

Measurement of Nitrogen Dioxide using Palmer Diffusion Tubes

READING: 3 references Atkins, Campbell and Shooter, here:

<http://academics.rmu.edu/faculty/short/envs4020/references.htm>

See here for more: <http://academics.rmu.edu/faculty/short/envs4020/references-diffusion-tubes.htm>

Proposed plan for student experimental write-up:

Introduction

- Sources of NO₂, why measure NO₂? (it's a clean air act requirement), health effects.
- List and briefly describe other methods in use today. See Brown (1993) for other diffusion tube methods, Harrison, R.M., Measurements of Concentrations of Air Pollutants, in: Holgate, S.T., Koren, H.S., Samet, J.M. and Maynard, R.L. (eds.) (1999) *Air Pollution and Health*. Academic Press, NY. For direct instrumental methods (chemiluminescence).
- Why use PDT's (time-weighted/integrating method) and not direct reading instruments?
- Pros and Cons of PDT's? Paragraph 2, page 1 of Atkins et al. (1986)
- Examples of studies (and results) using PDT's (N. America and Europe) e.g. Campbell (1998), Stevenson et al. (2001), Gair et al. (1991), Glasius et al. (1999), Hansen et al. (2001).

Experimental

- **Sampling:** locations of sites, use of tube holders, length of sampling time required- 1 month (why this long?).
- **Analysis:**
- Must reference 'Regional Analysts Laboratory of Lothian Regional Council' as source of method, derived from Palmer et al. (1976).
- Cleaning of tubes and mesh. Cleaning of glassware.
- TEA prep, we used 50% solution of TEA in water, compare with Atkins et al. (1986) method which uses acetone/TEA mixture and Kirby et al's (2000) comparison of techniques.
- Solutions required.
- Method.
- Blank discussion: equipment blank, field blank and reagent blanks compare what we did with Atkins et al. (1986).

Calculation

- Include diagram of PDT tube and dimensions of our tubes, measure using a micrometer.
- Show derivation of $74 \text{ cm}^3 \text{ hr}^{-1}$ collection rate using the dimensions of the tube and Fick's law. Use either Shooter (1993) (best one) or Atkins et al. (1986).
- Show simplified equation relating absorbance/time/molar mass/molar volume to concentration of NO_2 in air (ppm).

Results

- Show standard curve.
- Use calculation page on excel sheet to calculate each NO_2 concentration.
- Include statistical analysis of errors...needs more data! We only had 2 tubes each.
- Present results in a table.

Discussion

- Discuss NO_2^- standard equivalence to NO_2 (see page 5 of Atkins). Nitrite is obviously not the same chemical as NO_2 .
- Discuss how these measurements should be compared with another technique (chemiluminescence) for quality control.
- Compare to previous RMU results.
- Compare PDT results with Carnegie Science Center EPA data for the month of January and February, are we close? Are we of the same order of magnitude?
- Discuss possible errors and interferences by meteorology (Atkins et al (1986)) and atmospheric gases.
- Describe examples of studies where PDT's have been used and what we may use them for in the future e.g. Shooter et al (1997).

References

- List all references used, must use at least 5.
- Include at least one of your own found using SCOPUS, must be relevant to the course.