PID UV Lamp Excitation Methods

There are numerous methods of gas excitation inside the PID lamps. The UV light source usually is the most power demanding element in a PID instrument. Therefore, the excitation method greatly impacts the overall dimensions of the instrument.

DC Discharge Method

This type of method is used for lamps designed with two metal electrodes seated inside the glass envelope. The excited gas directly comes in contacts the electrodes, which creates a potential for corrosion, and thus the choice of fill gas is limited. A high voltage DC (~600-1500V) is applied between the anode and cathode to initiate a glow discharge inside the lamp. A precision orifice inside the lamp is used to confine the discharge and excite the natural renounce frequencies of the gases. After the initial excitation, the voltage is then reduced to ~300V to maintain the glow discharge. The power consumption of DC discharge is relatively high, around several watts. The heat generated by these lamps can result in a lengthy warm-up time for the PID instrument to come to thermal equilibrium.

RF Method

This type of method uses a radio frequency (RF) coil wrapped around the glass envelope to excite the gas. No metal parts will be in contact with the fill gas. The electric or magnetic field RF frequency can be in the range of hundreds of kHz to tens of mHz (typically 14 MHz), The RF coil acts as an antenna, which connects the electromagnetic energy into the gas inside the lamp. The power consumption of RF excited lamps is usually in the range of a fraction of a watt to a few watts.

The disadvantage of RF excitation is the antenna radiates radio waves both outwardly and inwardly. This potentially causes interference with other instruments. Additionally, the energy connecting from the RF coil to the lamp is not very efficient unless the operating circuit is perfectly tuned. Therefore, an RF excited UV lamp requires more complexity and constant tuning in order to maintain the connecting efficiency.

AC Electric Field Excitation

This type of method uses a pair of parallel electrodes placed outside the glass envelope. A high-voltage-low-frequency RF signal (<100kHz) is applied to the electrodes to excite the lamp. The remaining ions travel alternately toward each electrode and excite and further ionize the fill gas by cascading collisions. The glow discharge can be operated in a non-continuous way, but with on-off frequency that is rapid compared to the time constant of gas flow through the ionization chamber. In this fashion, the power consumption of the PID can be reduced without affecting its measurement capability.

This excitation method occasionally will result in an initial difficulty in turning the lamp. Therefore, a relatively high initial power is used to turn on the lamp, followed by a power reduction during normal use. Once turned on, the lamps seem to hold the ability to turn on easily for more than a year, presumably by retaining a touch of ions by an unknown mechanism. An advantage of this method is that the low frequency of <100kHz is well below radio and communications equipment, thus reducing potential RF interference.