

Toluene And The Intoxilyzer 5000[®]: No Response To Concentrations Found On Human Breath

P. L. Glover

Forensic Tests for Alcohol Branch, North Carolina Department of Health and Human Services, 1922 Mail Service Center, Raleigh, North Carolina, 27699-1922, USA.

Abstract

The response of the Intoxilyzer 5000[®] (series 66, 3 filter) to known amounts of ethanol vapor, toluene vapor and a mixture of ethanol and toluene vapors was determined. The ethanol concentration approximates a Breath Alcohol Concentration (BrAC) of 0.08 gm/210 L. The toluene concentration used was approximately 5 times that reported to be found on the breath of test subjects 30 minutes post exposure. There was no response by the Intoxilyzer to the toluene alone and there was no added response to the ethanol/toluene mixture response over that of ethanol alone.

Introduction

The possibility of other substances contributing in one way or another to a BrAC has been a concern raised primarily by the defense community. There have been various attempts to measure or calculate the possible effect of some compounds on an alcohol breath test (1-5). One of the more flawed assumptions made in many of these studies is that the compounds studied behave in the same way that ethanol does in the human body. Toluene is one of the most widely used hydrocarbons in the world and as such, exposure to it has been a popular explanation by defense strategists for a client's breath result. We undertook this study for many reasons. We wanted to resolve the issue of toluene and the Intoxilyzer (presently approved for use in North Carolina), and design a method that could easily be employed by other states to test both this compound and others with minimal expense.

Methods

An Intoxilyzer 5000[®] (series 66, 3 filter) breath test instrument was used to analyze the gases utilized in this study. The Intoxilyzer 5000 employs the absorption of infrared light at specific wave lengths as the means of quantitating the amount of ethanol present in a sample. The gases were delivered to the instrument through the breath sample tube at a flow rate of 10 liters per minute and at pressure sufficient to activate the pressure sensing switch. An inline flow meter was used to insure a consistent flow rate. The test sequence used was: Air blank, Breath sample (Gas sample), Air blank, Breath sample (Gas sample), Air blank (ABABA). The instrument received factory authorized electronic calibration prior to these experiments. The calibration was verified before, during and after these tests with a wet bath simulator corresponding to 0.08 BrAC. The display was set so that the results were not visible during the sample administration. The gas was delivered until three seconds after the asterisk was displayed which indicated that the time and pressure requirements of the instrument had been satisfied. Results were reported to the third digit (0.001 grams/210L)

and printed out. During the Air Blank cycle the gas was turned off and an inline "y" connector allowed the introduction of room air without disconnecting the gas tank. During the breath or gas delivery cycle, the "y" connector was occluded to ensure proper gas delivery. Exhaust from the instrument was filtered to avoid contamination of the room air.

Since toluene is insoluble in water a certified gas was chosen as the means of delivering a known concentration of the test gas. Others (4) have used non water solvents in wet bath simulators however it was felt that a certified gas was simpler and more accurate.

Tanks of ethanol (201.4 ppm) in nitrogen; toluene (10.44 ppm) in nitrogen; and a mixture of ethanol (201.4 ppm) and toluene (10.3 ppm) in nitrogen were purchased from Scott Specialty Gases (Durham, NC). Gas pressures were reduced via a high pressure single stage regulator. All gases were Certified Master Class by the manufacturer.

50 gas samples were analyzed for each gas and the mean and standard deviation for each group of measurements was calculated.

Results

The results of the analyses of the test gases are reported in Table 1.

Table 1: Response of the Intoxilyzer 5000® (series 66, 3 filter) to toluene gas, ethanol gas and a mixture of ethanol gas and toluene gas.

Gas	Response (gms/210L)
Toluene (10.44 ppm)	0.000
Ethanol (201.4 ppm)	0.0799 ± 0.0010
Ethanol (201.4 ppm) Toluene (10.3 ppm)	0.0800 ± 0.0008

The toluene gas alone gave a response of 0.000 on all tests and consequently no standard deviation was calculated. Student's T test applied to these results indicates that the difference between the response to the ethanol gas and the response to the gas mixture was insignificant at the 0.05 level.

Discussion

In judicial proceedings, defense attorneys have always challenged the breath test results used in Driving While Impaired (DWI) charges. With nationwide and worldwide decreases in per se limits and with increases in punishment, the challenges have also increased.

Over the years there have been attempts to resolve the issue of the possible involvement of various inhaled substances as they relate to BrAC testing. In several tests, subjects were used who were either unsupervised prior to exposure or during exposure, or exposed to mixtures of compounds for which no composition was given or known. Exposures to other compounds outside of the "experimental" setting were not documented and findings were vague: i.e. reports of "alcohol" being found without identifying which alcohol was found (1,2). Another

set of studies tended to show that inhalation of volatiles did not affect the BrAC test (5) or had insignificant impact (3). Once again exposure was unclear since the subjects in ImObersteg's test wore vapor masks and the subjects in Denney's test were exposed to a mixture of compounds and exhaled compounds were not identified.

In 1997 Caldwell and Kim (4) reported that toluene did have an effect on the Intoxilyzer 5000® (series 66, 3 filter). A review of their paper and personal communication revealed that their reported "breath" values were in fact not breath measurements but rather calculated values based on blood concentrations reported by others. Furthermore, except for the two lowest concentrations used, their test concentrations were far in excess of those reported to be found on human breath.

The number of comprehensive studies that directly involve breath testing instruments and inhaled substances have been limited. In a series of papers in 1991, Gill et al (6-8) looked at the effect of several compounds including toluene on breath test results using the Lion Intoximeter 3000 and Camic Breath Analyser. They found that toluene had no effect on the breath result of alcohol free test subjects. Both of these units perform analyses via infrared absorption.

A number of studies have been conducted (9-14) where humans were exposed to toluene and both their breath and blood concentrations were reported over a time course. These studies tend to show that the concentration measured in the exhaled breath falls very quickly and that within about 30 minutes are at or significantly below the concentration used in the present study. One of the more interesting aspects of toluene is that it disappears from the breath much more quickly than it does from the blood. This shows that simply using a partition coefficient and a blood concentration will not give an accurate breath concentration in the case of this compound. There have been reports of higher breath concentrations, however, there was no control over the test subjects and the dosing (15) or exposures were coma inducing (16).

Our results show that at the concentrations of toluene found on human breath approximately 30 minutes post exposure, there is no effect on a breath analysis whether ethanol is present or not. Through its design, the Intoxilyzer 5000 will respond specifically to ethanol and subtract the substance (acetone) most likely to be found on human breath that might interfere with the analysis (17,18). This "interferant subtract" feature is always active but only displays and prints out a notice of the action if concentrations of the interferant are excessive. During these studies this feature was properly functioning and there was no notice of "interferant subtracted" displayed. The concentration of toluene was either below the detectable limit of the instrument or instrument detected the toluene and subtracted it out. Whether the instrument did not detect the presence of the toluene or subtracted it out does not matter. What does matter is that the BrAC was not affected by the presence of toluene in concentrations comparable to that found on the breath of ambulatory humans.

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