Using UV-DOAS to Collect Reference Spectra for NO\textsubscript{2} and O\textsubscript{2}

Yen-Ju Chou, Robert S. Crampton, Ming-Yi Tsai, Michael G. Yost

Department of Environmental and Occupational Health Sciences, University of Washington, Seattle WA

**Objective**

Ultra violet differential optical absorption spectroscopy (UV-DOAS) is a modern technique to monitor trace gas concentrations and air pollution. In the research, I collected UV absorbance spectra for NO\textsubscript{2} and O\textsubscript{2} with a gas cell and spectrometer. The background spectrum for both gases uses pure N\textsubscript{2}. For the NO\textsubscript{2} reference spectrum, the NO\textsubscript{2} permeation tube was used in the dynacalibrator. For the O\textsubscript{2} spectra, a drycal was used to measure volumetric flows into the gas cell.

**Results**

Table 1. Weighed NO\textsubscript{2} permeation tube results for the permeation rate=2251ng/min at 30 Celsius.

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Weight(g)</th>
<th>Mass(ng)</th>
<th>Rate(ng/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7/09/2008</td>
<td>14:28</td>
<td>9.78951</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7/11/2008</td>
<td>10:38</td>
<td>9.78305</td>
<td>6460000</td>
<td>2437.736</td>
</tr>
<tr>
<td>7/15/2008</td>
<td>12:35</td>
<td>9.77037</td>
<td>12680000</td>
<td>2157.563</td>
</tr>
<tr>
<td>7/18/2008</td>
<td>10:02</td>
<td>9.75894</td>
<td>11430000</td>
<td>2742.981</td>
</tr>
<tr>
<td>7/22/2008</td>
<td>10:38</td>
<td>9.74349</td>
<td>15442500</td>
<td>2664.337</td>
</tr>
</tbody>
</table>

**Experimental Methods**

- **Balance:** Weighed the NO\textsubscript{2} permeation tube over time with a Mettler microbalance.
- **Dynacalibrator:** Adjusted the mode control at Span 2 and used a one meter gas cell to collect a spectrum of NO\textsubscript{2} from the permeation tube.
- **The Spectra Collection**
  - Cerex UV Sentry with a resolution of 0.075 nm and a one meter gas cell.
  - The background N\textsubscript{2} spectrum (I\textsubscript{b})
  - The O\textsubscript{2} spectrum in different concentrations (I\textsubscript{A})
    - a. Transmission = I\textsubscript{A}/I\textsubscript{b}
    - b. Absorbance according to Beer’s law is linear with concentration:
      \[ -\log(I\textsubscript{A}/I\textsubscript{b}) = A = \varepsilon bc \]

**Discussion & Conclusions**

- Table 1. shows the weight of the NO\textsubscript{2} permeation tube decreasing with time.
- Fig. 1. shows the NO\textsubscript{2} features from the collected spectrum matching the reference spectrum.
- Fig. 2. shows the higher O\textsubscript{2} concentration increased the absorbance at 197 nm.
- Fig. 3. indicates that a linear relationship (R\textsuperscript{2} = 0.995) exists between O\textsubscript{2} concentration and absorbance.

**Acknowledgements**

This research was made by funding through the National Institute of Environmental Health Sciences (NIEHS) Grant IR25ES016150-01 and DEOHS.