9.10 Simple NO, NO₂ measuring methods

9.10.1 Introduction

A simple measuring method centered around NO₂ is one of the methods concentrated upon in the field of epidemiological surveying that was looked at in 9.12. When a compound of TEA (triethanolamine), which is a collection reagent, is used with PTIO (2-Pheny 1-4.4.5.5-tetramethylimidazoline-3-oxide-1-oxyl), NO and NO₂ can be measured simultaneously.

This section focuses on simple methods of measuring airborne NO and NO₂ using a small sampler through the principle of molecular diffusion, using the above compound. Both the sampler and the peripherals for this method are available commercially, in addition to which, a batch personal sampler that is used for NO₂ measuring is also available.

9.10.2 Sampler construction and collection method

The sampler collector is divided into NO₂ and NOx, and the airborne NO and NO₂ both collected separately in the collector. The sampler construction is shown in Fig.9.10.1.

The NO₂ is collected in part 2 of Fig.9.10.1, while on the other hand, the NOx (NO + NO₂) is collected in part 7 of the same figure, by which means, the collected NO volume and be determined simply by Nox − NO₂.

---

1 Polyethylene multiporous seal (cylindrical, with 25 absorption vents)
2 Stainless steel mesh (80 mesh)
3 NO₂ collection element
4 Teflon ring (2 mm thick)
5 Teflon panel (1.5 mm thick, 14 mm diameter)
6 Acrylic cylinder (15 mm internal diameter, 19 mm external diameter, 26 mm length)
7 NOx collection element

Fig.9.10.1 PTIO method NOx sampler construction
9.10.3 Sampler preparations

(1) reagent adjustment
① NO₂ absorption solution (10% V/V TEA/acetone solution)
   Triethanol amine (high quality) 20 ml dissolved in acetone (high quality), making 200 ml.
② NOx absorption fluid (PTIO and TEA solution)*
   PTIO 0.3 g dissolved in NO₂ absorption fluid, making 10 ml.
   *) Because PTIO separates even at room temperature, should ideally be prepared when necessary, and stored chilled.

(2) NO₂ collection element preparation
   Place a cellulose filter paper (Toyo No.50) with 14.5 mm diameter perforations on top of a Teflon mesh and, using a micro syringe, drip 50 µl of NO₂ absorption solution onto the filter paper to make the NO₂ collection element.

(3) NOx collection element preparation
   Place a cellulose filter paper (Toyo No.50) with 14.5 mm diameter perforations on top of a Teflon mesh and, using a micro syringe, drip 50 µl of NOx absorption solution onto the filter paper to make the NOx collection element.

9.10.4 Sampler assembly

Insert a Teflon board and a Teflon ring as deep as possible on both the left and right sides of the sampler. Next, squeeze both the NO₂ and NOx collection elements between two sheets of stainless steel mesh (80 mesh), insert one each into each collector, and seal tight and fix the polyethylene multiporous seal (see Fig.9.10.1 construction diagram). Attach this sampler unit to a metal safety pin clip and attach the fixing batch, then immediately insert the zippered polythene bag, and store and seal tightly in the Styrofoam bottle (a 70 ml wide mouth agent preserving anti-humidity container is suitable).

9.10.5 Collection of nitrogen oxides

(1) Expose the sampler in a pre-examined site. An exposure time of 24 hours is standard. When the sampler has been exposed for 24 hours, it is possible to measure the concentration of NOx within the concentration range to several ppm from the ppb number.
(2) When using measurements from the outdoor air, fix the sampler in the accompanying shelter, and in addition to avoiding direct sunlight, ensure that the sampler does not come directly into contact with any rain.
(3) When using individual exposure volume measurements, fit the sampler with a hood before exposure.
9.10.6 Analysis methods

(1) Preparing the reagent

① Sulfanilamide solution
Dissolve a mixture of 80g sulfanilamide (high quality), 200 ml phosphoric acid (high quality) and approximately 700 ml of water together in solution, and add more water to make 1 l. Store in a cool, dark place.

② NEDA solution
Dissolve 0.56g N-(1-naphthyl) ethylene diamine dichloric acid in 100 ml of water. Store in a cool, dark place.

③ Colorproducing reagent
Mix 10 containers of sulfanil solution and 1 container of NEDA solution. Prepare when needed for use.

④ NO₃ standard original solution
Heat sodium nitrite at 105 to 110°C for at least four hours, adjust accurately to a weight of 1.50g, and dissolve in water to make 1 l. Include NO₃ 100 μg in the 1 ml solution.

⑤ NO₂ standard solution
Dilute No₃ standard original solution 100 times in water, take a further 0, 2, 4, 6, 8, 10 ml, dilute each of those with water, make 100 ml, and prepare the standard solution (0 to 1.0 μg NO₂/ml) when needed for use.

(2) Analysis operation

① Remove with pincers the collection element together with the NOx and NO₂ collector wire meshes from the exposed sampler, and insert each of them into a 25 ml combined stopper test tube.

② Add 8 ml of water, and following extraction for 30 minutes, shake lightly to mix.

③ After cooling this at 2 to 6°C, add 2 ml colorproducing reagent while simultaneously agitating rapidly, and leave to cool for 30 minutes.

④ Return to room temperature, and measure the spectrometry at the maximum absorption wavelength lose to 545 nm.

⑤ Conduct an identical operation for the unexposed collection element, and measure the air test values.

⑥ Accurately take a fixed volume (8 ml) of NO₂ control solution (0 to 1.0 μg NO₂/ml) that has been prepared in stages, add 2 ml of color reagent, conduct the same coloring operation and compile a calibration curve.

(3) Calculating concentration
NO and NO₂ concentrations are calculated using Eq. (1) and (2).

\[
\text{NO concentration (ppb)} = \alpha_{\text{NO}} \times \frac{W_{\text{NO}} - W_{\text{NO}_2}}{t} \hspace{1cm} (1)
\]

\[
\text{NO₂ concentration (ppb)} = \alpha_{\text{NO}_2} \times \frac{W_{\text{NO}_2}}{t} \hspace{1cm} (2)
\]
Here,

$W_{\text{NO}_x}, W_{\text{NO}_2}$ : NO$_x$ volume (ng) collected by the NOx and NO$_2$ collection elements determined with reference to the calibration curve

$\alpha_{\text{NO}}, \alpha_{\text{NO}_2}$ : ppb concentration conversion factor (ppb/min/ng)

$t$ : Exposure time (mins.)

Normally, conducted with air temperature 20°C, relative humidity 70%, and calculated as

$\alpha_{\text{NO}} = 60$

$\alpha_{\text{NO}_2} = 56$