

Effect of wind on the NO₂ sampler

The migration of nitrogen dioxide molecules to the absorption layer at the lower end of the diffusive sampler is determined by the length of the diffusion path. Wind turbulence shortens this distance, thus increasing the sampling rate and producing higher results.

This phenomenon can be countered in two ways:

- By using protective shelters
- By attaching membranes

Laboratory evaluation

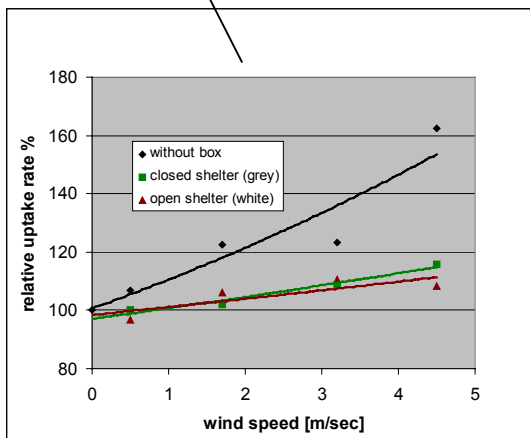
The wind speed was simulated using a rotating wheel in a 14 m³ test chamber.



With this design, diffusive samplers including their protective shelters were evaluated.

Box A: white shelter with bottom open

Box B: grey shelter bottom closed for ozone tubes (See Info sheet number 7)



Up to wind speed of 4 m/sec the influence on uptake rate is less than 10 %.

Field evaluation

To figure out the influence of wind on sampler performance under field conditions, the meteorological parameters were correlated with the fraction: monitor/diffusive sampler [1].

The analysed data are taken from a year-long trial conducted at 3 monitoring sites in the same town. In total, 78 14-day measurement comparisons have been available.

Type of shelter	A: NO ₂	B: Ozone
Correlation r with v	0.021	0.002
Range of windspeeds	0.7 – 2.6	1.9 – 3.3 m/sec
Median of wind speeds	1.4	2.3
Median test	Not significant	Not significant

The influence of wind is not significant up to 3 m/sec. In Switzerland, 80 % of wind speed are below 1 m/sec, so use of shelter to minimize wind is adequate.

Evaluation of membranes

The following membranes were tested

- Whatmann Teflon membrane 1 µm pore size
- GF6 glass fibre filter
- Polyethylene hydrophob 15-45 µm pore size

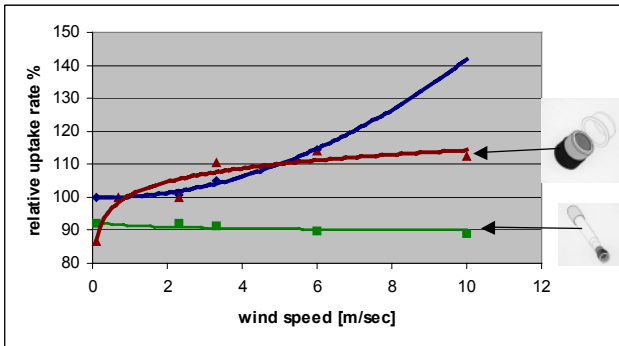
The tests were conducted in a glass chamber with concentrations of 50 and 100 µg/m³ and wind speeds of 0.01 and 0.5 m/sec.

	50 µg/m ³ 0.5 m/sec	100 µg/m ³ 0.5 m/sec	100 µg/m ³ 0.5 m/sec
Tube open	100 %	100 %	100 %
Fluoropore 1 µm	90 %	95 %	94 %
Glass fibre EPM 2000	91 %	93 %	94 %
Polyethylene 15-45 µm	87 %	90 %	89%

The sampling rate of the NO₂ sampler is reduced by approx. 8 to 12 %. It makes no significant difference which type of membrane is used.

High wind speeds

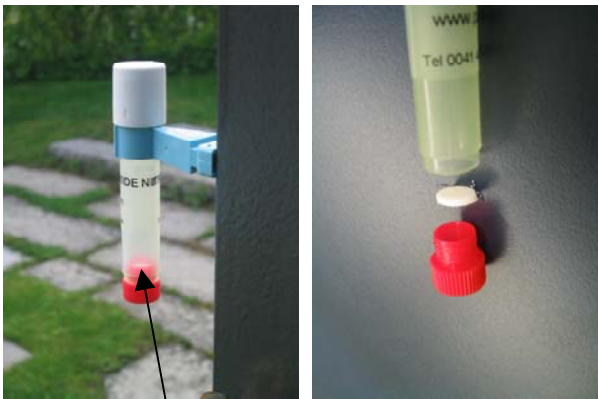
Under certain conditions, wind speed can be excessive e.g. In coastal areas or near heavy trafficked highways, where lorries or high speed cars cause turbulences



The batch-type sampler underestimated at low wind speeds, the tube type sampler has a lower sampling rate of a about 10 %.

Membrane accessory

To make available to clients, a new design of easily mountable membranes were designed.



The photo on the left shows the sampler equipped with a membrane and the photo right shows the exploded view.

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Environmental analysis

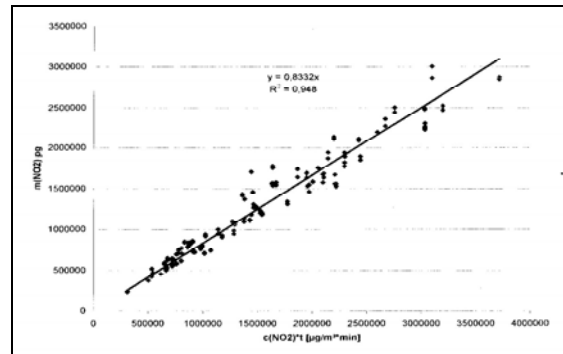
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Field tests

This sampler has been tested in the field. The comparisons with continuous monitors were carried out



out in the neighbourhood of heavy trafficked sites.

The concentration x time of the monitors were plotted against the amount on NO₂ on the samplers. The slope of the regression line represents the sampling rate

The sampling rate found in the field was 0.8332 ml/min.

References

- [1] M. Hangartner: Influence of Meteorological Factors on the Performance of Diffusive Samplers. International Conference Measuring Air Pollutants by Diffusive Sampling. Montpellier, 26 – 28 September 2001, Proceedings EUR 20242 EN (2002).

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