

Highlights of Analytical Sciences in Switzerland

Division of Analytical Sciences

A Division of the Swiss Chemical Society

New Calibration System for Breath-Alcohol Analysers Based on SI

Martin Stalder, Daniel Schwaller, Bernhard Niederhauser, Hanspeter Andres, and Samuel Wunderli*

*Correspondence: Dr. S. Wunderli, Eidgenössisches Institut für Metrologie METAS, Lindenweg 50, CH-3003 Bern-Wabern, Tel.: +41 58 387 03 83, E-mail: samuel.wunderli@metas.ch

Keywords: Breath-alcohol · Calibration · Traceability · Uncertainty

Based on a new ordinance, the Swiss police have been using verified breath-alcohol test instruments for official controls since January 1st 2012. Such instruments are increasingly used for medical prevention and occupational security. The measurement stability cannot be solely left to the manufacturer or his representatives.



Drink and drive...

For the yearly verification, type approval test, and conformity assessment of breath-alcohol devices, wet breath is generated by a saturation system. The traceability is given by a recommendation of the International Organisation of Legal Metrology (OIML) only,^[1] which is heavily disputed and partly modified nationally. For the OIML generation method, the 'Physikalisch-Technische Bundesanstalt' in Germany reports a bias of 1% to 2%.^[2]

The traceability of the breath-alcohol mass concentration is effected by gravimetrically prepared gas mixtures in pressure cylinders or by a wet generation with bubble trains using the convention of Dubowski:^[3] $\beta_{\text{gas}}(\text{EtOH}) = \beta_{\text{liquid}}(\text{EtOH}) \cdot A_{\text{Dub}} \cdot \exp(B_{\text{Dub}} \cdot t)$.

β is the mass concentration β_{gas} , β_{liquid} in (mg/L); t is the temperature in °C; the constants of the Dubowski formula are $A_{\text{Dub}} = 0.04145 \cdot 10^{-3}$, $B_{\text{Dub}} = 0.06583 \text{ °C}^{-1}$.

The SI-traceability of the breath-alcohol tests results is desirably ensured without the OIML-convention.^[1,3,4]



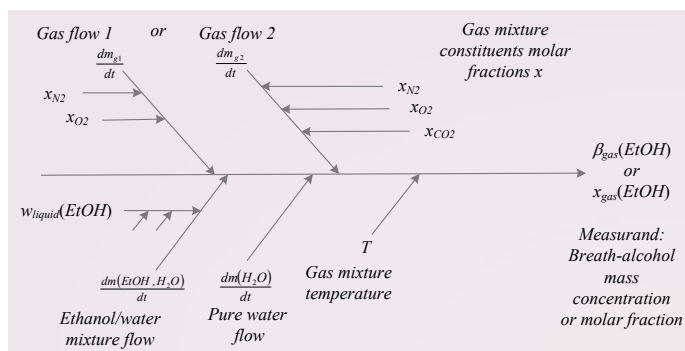
The generator for wet breath-alcohol analysis built at METAS.

A generator for wet breath-alcohol was built and is now tested at METAS. Using low-pressure, programmable micro annular gear pumps, water and water/ethanol mixtures are mixed dynamically in an evaporator with calibrated gas mass flows of certified air-like gas mixtures. Breath-alcohol of 0.5 mg/L to 1 mg/L, at 34 °C, 95% relative humidity and 1 atm results. First-order influence parameters are displayed in the fish-bone diagram. Gravimetrically calibrated liquid mass flows of pure water are accumulated in tared vials containing silica gel.

A preliminary uncertainty evaluation based on empirical input quantity data showed that a combined relative uncertainty better than 1% can be achieved. As a consequence, the Dubowski formula constants can be made traceable to the SI.

Received: October 12, 2013

- [1] a) International Organisation of Legal Metrology, 'OIML R 126: Evidential breath analyzers', **1998**.
- [2] S. Pratzler, D. Knopf, P. Ulbig, S. Scholl, *Chemie Ingenieur Technik* **2010**, 82, 1753.
- [3] K. M. Dubowski, *J. Anal. Toxicol.* **1979**, 3, 177.
- [4] DIN VDE 0405, 'Ermittlung der Atemalkoholkonzentration', **1995**.



Cause-and-effect diagram of breath-alcohol analysis.

Can you show us your analytical highlight?

Please contact: Dr. Veronika R. Meyer, EMPA St.Gallen, Lerchenfeldstrasse 5, 9014 St.Gallen
Phone: +41 58 765 77 87, Fax: +41 58 765 77 62, Mail to: veronika.meyer@empa.ch