

## Introducing the Vapourtec UV-150 Photochemical Reactor

### Photochemical reactor – continuous photochemical reactions

Photochemistry, or the use of light in chemical reactions, has a number of important applications both in nature and industry. Photochemical reactions lie at the heart of photosynthesis and vitamin D formation, and play important roles in the manufacture of electronic equipment, protective coatings and the synthesis of drugs and fragrances.

Traditional batch photochemistry however has fallen out of favour. A number of problems such as safety, the availability and complexity of equipment, the control of reaction conditions and the difficulty in scale-up, limit its use.

The breakthrough Vapourtec UV-150 photochemical reactor makes photochemistry accessible. Eliminating the problems of traditional batch photochemistry, the UV-150 reactor allows the full potential of photochemistry to be exploited. It offers safe, precise, efficient, consistent and scalable photochemistry under continuous flow operation.

### Features of the UV-150 photochemical reactor

- Compatible with R-Series and E-Series.
- 3 light sources available.
- Interchangeable light sources – all fit in same reactor body.
- Temperature control.
- Multiple gram/hour scale-up.
- Easily changed reactors.
- Compact, space saving design.
- Optional spectrometer for real time transmission spectra.
- Interlocks for safety.



### Compatible with R-Series and E-Series

The UV-150 photochemical reactor has been designed to interface with both Vapourtec R-Series and E-Series flow chemistry systems. In common with the Vapourtec's family of reactors, the UV-150 simply plugs into the ports in the system. Connecting the temperature sensor and power supply module completes the installation. Installing and getting a reaction running with the UV-150 reactor takes less than 5 minutes.



### Light sources

Vapourtec offer 3 different light sources to offer precise wavelengths between 220 nm and 650 nm. Available light sources:

- Medium pressure mercury lamp
- Low pressure mercury lamp
- Monochromatic LEDs

### Temperature control

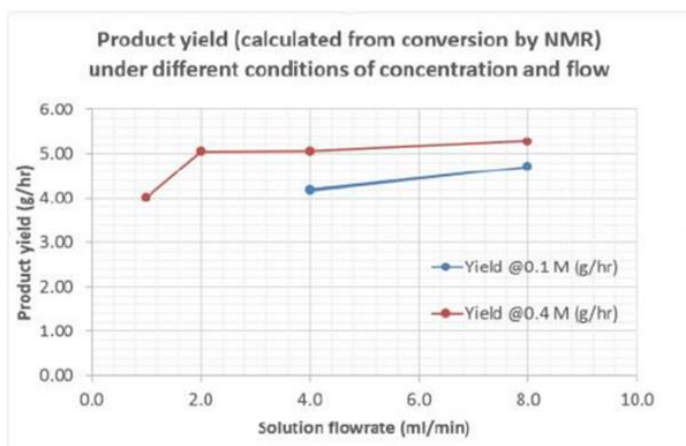
The UV-150 photochemical reactor is designed to give safe and accurate heat management as well as the best possible reaction selectivity. It provides a temperature controlled environment which can be set between -20°C and 80°C.

The reactor and lamp are housed in separate, sealed quartz chambers. Air is circulated within each chamber to dissipate heat and then separated exhausted from the system. The high flow rate of gas gives effective temperature control. A dichroic mirror further removes heat from the system and reflects more than 90% of UV energy back into the reactor.



### Multiple gram/hour scale-up

## [2+2] Cycloaddition of Maleimide and 1-Hexyne



The scale-up of traditional batch photochemistry is challenging. The UV-150 photochemical reactor makes scale-up accessible.

The high power of the medium pressure mercury lamp for example, allows the synthesis of multiple gram / hour quantities of material. In an experiment to replicate the [2+2] Cycloaddition of Maleimide and 1-Hexyne from published literature, conversions of greater than 5g / hour have been achieved.

### Easily changed reactors



The UV-150 reactor is made from a single layer of thin walled, small bore fluoropolymer tubing. This maximises the absorption of light photons by reagents.

Tubing is constructed into cartridges which can be easily removed and replaced within seconds. Standard reactor cartridges are available in 2ml, 5ml or 10ml volumes, with smaller reactors advantageous in minimising reagent consumption when optimising reaction conditions. Vapourtec now offer a user rewindable 10 ml cartridge.

### Compact design

The compact design of the UV-150 photochemical reactor means it is much smaller than traditional photochemical reactors. In addition, there is no need for a large external recirculating chiller that has traditionally been used for cooling the lamp in other reactors.

The compact design means that the UV-150 reactor occupies only one reactor position on the E-Series or two reactor positions on the R-Series. This allows the scope for completing multiple step (telescoped) photochemical reactions.



E-Series

R-Series

### Real time spectra data



Real time spectral data is a huge benefit in photochemical reactions. The UV-150 photochemical reactor offers an optional spectrometer allowing spectral intensity, wavelengths and reactant adsorption to be measured.

The reactor is provided with a fixture to clamp a fibre-optic probe. This probe conveys light to a spectrometer for analysis. The position of the fixture enables the probe to 'look through' the reactor directly towards the lamp. This allows the relative spectral intensity of the reactants to be measured as the reaction occurs.

Vapourtec can supply a suitable fibre-optic probe and CCD Spectrometer if required.

### Interlocked for safety

Safety is fundamental in the UV-150 photochemical reactor design. The light source is completely enclosed allowing it to be safely used in a standard laboratory fume cabinet without any additional light shielding.

The power supply to the reactor is interlocked ensuring power is safely and automatically disconnected if the lamp become exposed. The forced ventilation system prevents build-up of flammable gases or vapours.





## Medium pressure mercury lamp

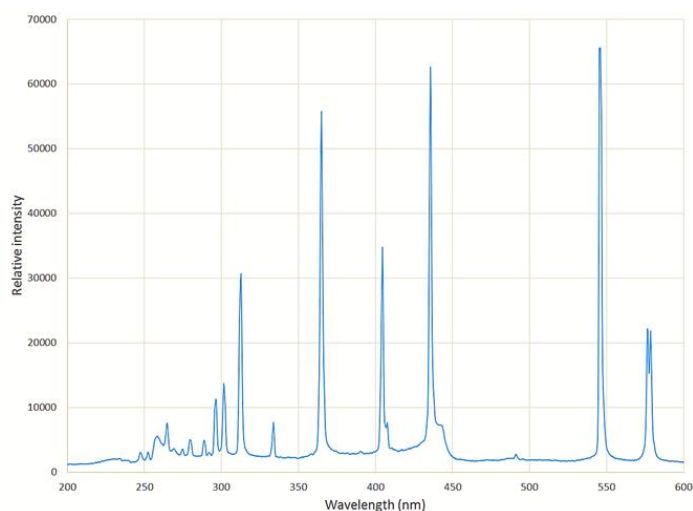


The medium pressure mercury lamp provides constant and precise UV output, with user selectable UV power between 75 W to 150 W. This allows dimmable operation without compromising lamp life or spectral output.

Manufactured specifically for Vapourtec, power is supplied by a state-of-the-art electronic ballast - maximising lamp life. Lamp end-life and fault conditions are automatically detected, with automatic system shut down for safety.

Due to the high intensity of the medium pressure mercury lamp, the light source is maintained under cooled air conditions. Cooling is provided by the Vapourtec cooled gas generator and existing cooled gas generators (purchased with the cooled tube reactor) can be used.

Cooling provides precise temperature control between  $-5^{\circ}\text{C}$  to  $80^{\circ}\text{C}$  with  $\pm 1^{\circ}\text{C}$  resolution. Temperature is measured directly at the reactor wall giving the most accurate temperature representation.



The high intensity medium pressure mercury lamp has a broad radiant output – providing wavelengths from 220 nm to 600 nm. For this reason, Vapourtec offers a range of 9 wavelength filters for use with the medium pressure mercury lamp.

## Wavelength filters



The unfiltered medium pressure mercury lamp provides a broad radiant output of wavelengths between 220 nm and 600 nm. Vapourtec offer a range of 9 wavelength filters for use with the mercury pressure mercury lamp. These allow the selection of desired wavelengths, in addition to eliminating unwanted wavelengths that cause side reactions or the decomposition of products. Filters also have a key role in reducing the heating effect of the lamp.

Wavelength filters are positioned between the lamp and the reactor and can be quickly and easily changed by hand. Both long-pass and band-pass filters are available. A 'blank' filter allowing the full spectral output to be transmitted is also available.

## Monochromatic LEDs

In addition to the medium pressure mercury lamp, Vapourtec also offer a selection of 13 specific LEDs ranging from 365 nm to 525 nm. These provide a precise wavelength and therefore do not need to be used with a filter.



Each of the LEDs provided are interchangeable and fit into the same reactor body. They can be easily changed by hand in less than a minute - providing versatility as your research needs change.

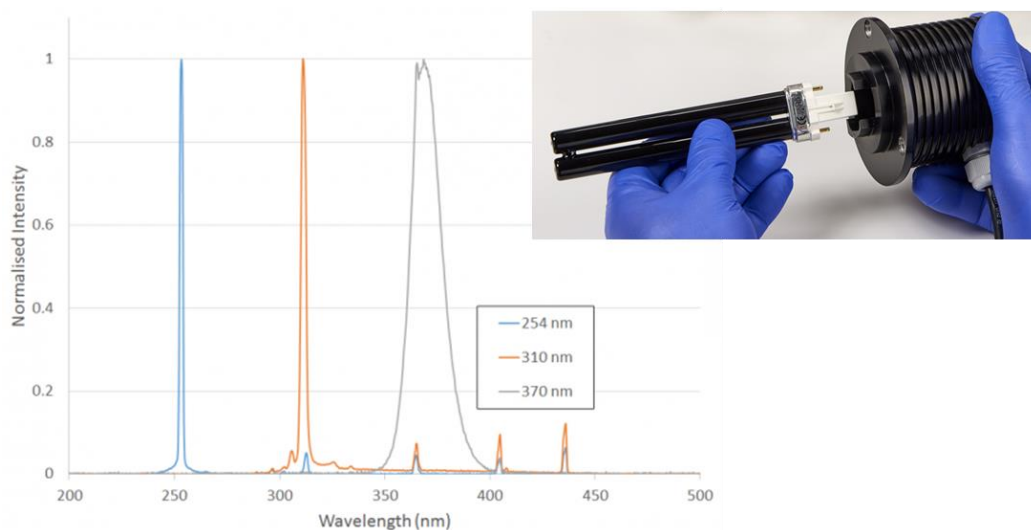
LEDs are extremely efficient with a life expectancy of approximately 10,000 hours. Their low heat load means they can be cooled to temperatures as low as  $-40^{\circ}\text{C}$ , in addition to the ability to heat to  $80^{\circ}\text{C}$ .

### Low pressure mercury lamp

In addition to the medium pressure mercury and LED light sources, Vapourtec also offer three low pressure mercury lamps. These offer specific wavelength emission and provide wavelengths not available with the medium pressure mercury or LED light sources. The three wavelengths available are:

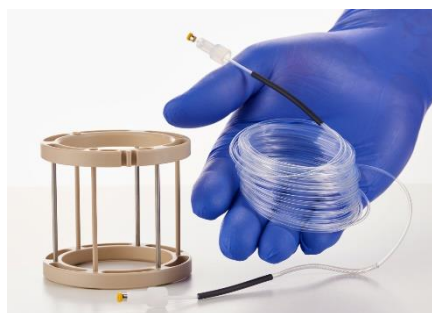
- 254 nm
- 310 nm
- 370 nm

Due to the low heat load of the low pressure mercury lamps, lamps do not require filtering and allow a temperature range of  $-40^{\circ}\text{C}$  to  $80^{\circ}\text{C}$  to be achieved.



### Rewindable reactors

UV-150 photochemical reactors are constructed in cartridges. Standard reactor cartridges of 2 ml, 5 ml and 10 ml volume are available, and can be removed and replaced in seconds.



Reactor coils of 10 ml can be purchased as rewindable coils. The fluoropolymer tubing is supplied pre-coiled making it easy to assemble on the cartridge. The reactor can then be easily replaced by the user reducing the cost of ownership.

For more information on rewindable coils, please contact Vapourtec.

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