

Odor Detection Threshold Study

Description: A study to perform state-of-the-art assessment of population detection and readily detectable thresholds of natural gas odorants.

Status: Project underway. Olfactometer testing to gather information in controlled conditions designed to represent the full population.

BENEFITS

Odorization of natural gas is considered one of the most significant public health advances of the 20th century and has shown to be the optimal method to warn of a natural gas leak. However, updated odor threshold data can result in more informed decisions about human detectability of gas odorants and potentially provide more information to optimize the type of odorants used as well as the odorant injection levels.

BACKGROUND

Recent gas quality research projects and the changing sources of natural gas have identified the need to further quantify human variability in detecting mercaptans. Given that need, NYSEARCH sought out experts in olfaction science and have learned that there is new methodology that provides very precise measurements of olfactory detection. These methods have led to a better understanding of the genetic and anatomical variability of odor response in the human population which is relevant to organic sulfur compounds and therefore to thresholds for detection of natural gas odorants.

The gas industry definition for the “threshold detection level” is the concentration of odorant in air where a change in odor is first perceived. Additionally, the “readily detectable threshold level” is the concentration of odorant where recognition of the odor is achieved. These detection levels are important because industry safety standards require that natural gas contains a sufficient level of odorant so that it is readily detectable by a person with a “normal sense of

smell” at a level of gas in air of 1/5 the Lower Explosive Limit (LEL) or approximately 1% gas in air.

TECHNICAL APPROACH

With help from gas company subject matter experts, NYSEARCH issued an RFP that sought a study to quantify the threshold detection and readily detectable levels for 95% of the population for t-butyl Mercaptan (TBM), Tetrahydrothiophene (THT), a blend of TBM/THT, and other organosulfur compounds.



Figure 1: Example Setup for Olfactometer Test

After an evaluation, NYSEARCH funders have selected Monell Chemical Senses Center to conduct Phase I of what could become a multi-phase study. The overall objective of the project is to complete a comprehensive literature review of the state-of-the-art methodology to measure natural gas odorant compounds and blends and to update the measurement of detection and readily detectable (recognition) thresholds.

As selected by the funding companies, this work is being performed on TBM, THT, and a 50/50 blend of THT/TBM. The selected compounds and blend are being presented to a diverse group of participants in order to fully characterize the response of the population.



Figure 2: 6-person Olfactometer Test Setup

An extensive olfactory test program is being conducted to achieve statistically significant data for precise concentrations of the two odorant compounds and the odorant blend. Using state of the art olfactometry equipment, multiple individuals can be tested simultaneously. See figure 2 for details. Once a participant's detection threshold has been confidently characterized, they will be subjected to a number of "distractors," which are other odors that do not smell like natural gas. The goal is to determine not only the threshold of odor detection, but also the effectiveness on recognition of each odorant and blend.

Data collected throughout the testing will provide information about the proportion of the population that can detect and recognize the odor at different levels of confidence. With this data acquired in controlled conditions, risk analysis can be performed.

If the methodology proves sound and the funders agree to continue research, Phase I of the study will be expanded to include additional odorant compounds and blends. The objective is to create a functional database of human responses to commonly used odorant compounds and blends.

Pending favorable results from Phase I, future phases of this effort could include studies and testing to examine the odorant threshold in more complex conditions such as in residential and industrial spaces.

PROGRAM STATUS

Odor detection and recognition threshold testing of TBM, THT, and a 50/50 mixture of the two compounds is underway at Monell Chemical Senses Center in Philadelphia, PA. Participants are being exposed to a range of concentrations throughout each testing session in order to characterize their responses to each odor. The testing protocol was informed by the historical research conducted at the onset of the project as well as contemporary scientific best practices.

Highlights

Assess odor detection threshold of mercaptans

Characterizes the response of 95% of the population

Creating a database of human responses to commonly used odorant compounds and blends

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