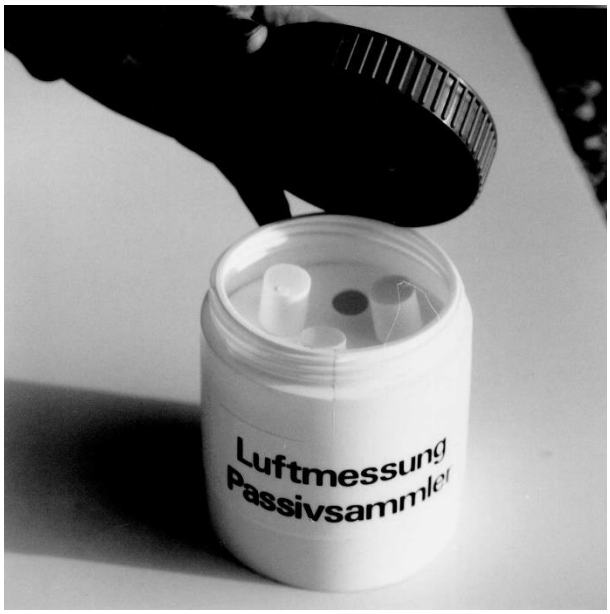
Diffusion tube for Nitrogen dioxide

Nitrogen dioxide is a toxic gas which may have both chronic and acute adverse health effects and may increase the frequency and severity of lower respiratory symptoms. Nitrogen dioxide plays an important role as a precursor in the formation of ozone and oxidants. The sources for nitrogen dioxide are mainly motor traffic, but also domestic fires and combustion processes in industry.

The sampler is based on that of Palms and is a passive device requiring no power for its operation. It collects NO_2 by molecular diffusion along an inert tube to an absorbent, in this case triethanolamine. The sampler, which is shown in the following diagram, consists of a polypropylene tube of 9.8 mm internal diameter and 7.35 cm length. The samplers are placed in a special shelter to protect them from rain and minimize the wind influence



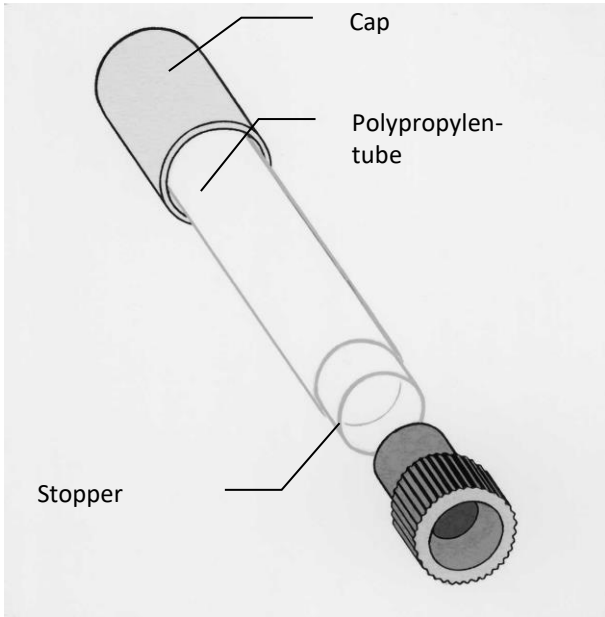
Diffusion tubes for Nitrogen dioxide and protective shelter

In use the samplers are mounted vertically and the lower stopper is removed at the onset of sampling allowing NO_2 to be transported by molecular diffusion up the tube to the TEA, where it is retained. The plug is replaced at the end of sampling and the collected NO_2 determined spectrophotometrically by the well-established Saltzmann method. Sampling periods range usually from one to two weeks.

Air quality standards differ from country to country:

European Union	40 µg/m^3
Switzerland	30 µg/m^3
USA	100 µg/m^3

The long-term standards can be monitored. For short term loads the 95th or 98th percentiles are defined as the limits. These cannot be registered with this method. Evaluations of measurements of NO_2 immissions at multiple measurement stations close to transport routes in various regions over many years have revealed that the ratio of the 98% value to the arithmetic mean generally lies between 2.0 and 2.2.



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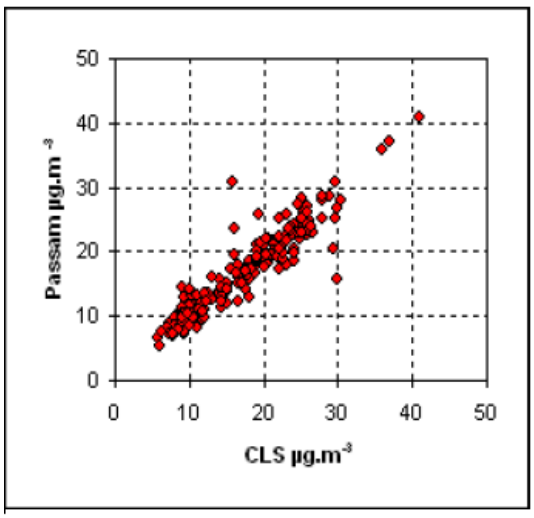
The diffusive sampler is suitable for area wide surveillance of nitrogen dioxide, e.g. for the characterization of trends resulting from the implementation of state plans.

The influence of traffic projects on air quality can be assessed in an easy and low cost way. The sampler is suitable as well for personal monitoring in epidemiological studies.

Specifications



In France passam samplers were extensively compared to the chemiluminescence reference method]. During the years 2005, 2007 and 2008 samplers were exposed side-by-side with the reference method at 6 locations with exposure periods of 4 weeks, resulting in a total of 181 valid data pairs [1].

When subjecting the data to the evaluation of equivalence [2] the following results are found.

REGRESSION OUTPUT		
slope b	0,975	
uncertainty of b	0,010	significant
intercept a	0,1	
uncertainty of a	0,19	
number of data pairs	181	
EQUIVALENCE TEST RESULTS		
random term	2,4	µg/m³
bias at LV	-0,9	µg/m³
combined uncertainty	2,6	µg/m³
relative uncertainty	6,4%	pass
reference uncertainty	1,0	µg/m³
limit value	40	µg/m³

The evaluation reveals excellent agreement between the results of both methods. The resulting uncertainty - 13% for a 95% confidence level – fulfils the 15% uncertainty requirement for fixed measurements of NO_2

Sampling rate (at 20°C)	0.7340 ml/min with protective filter (LANUV)
Working range	1 – 200 µg/m³
Sampling time	1 – 4 weeks
Detection limit	0.3 µg/m³ (monthly exposure)
External influences: wind speed	< 10% up to 4.5 m/sec (using protection shelters) negligible (used with protective filters and shelters)
temperature	no influence between 5 to 40°C
humidity	no influence between 20 to 80%
Storage	before use: 24 months after exposure: 6 months
Cross sensitivity	nitric oxide and sulphur dioxide do not interfere, peroxyacetyl nitrate will give higher results
Expanded uncertainty*	
using protective filters	23.3 % at concentration level of 40 µg/m³
using no protective filters	20.8 % at concentration level of 40 µg/m³
*according to GUM; subject to change without notice	revised 20.02.2023

References

[1] Review of the application of diffusive samplers for the measurement of nitrogen dioxide in ambient air in the European Union. EUR 23793 EN-2009; ISBN978-92-79-12052-7

[2] Guide to the demonstration of equivalence of ambient air monitoring methods. http://ec.europa.eu/environment/air/quality/legislation/assessment.htm.

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