Analysis of ppb Levels of Nitrous Oxide by Gas Chromatography

- **Paper # 460-7**

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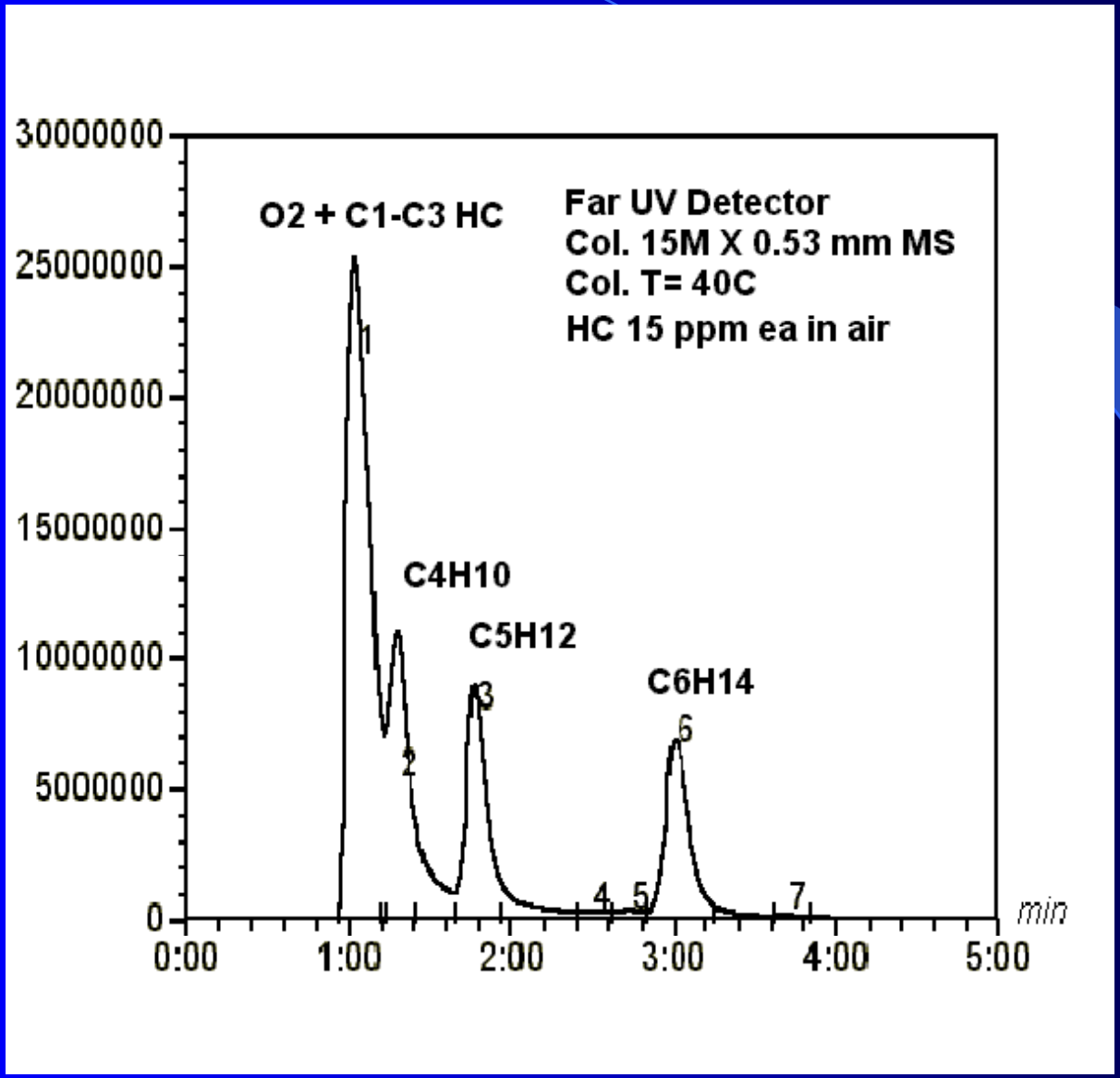
INTRODUCTION

- Nitrous oxide (N_2O) is produced in the soil by the decomposition of nitrogen compounds. This results in an average atmospheric concentration of approximately 0.25 ppm. It is also used in dental offices and in hospital operating rooms during surgery.
- Methods used for determination of N_2O include infrared (IR) spectroscopy and gas chromatography. The former method is useful to just below 1 ppm although photoacoustic IR has a detection limit of 30 ppb. The GC detectors used for N_2O include the thermal conductivity detector (TCD) for high levels (> 100 ppm) and the electron capture detector (ECD) (100 ppm to app. 0.1 ppm).
- We will be evaluating a Far UV absorbance detector coupled to a concentrator to detect low ppb levels of N_2O

FUV Detector

- Consists of a uv lamp (120 nm), a 1 cm pathlength cell (50 uL) and a UV photodiode that measures lamp intensity
- As a sample enters the cell, the signal will decrease in proportion to the absorption coefficient of the species
- Response- organic HC, fixed gases & inorganic gases as shown in next slide

Chromatogram of HC with FUV Detector



Far UV Detector

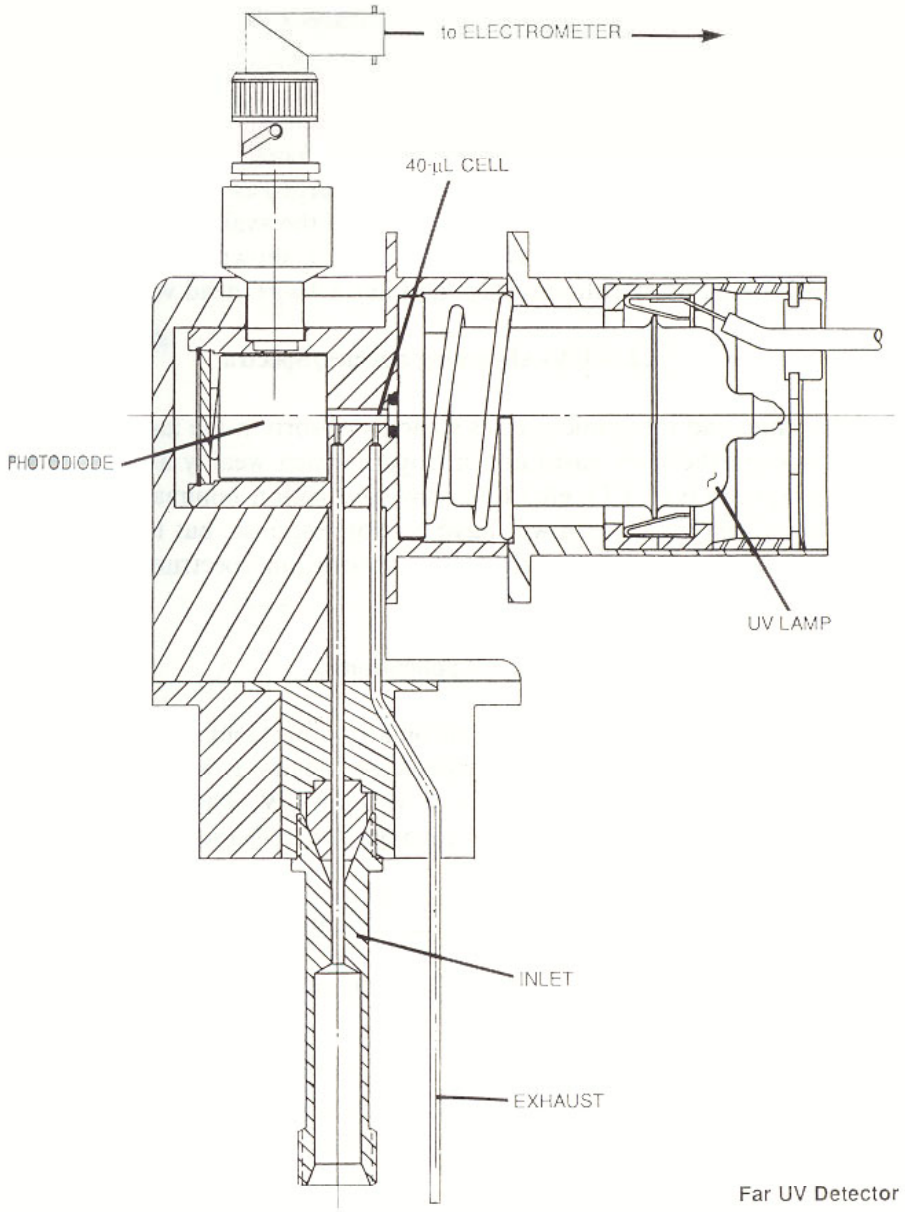
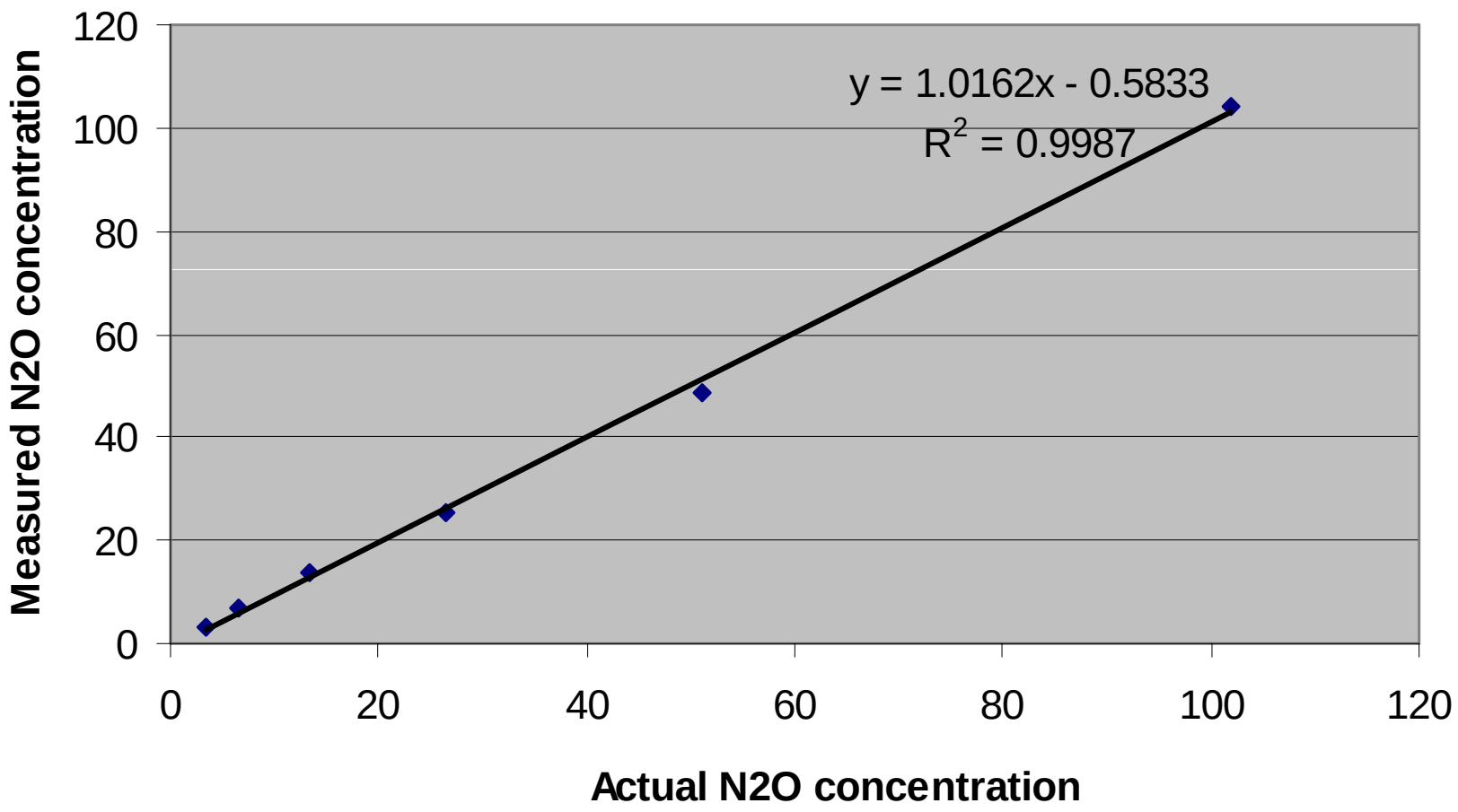


Figure 4.20. Schematic drawing of far-UV absorbance detector.

Photo of Model 301-B

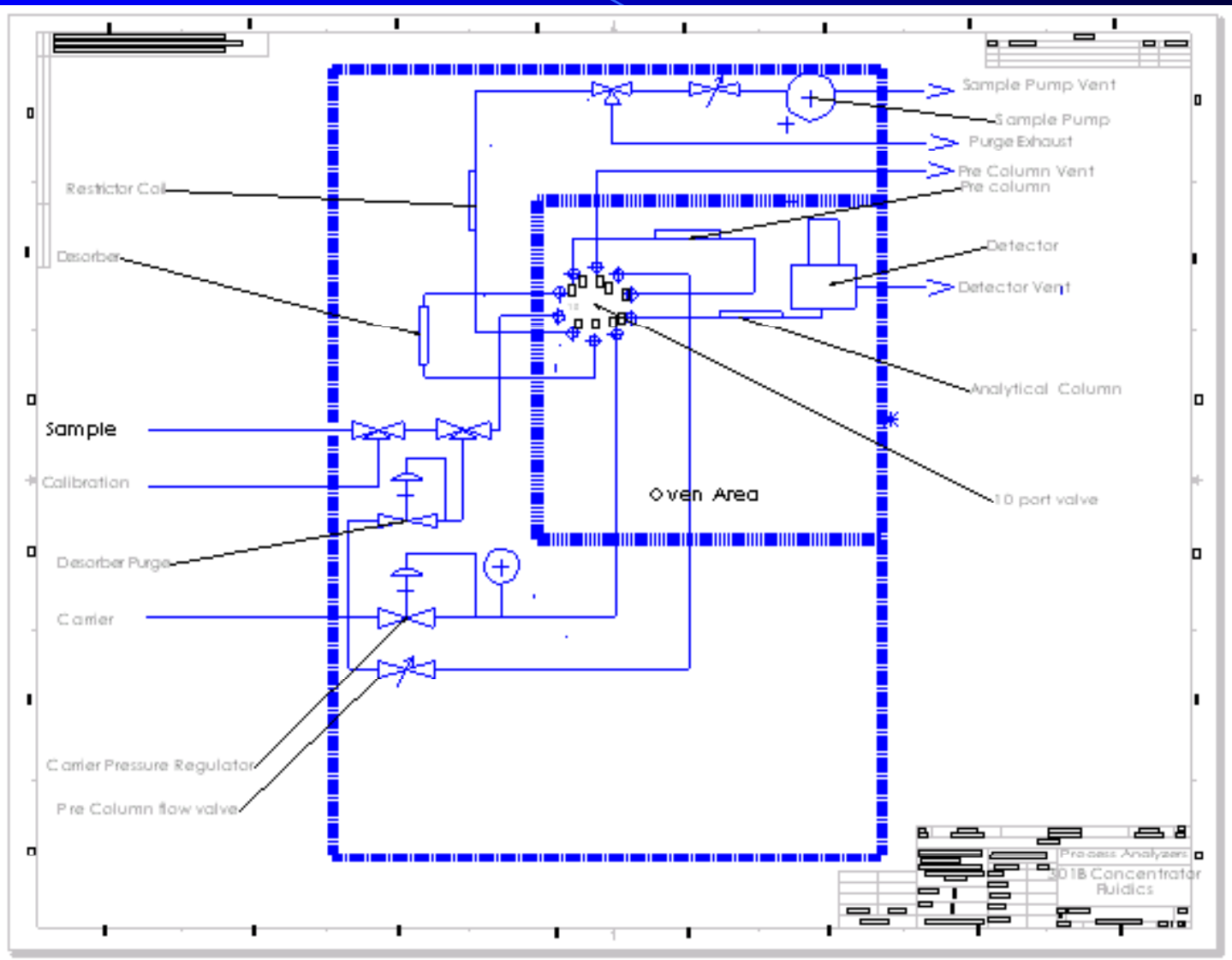
Equipment used

- PA Model 301-B GC
- Modified by adding a 6 port manual valve with sample loops from 0.1 to 50 cc
- Low ppm concentrations prepared by dilution of gas standard (1000 ppm N_2O) in zero air
- 10 M x 0.53mm PLOT Molesieve
- Far UV detector (50 uL dead volume)



Detection limit- 500 ppb

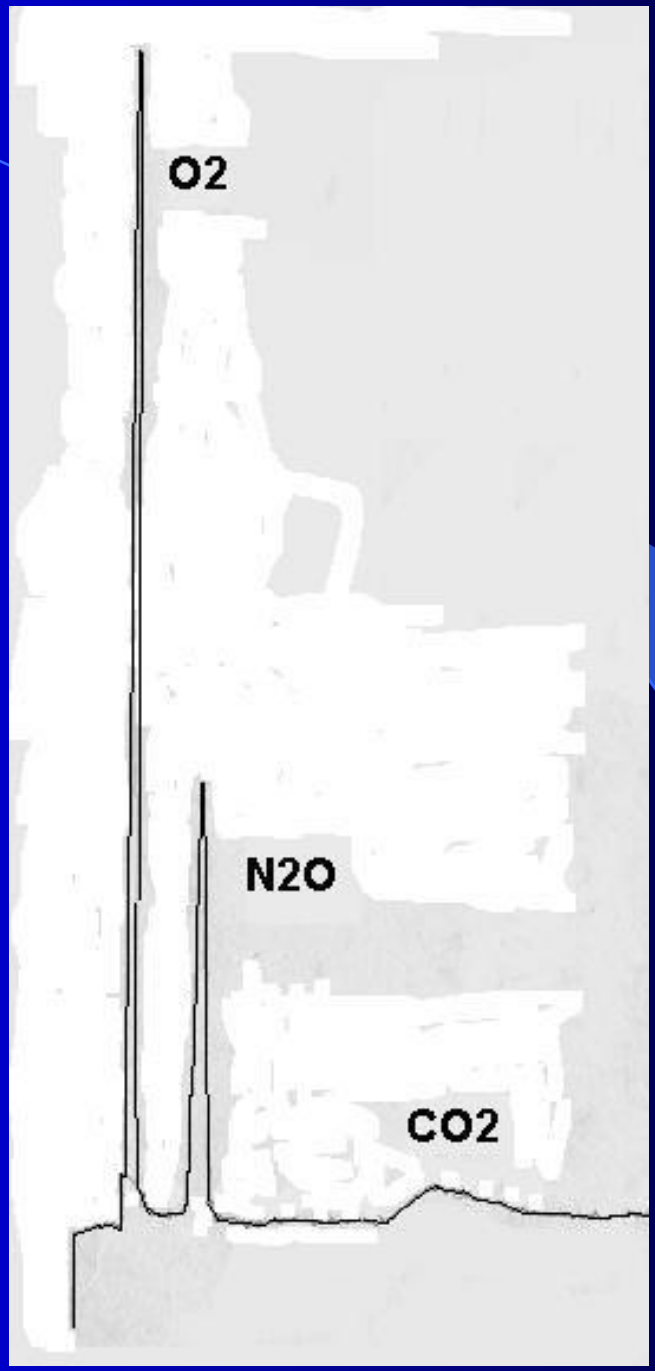
Concentrator for N_2O



Concentrator Parameters

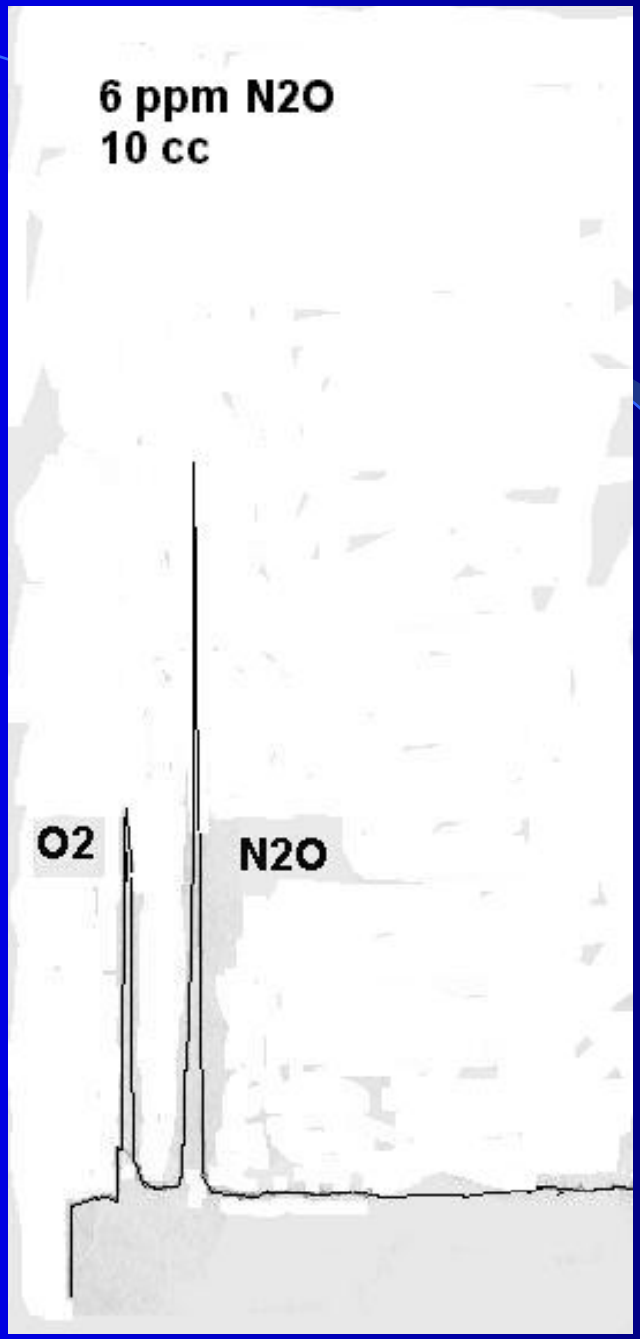
- Material : molecular sieve- 80/100 mesh
- Desorb volume- 10-50 cc
- Desorb temperature: 150°C
- Time to max.T – 4 seconds
- Can vary T_{max} from 1 second to 4 min.
- Cycled between runs to clean column
- All parameters are under PC control

Chromatogram of 50 ppm N_2O with FUV Detector

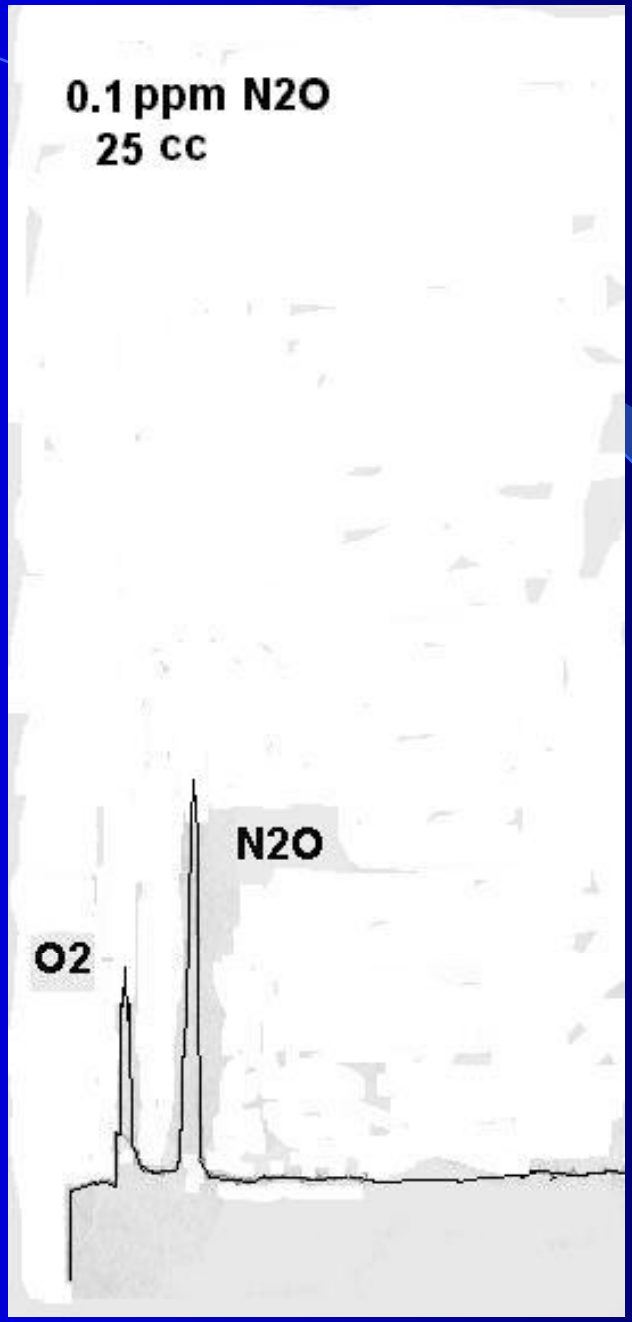


10 M x 0.53 mm PLOT Molesieve, 15 cc/min. 80C; 50 ppm N_2O in ambient air

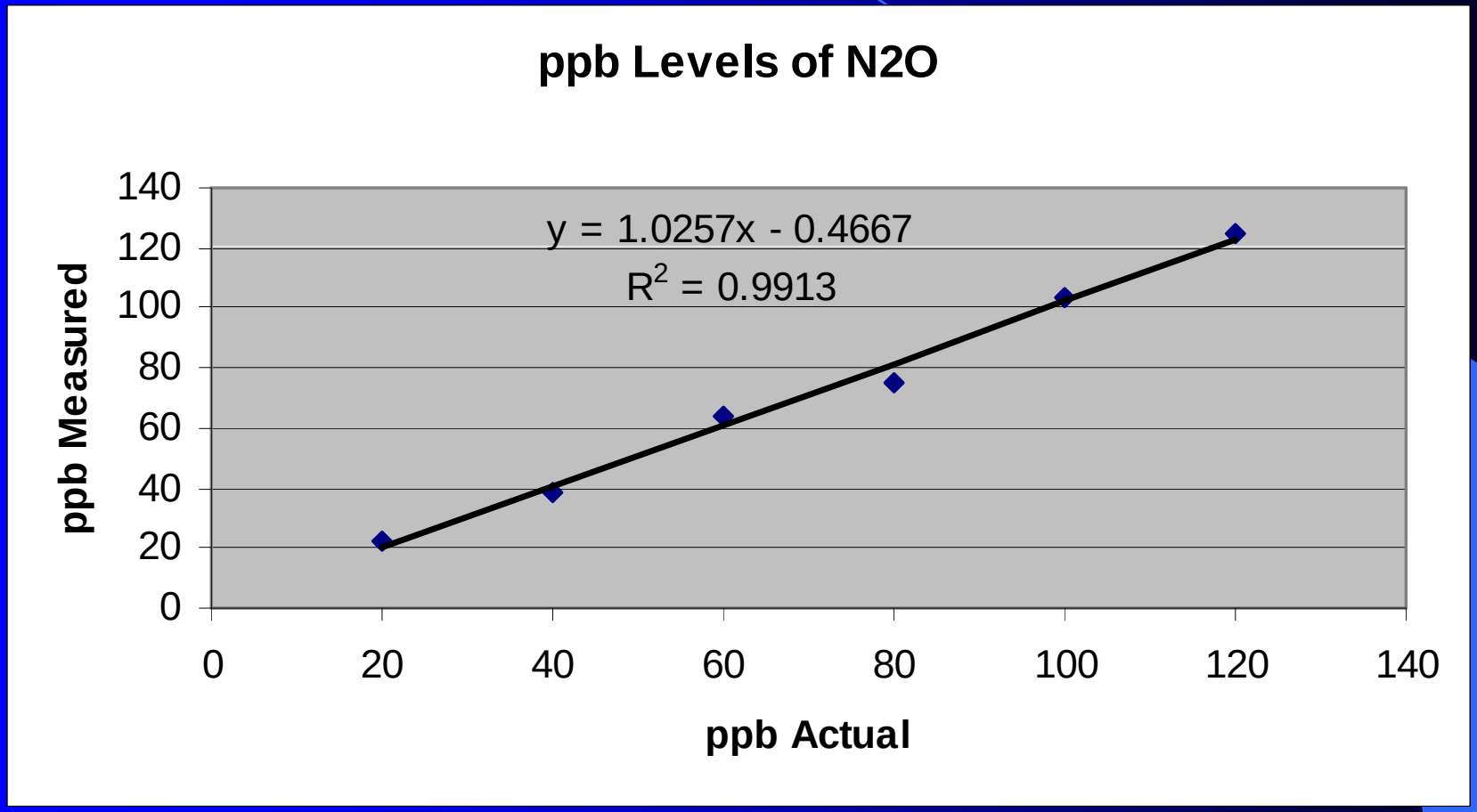
N_2O 10 fold concentration



100 ppb N_2O
25 fold
concentration



Calibration Curve for Concentrator



SUMMARY

- By coupling a FUV detector to a PLOT column, we have been able to detect from 500 ppm down to 250 ppb of N_2O.
- This covers approximately the same range as the ECD
- We have evaluated a concentrator/ thermal desorber
- That improves the detection of N_2O to 5 ppb.
- The FUV (without a concentrator) is will provide a range that would be adequate for workplace monitoring of N_2O.
- The FUV with a concentrator is ideal for monitoring N_2O in ambient air