICATIONS

Phillips, Training Dogs for Explosves Detection, http://www.dtic.mil/dtic/tr/fulltext/u2/733469.pdf, Oct. 1971, pp. 1-49.*
(Continued)

Primary Examiner — Danielle Clerkley
(74) *Attorney, Agent, or Firm* — Marshall, Gerstein & Borun LLP

(57) **ABSTRACT**

The primary aspect of the Controlled Odor Mimic Permeation System (COMPS) is that it provides a field deployable instant and reproducible source of known amounts of target odors. This technology consists of a permeable polymer container (chosen to suit target odor and release rate required), stored inside a non-permeable package. The design allows for the pre-equilibration of the target odors such that the outer surface of the inner package can saturate with odor during storage. Removal of the inner item then provides an instant and reproducible source of known target vapor flux. We have successfully demonstrated this technology by placing the target odor chemicals within permeable membranes such as low density polyethylene which are then sealed within a non-permeable membranes such as metallized polyester. This design has multiple advantages including preventing cross contamination when storing multiple odor targets (5-10 targets are commonly employed) as well as being light-weight disposable, low unit cost potential, no external power/operating unit/machinery/hardware, simple to use and providing a known reproducible concentration of the target odors to the detector in the field. The applications of these COMPS include the whole range of biological (e.g. detector dog) and electronic (e.g. field sensors) detectors with examples such as explosives (e.g. 2-ethyl-1-hexanol simulating plasticized explosives), drugs (e.g. 3,4-methylenedioxybenzaldehyde simulating ecstasy), human remains (including dimethyl disulfide and pentanoic acid) and live human scent (including 5-heptene-2-one and nonanol).

19 Claims, 57 Drawing Sheets

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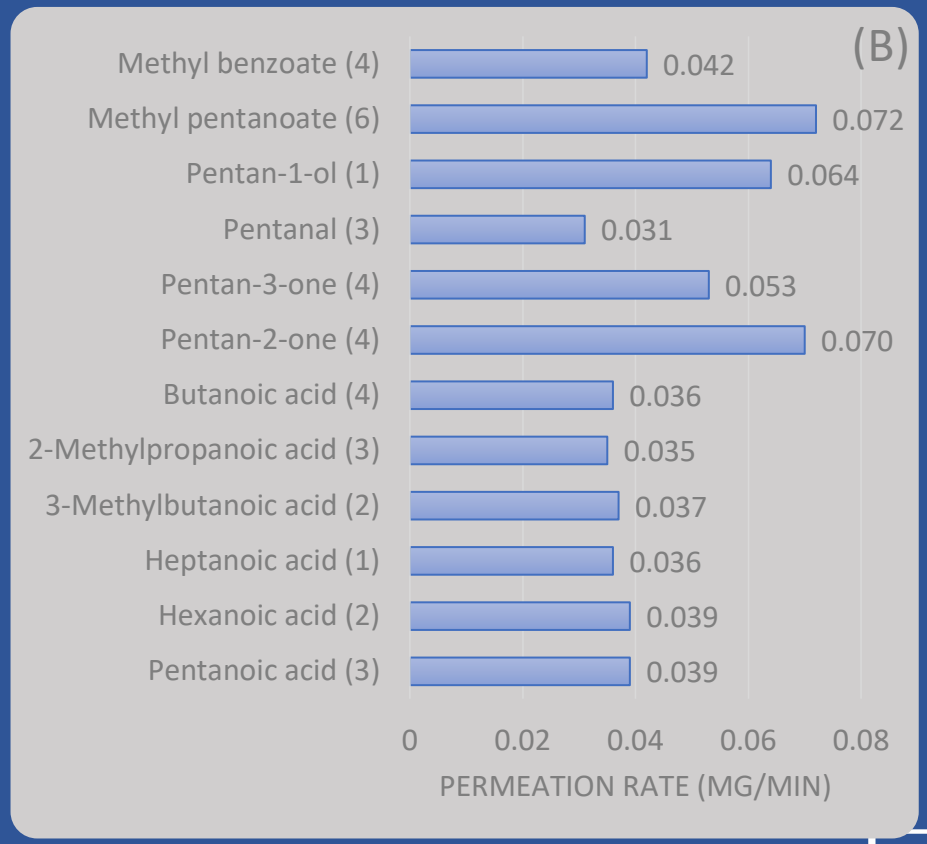
Control Odor Concentration from Compounds of Varying Vapor Pressures

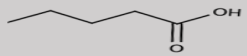
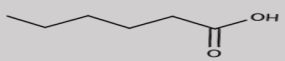
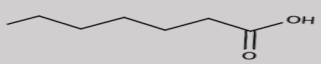
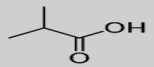
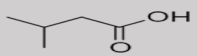
- 12 compounds of varying vapor pressures selected for field testing
- Thickness of COMPS adjusted to control the amount of odor
- COMPS allow compounds to achieve increasingly similar rates of permeation



Proof-Of-Concept: Canine Olfactory Testing

Discrimination of molecularly-similar compounds

- Tested discrimination between carboxylic acids of varying chain length and confirmation
- Target odor: pentanoic acid
- Training odors:

Compound	Structure	Vapor pressure (mmHg at 25°C)
Pentanoic acid		0.196
Hexanoic acid		0.0435
Heptanoic acid		0.0107
3-Methylbutanoic acid		0.44
2-Methylpropanoic acid		1.81
Butanoic acid		1.65