FACT SHEET FOR TRACE LEVEL CO MONITORING

Principle of Operation

The current recommendation for the measurement of Carbon Monoxide (CO) is the use of Non-dispersive Infrared (NDIR) with a gas filter correlation wheel. This procedure is identical to the current methodology used to measure CO, however, the trace level version must have a detector that is more sensitive, have tighter bench temperature control, be able to remove water and be able to adjust the baseline.

Trace Level Modifications

A number of modifications are made to the standard CO monitor to improve the detection limit for trace gas monitoring. Depending on the particular make, modifications should include the following:

- Required sample stream dried using permeation or Nafion Dryer;
- Analyzer baseline determined and corrected using heated palladium or hopcalite catalyst;
- Frequent auto-zero, at a minimum of once per hour, through the catalyst.

Issues with the Method

1) Stable Detector

It is important for the detector to be operated at a very stable temperature in order to measure in the ppb range. The detector and optical bench should be operated within +/- 1.0 degree Celsius to get a stable baseline.

2) Water interference

Water is known to absorb in many wavelengths in the Infrared spectrum. Therefore, water must be removed from the sample stream before it is allowed to enter the optical bench. This is performed using Nafion or a permeation dryer.

3) CO_2 interference

Carbon Dioxide has been shown to be an interferent for CO. It is important that a narrow wavelength band be used to minimize these interferents. The current instruments are using 4.6 - 4.8 *u*m, which is selective for Carbon Monoxide.

Literature Search

OAQPS has performed a literature search via the Internet and was able to find five vendors that claim to have trace level CO instruments: Horiba LTD., Teledyne-Advanced Pollution Instrumentation (TAPI) Inc., Thermo Electron Corp., Ecotech Inc. and Environment-SA. An instrument matrix can be found in Table 1. Of these vendors, the Teledyne-API, Thermo Electron and Ecotech are the only vendors that currently have instruments with all three options

available. Teledyne-API sells a model 300EU, when equipped with option 53, includes internally mounted auto-zero switching solenoid system that works in conjunction with a heated palladium catalyst. API uses this option to adjust the baseline on an hourly basis. Thermo Electron Inc, who markets the TECO 48C-TLE, is in the last phases of their development of a trace level CO instrument with the above mentioned configuration. The zero air scrubber uses a hopcalite scrubber instead of palladium. Ecotech offers the 9830T, which has the above mentioned configuration and also uses a hopcalite scrubber instead of palladium. The price of the Teledyne and Thermo instruments is in the range of $10,000 to $15,000. Please see the Internet web-sites below where you can get information on these instruments and vendors contacts in your area.

Internet Addresses:

http://www.environnement-sa.com/index2.html
http://www.thermo.com/eThermo/CDA/BU_Home/BU_Homepage/1,,156,00.html
http://www.teledyne-api.com/products/index.asp
http://www.hii.horiba.com/
http://www.ecotech.com.au/newproductframeset.htm

Calibration and Zero

Calibrations are performed with commercially available standard mass flow calibration devices and cylinders containing CO as a stand alone gas or in multi-blend mixture. Once per hour, sample air is routed through a heated palladium or hopcalite scrubber, which converts all CO_2 to CO. This “scrubbed” air is allowed to enter the optic chamber and baseline is automatically adjusted once per hour.

Table 1. Trace Carbon Monoxide Instrument Matrix

Instrument Make/Model	**Lowest Range**	**LDL**	**Response Time**	**Z. Drift**	**S. Drift**	**Auto Ranging**	**Precision**	**Linearity**	**Auto zero solenoid**	**Heated Palladium or Hopcalite zero scrubber option**	**Nafion or Permeation Dryer option**
Teco 48C-TLE*	1000 ppb	40 ppb	30 sec	100 ppb/ day	1% FS/day	Yes	1% FS	1% FS	Yes	Yes	Yes
TAPI 300-EU*	1000 ppb	40 ppb	60 sec	100 ppb/ day	0.5% FS/day	Yes	0.5% FS	1% FS	Yes, option 53	Yes, option 53	Yes, internally mounted on request
Horiba GA-360E	1000 ppb	10 ppb	180 sec	20 ppb/day	2 % FS/day	NA	1% FS	1% FS	No	No	Yes, as an option
Environment-SA CO12M	10 ppm	50 ppb	30 sec	100 ppb/day	1% FS/day	NA	NA	1% FS	No	No	No
Ecotech 9830T	3000 ppb	25 ppb	300 sec	25 ppb/day	0.5% FS/day	Yes	5% for range 0-3 ppm	5% FS	Yes	Yes	Yes