9.10 Simple NO, NO_2 measuring methods

9.10.1 Introduction

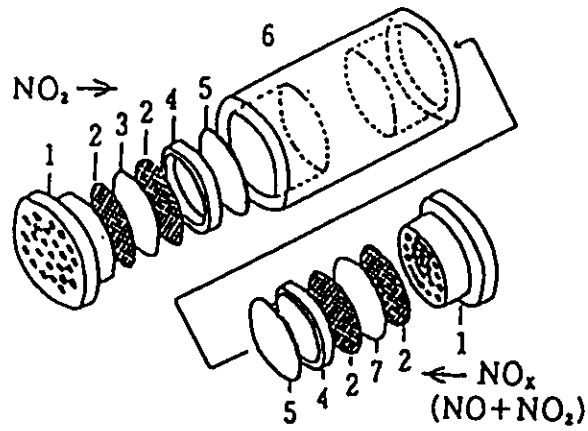
A simple measuring method centered around NO_2 [1)-5)] is one of the methods concentrated upon in the field of epidemiological surveying that was looked at in 9.12. When a compound of TEA (triethanolamine), which is a collection reagent, is used with PTIO (2-Pheny 1-4.4.5.5-tetramethylimidazoline-3-oxide-1-oxyl), NO and NO_2 can be measured simultaneously.

This section focuses on simple methods of measuring airborne NO and NO_2 using a small sampler through the principle of molecular diffusion, using the above compound [5)]. Both the sampler and the peripherals for this method are available commercially, in addition to which, a batch personal sampler [4)] that is used for NO_2 measuring is also available.

9.10.2 Sampler construction and collection method

The sampler collector is divided into NO_2 and NOx, and the airborne NO and NO_2 both collected separately in the collector. The sampler construction is shown in Fig.9.10.1.

The NO_2 is collected in part 2 of Fig.9.10.1, while on the other hand, the NOx ($NO+NO_2$) is collected in part 7 of the same figure, by which means, the collected NO volume and be determined simply by $Nox-NO_2$.



1 Polyethylene multiporous seal (cylindrical, with 25 absorption vents)
2 Stainless steel mesh (80 mesh)
3 NO_2 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 [5)]

9.10.3 Sampler preparations

(1) reagent adjustment

① NO_2 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 NO_2 absorption fluid, making 10 mℓ.

*) Because PTIO separates even at room temperature, should ideally be prepared when necessary, and stored chilled.

(2) NO_2 collection element preparation

Place a cellulose fiber 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 NO_2 absorption solution onto the filter paper to make the NO_2 collection element.

(3) NOx collection element preparation

Place a cellulose fiber 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 NO_2 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 Sulfanil amide 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-naphtyl) 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 NO_2 standard original solution

Heat sodium nitrite at 105 to 110℃ for at least four hours, adjust accurately to a weight of 1.50g, and dissolve in water to make 1 ℓ. Include NO_2 100 μg in the 1 mℓ solution.

⑤ NO_2 standard solution

Dilute NO_2 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 NO_2/mℓ) when needed for use.

(2) Analysis operation

① Remove with pincers the collection element together with the NOx and NO_2 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℃, 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 NO_2 control solution (0 to 1.0 μg NO_2/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 NO_2 concentrations are calculated using Eq. (1) and (2).

$$\text{NO concentration (ppb)} = \alpha_{NO} \times \frac{W_{NO_x} - W_{NO_2}}{t} \quad \cdots\cdots (1)$$

$$\text{NO}_2\text{ concentration (ppb)} = \alpha_{NO_2} \times \frac{W_{NO_2}}{t} \quad \cdots\cdots (2)$$

Here,

W_{NOx} , W_{NO_2} : NO_2 volume (ng) collected by the NOx and NO_2 collection elements determined with reference to the calibration curve

α_{NO} , α_{NO_2} : ppb concentration conversion factor (ppb/min/ng)

t : Exposure time (mins.)

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

$$\alpha_{NO} = 60$$

$$\alpha_{NO_2} = 56$$