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Traceability of mercury vapour

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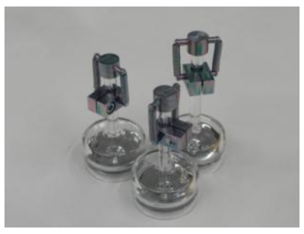
Abstract
Within the EMRP (European Metrology Research Programme) project MeTra mercury vapour generators are being developed to establish traceability of mercury measurement results for ambient air levels (1 – 2 ng Hg/m^3) as well as higher concentrations.
The newly introduced capabilities, to calibrate mercury monitors at levels of 10 ng Hg/m^3 and higher, are especially important for measurement services testing indoor and work place related mercury content levels according to health standards (from 50 ng Hg/m^3).

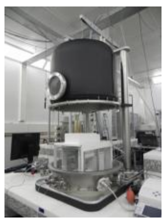
Introduction
Human exposure to mercury occurs mainly through inhalation of elemental mercury vapours during industrial processes and through consumption of contaminated fish and shellfish. One intervention to prevent environmental releases and human exposure is to reduce the use and disposal of mercury-containing products and waste. Mercury is found in e.g.:

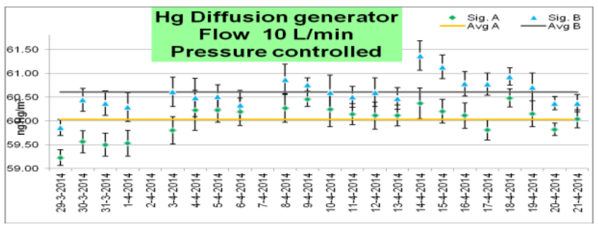
- Switches (electricity)
- Dental amalgam
- Cosmetics
- Pharmaceuticals

To monitor the effect of reducing the use of mercury, reliable and traceable measurement results are necessary. Measurement results of mercury in air and in emissions (and also in other environmental compartments) are almost universally traceable to the mass concentration of mercury in air at saturation. In the final analytical step of measurement methods using gaseous atomic absorption or atomic fluorescence measurement, calibration is based upon using very low, known masses of mercury obtained by withdrawing known volumes of mercury-saturated air from a thermostatically equilibrated space in which a mercury vapour atmosphere is allowed to build up above a small quantity of elemental mercury. Several empirical equations are available to describe the vapour pressure of mercury at a given temperature. However, the agreement between the equations available is not good as data from different equations sometimes differ 5% or even more. To remove the dependency of mercury vapour measurement on these empirical equations, and to provide stability and comparability, traceability to the SI system of units needs to be developed and implemented for measurements of mercury vapour.

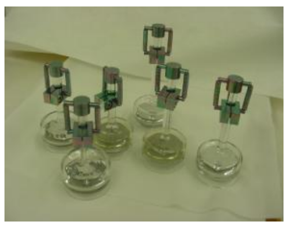
New gravimetric approach
In order to realize gravimetric traceability of mercury vapour we developed a strongly modified type of diffusion tube, a new measurement method to weigh the loss in (mercury) mass of these diffusion tubes during use (ca. 6-8 µg mass difference between successive weighings), and a new housing for the diffusion tubes to optimize flow characteristics and to minimize temperature variations and adsorption effects.

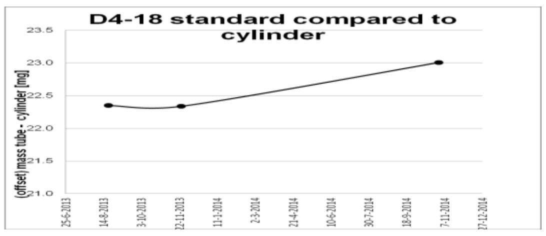






Proof of principle
The results show that the filter system, to produce mercury free air, is working properly and that the system is producing a stable mercury containing flow. Despite this progress we didn't fulfill our goal of a new gravimetric approach yet. Whereas the diffusion principle would be expected to result in having diffusion tubes with a slowly reducing mass, the contrary proved to be true. Not only for the diffusion tubes inside the mercury generator, but also for those outside which served as mass reference weights. Therefore some challenges still lay ahead. Within the MeTra project we recently started to cope with these challenges, which resulted in a metal diffusion tube and the design of separate mercury generators for low and high mercury vapour concentrations.





Conclusion
The newly developed mercury vapour generators will contribute to more reliable measurement results of mercury vapour at ambient and background air levels, workplace atmospheres (e.g. at CFL, TL and LCD TV disposal sites: MAC 20 µg Hg/m^3) and also to higher safety standards and cost reductions in e.g. the LNG field.

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