Combating Drift In Portable And Fixed PIDs

The portable photoionization detector (PID) has traditionally been known as a technology subject to drift. In recognition of this potential problem, EPA field manuals often recommend daily calibration of PIDs. RAE Systems has developed and patented novel methods of cleaning both portable and fixed (continuously operating) PIDs to address the problem of drift.

What Causes PID Drift?

A PID is an optical system. Light energy needs to get out of the PID lamp in sufficient quantities to ionize compounds so that the sensor can produce a signal. As the lamp surface gets dirty the light getting out of the lamp is obscured and the PID signal is reduced. In some situations when large quantities of chemical have been deposited in the PID sensor, the signal can even increase. This is most often seen as difficulty in zeroing the sensor. However, the dominant concern with PID drift is signal loss. As the lamp gets dirty, the PID response decreases. For example, if the PID is initially calibrated on 100 ppm isobutylene and suffers loss of signal drift from a dirty lamp, then the PID might only read 70 to 80 ppm when challenged with 100 ppm isobutylene. This represents 20 to 30% loss of signal. Drift is dependent on sampling conditions (dirty conditions produce more drift and cleaner conditions mean less drift), but 20% loss of signal after a week of use is not uncommon. Frequent daily calibration can readjust the loss of span, but still does not address the underlying problem of the lamp face getting dirty from exposure to contaminants in the sample. Gaseous vapors tend to deposit on the surfaces they touch. The higher their boiling point, or lower their vapor pressure, the more tendency they have to deposit themselves in the sample train.

Laminar Flow Sensor Reduces the Dirt Deposited on the Lamp

RAE Systems' laminar flow PID sensors direct the sample flow across the lamp lens rather than directing the sample flow towards the lamp lens like many other PIDs. This results in less dirt and solvent vapors accumulating on the lamp lens because contaminants ideally keep going past the lamp face.

Manual Cleaning Can Be Tedious

Manually cleaning the PID lamp has been the answer for most PIDs. In recent years, PID manufacturers have made it very easy to access lamps for cleaning. However, this often addresses only half of the problem. If the sensor is also dirty, then cleaning the lamp is not enough. If fuel is sucked into a PID, just cleaning the lamp does not the fuel products on the sensor, and the PID continues to measure the fuel products on the sensor until they eventually go away through evaporation or degradation. RAE Systems has addressed this problem by making lamp and sensor access easy without tools. Cleaning the lamp is accomplished simply by wiping it with a lens tissue soaked with lamp-cleaning solution, and the sensor can be quickly and easily cleaned by immersing it in cleaning solution. Putting a clean lamp into a dirty sensor is a lot like a runner taking a shower and then putting their dirty sweatsuit back on.

Automatic Cleaning in the MiniRAE 3000 and ppbRAE 3000

The ultraviolet (UV) light in PIDs generates a very low level of ozone. With the pump operating this level is inconsequential and does not interfere with the measurement. However, flow stoppages can allow the ozone to reside in the sensor housing and build up. Ozone is a very reactive compound that is

very efficient in "scrubbing" compounds out of the sensor. The MiniRAE 3000, ppbRAE 3000, UltraRAE 3000, and MiniRAE Lite utilize ozone generated by the lamp to scrub the sensor clean of contaminants. For the first four hours that a MiniRAE 3000 or ppbRAE 3000 are on charge, the lamp remains on even though the pump and the rest of the monitor are not operating. Without the pump

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running, ozone builds up in the sensor housing and scrubs the sensor clean of contaminants. Compared with normal PIDs that typically exhibit as much as 20% drift over a week of use, this patented cleaning cycle allows the MiniRAE 3000, ppbRAE 3000, UltraRAE 3000, and MiniRAE Lite to deliver typically less than 5% drift over 90 days of normal usage. This cleaning cycle has been in use since the initial release of the MiniRAE 2000 in 1998 and does not significantly reduce lamp life (**Note:** the MiniRAE 3000 has a 3-year warranty).

Using PIDs for Continuous Monitoring of VOCs

Applications like continuous monitoring of indoor environments for VOCs cannot tolerate drift or frequent calibrations, so drift problems have prevented the use of PIDs for applications in which they might seem ideally suited. For problems that require continuous monitoring, stopping for four hours of cleaning just is not practical, and calibrating daily, weekly or even monthly can be too labor intensive. RAE Systems has developed a method to clean the sensor while it operates called "duty cycling."

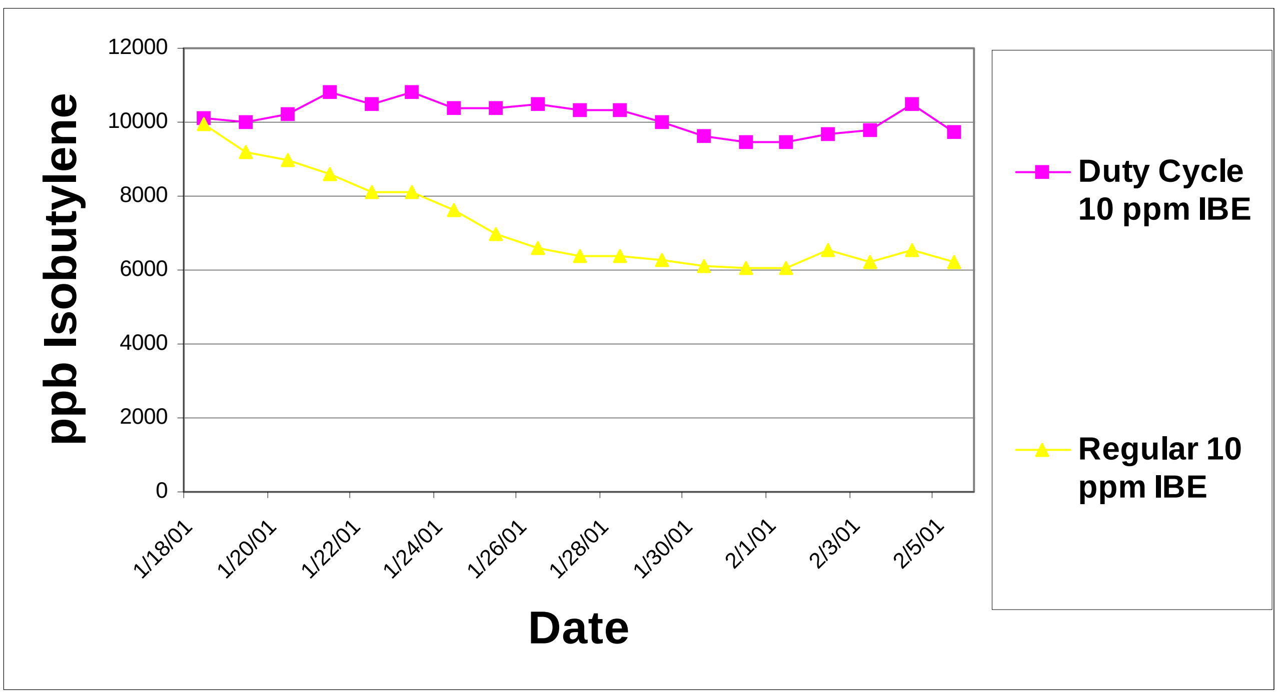
What is "Duty Cycling?"

In duty cycling, the PID runs continuously and the pump runs intermittently at a user-defined "duty cycle." The pump runs and then turns off, while the lamp remains on to clean the sensor and lamp surface. When concentration exceeds 2 ppm, the pump runs continuously until the sensor is cleared. The user can set the cycle period from 30 to 100% of a 10-second interval. If set to 30%, then it is on for 3 seconds and off for 7 seconds. If it is set to 50%, then it is on for 5 seconds and off for 5 seconds. Duty cycling reduces loss of span sensitivity to typically less than 5% when running 24 hours a day, 7 days a week, for over 90 days in backgrounds of less than 10 ppm. The following chart compares the performance of a ppbRAE 3000 running duty cycling and a non-duty cycling ppbRAE 3000. The duty cycling ppbRAE 3000 shows very low drift compared to the non-duty cycling ppbRAE 3000 that shows almost 40% loss of signal. The two lower plots show the ambient levels recorded by the ppbRAE 3000s. The high peaks represent solvent-based paint applications in this particular indoor environment.

References:

- P.C. Hsi, U.S. Patent 5,393,979 (1995).

H.T. Sun, P.C. Hsi, U.S. Patent 6,225,633 (2001).



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