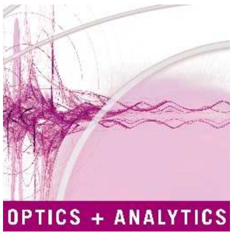
Heraeus



10.0eV PID lamps for 'Selective' BTEX Determination

Introduction

In general, Photoinisation Detection (PID) is not a selective technique because any compound present with an ionisation potential lower than the output energy from the PID lamp will be ionised and hence detected. To provide some compound selection, using a 10.0 eV rather than 10.6 eV PID lamp gives increased specificity when determining **BTEX VOCs**, by eliminating interference from those compounds with ionisation potentials above 10.0 eV. Heraeus has introduced a range of lamps which transmit only the 10.0 eV line and through careful selection of materials and control in manufacture, these lamps maintain a high quality pure spectrum and long life, charateristic of all the Heraeus PID lamp range.

Ionisation Potential of common BTEX compounds

Compound	Ionisation Potential eV
Benzene	9.3
Toluene	8.8
Ethylbenzene	8.56
Xylene	8.56

Fig. 1: RF PID lamp (12,7 mm dia x 53 mm length)

10.0 eV Lamps

Attaching a CaF_2 filter onto a standard 10.6 eV PID lamp permits output of the 10.0 eV line but blocks transmission of the 10.6 eV line. In BTEX determination, the advantage of this compared to a 9.6 eV (Xenon filled) lamp is increased detection sensitivity by approx. 20 times, because of the higher output from the 10.0 eV lamp.

The spectrum in figure 2 shows the relative intensities of lines from 10.6 eV, 10.0 eV and 9.6 eV lamps. This clearly demonstrates the effectiveness and output purity due to the construction of Heraeus 10.0 eV lamps.

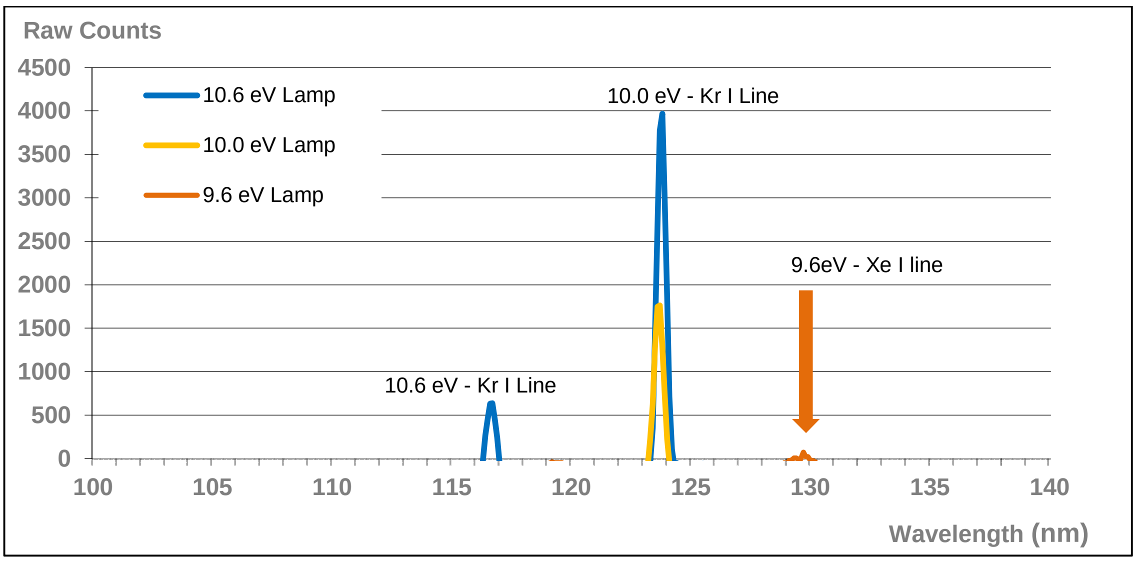


Fig. 2: Vacuum UV Wavelength scan of a 10.6 eV Kr lamp and 10.0 eV Kr lamp (with CaF2 filter) compared with a 9.6 eV Xe lamp

It is also clearly evident that the 10.0 eV line from the CaF_2 window lamp is about 50% lower than the 10.0 eV line from the standard MgF_2 window lamp. There is some attenuation of the line caused by reflection surfaces and by the CaF_2 filter. Of course careful attachment and positioning of the filter is important to produce a consistent intensity from lamp to lamp and minimise this attenuation. This will help users keep detector re-calibration within the range of their instruments when they replace lamps.

The filter sealing material must be as thin as possible to minimise the air gap between the two windows, as this will absorb some of the intensity from the lamp. Selection of this sealing material is also important, as it is necessary to avoid any outgassing which could lead to incorrect PID measurements.

At the same time, careful dimensional control of components avoids excess material and prevents mis-alignment of both windows. Poor control of the process could ultimately lead to seal problems between lamp and sensor, or result in contamination of the optical path with non VUV- transmitting compounds.

Selection of appropriate window thickness will minimise 10.0 eV attenuation and maintain the overall dimensions of the lamp, so enabling simple lamp interchangability from 10.6 eV to 10.0 eV lamps within the same PID sensor body.

Effectiveness of CaF_2 filter window

The response curves in figure 3 show the effect of flushing ammonia through a PID sensor fitted with a 10.0 eV lamp, compared with the same sensor fitted with a 10.6 eV lamp. Ammonia has an ionisation potential of 10.2eV and the absence of any response from the 10.0 eV lamp demonstrates the effectiveness of the filter window.

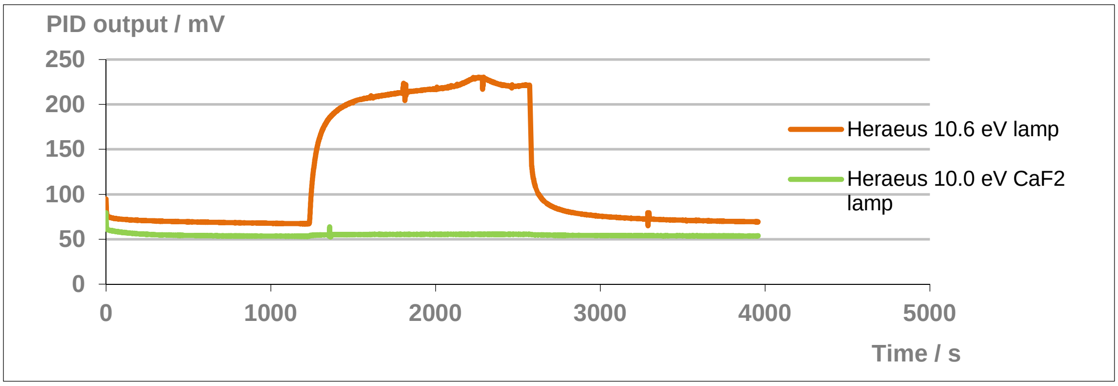


Fig. 3: 20 ppm ammonia response test

Isobutylene calibration

The calibration curves in figure 4 show the expected lower response using a 10.0 eV lamp compared to a standard 10.6 eV lamp due to the CaF_2 filter, but still a significant improvement when comapred to the 9.6 eV xenon lamp.

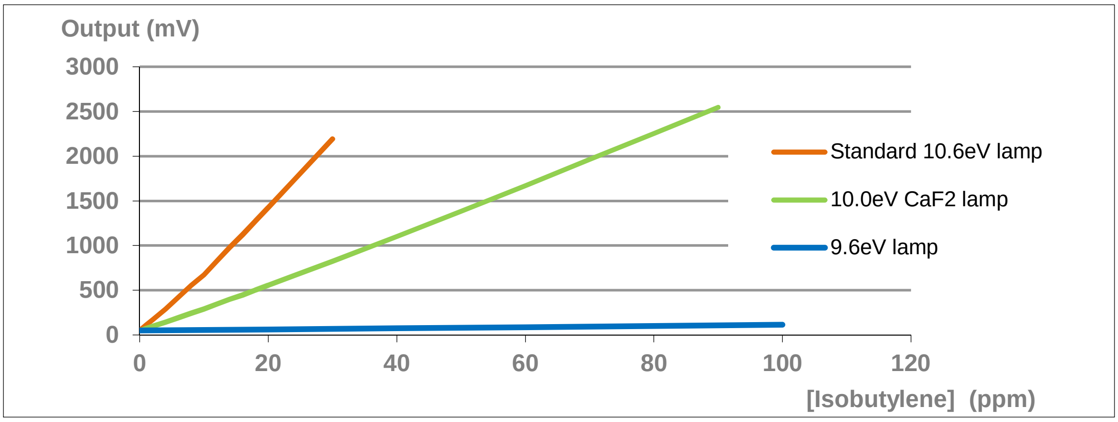


Fig. 4: Isobutylene calibration 0 - 100 ppm on standard 10.6eV lamp, 10.0 eV lamp with CaF_2 filter and 9.6 eV xenon lamp

Benzene calibration

Of course the primary interest in 10.0 eV lamps is for BTEX determination. The comparison in figure 5 shows that the 10.0 eV lamp is slightly lower in response to benzene when compared with the 10.6 eV lamp, but the calibration curve has a similar profile.

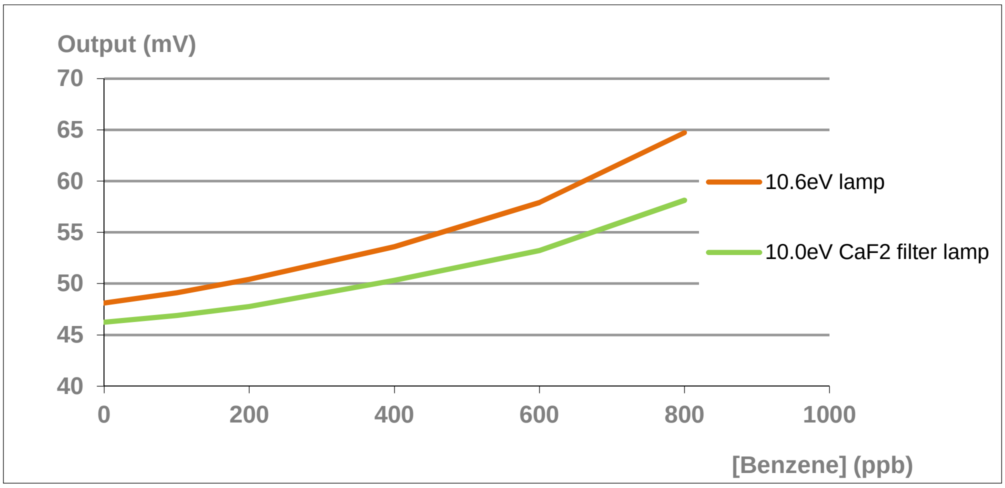


Fig. 5: Benzene calibration 0 - 800 ppb comparison with standard 10.6 eV lamp and 10.0 eV CaF_2 filter lamp

So-called "9.8 eV" Lamps

There are some PID lamps available on the market which are labelled "9.8 eV" and offered specifically for BTEX determination. Samples have been measured on a Vacuum UV monochromator and their line output is identical to that in figure 2, which would indicate these are in fact 10.0 eV lamps and therefore appear to be mislabeled as "9.8 eV". This "9.8 eV" designation could be misleading as users would expect compounds that ionise in the 9.8 – 10.0 eV range like vinyl bromide and nitro benzene not to be detected, resulting in possibly confusing detection results.

Conclusion

The use of a Heraeus 10.0 eV PID lamp can provide selective detection of BTEX compounds compared to a 10.6 eV lamp, and at increased sensitivity over a 9.6 eV lamp. Careful selection of materials and attachment of the CaF_2 filter window is critical to produce consistent and high performance lamps. This lamp still maintains the high spectral purity and long life that is a feature of Heraeus PID lamps.

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