

Spectra of the Month (August 2021)

Conducted by: David Ademe, Avantes Inc.

Theme: Absorbance

Background/Applications:

Absorbance spectroscopy can bring entirely new perspectives on samples through a wide range of industries. This includes the water industry, verifying the quality and purity water to determine what contaminants and particles may be present in the water, that may not be visible to the human eye.

Being able to detect low limits of particulates in water is extremely crucial, therefore a highly sensitive spectrometer is needed to detect parts per million (ppm). For this experiment, showing the power of Avantes equipment to detect these low concentrations.

Description of System:

The setup for this experiment utilizing an AvaSpec-HERO, coupled to a long path cuvette holder and AvaLight-DH-S-BAL light source to measure the absorbance through the sample.

The AvaSpec-HERO is the top of the line spectrometer! Based on our High Sensitivity Compact (HSC) optical bench ($f=100\text{mm}$; $NA=0.13$) and a 1024×58 backthinned CCD detector, it offers the best of both worlds: high sensitivity and resolution. The instrument is equipped with thermoelectric cooling, enabling long integration times in low light applications. In conjunction with our AS7010 electronics, including a high-end AD convertor, noise is kept to a minimum, which gives you an excellent Signal to Noise and Dynamic Range performance. A selection of gratings and slits offers you the flexibility of configuring the instrument for a wide range of applications in the 200- 1160 nm range. From low light fluorescence applications to demanding Raman applications, the AvaSpec-HERO is your ideal companion. With the high-speed USB3.0 and Gigabit Ethernet communication interface, the connection to your computer is fast and simple. The digital IO ports enabling external triggering, control of shutters, and pulsed light sources from the Avantes line of instruments are available as well.

The AvaLight-DH-S is a powerful deuterium halogen source, but, like any unbalanced deuterium halogen source, it does have a very dominant alpha peak at 656 nm. Therefore, Avantes developed the DH-S-BAL, in which this peak is drastically reduced by a dichroic filter. This means less power, but an increase in the dynamic range of a factor 20. The light source delivers a continuous spectrum with high efficiency. The highest stability is in the ultraviolet, visible, and near-infrared range, from 200 to 2500 nm. An integrated TTL-shutter and filter holder for filters of up to $50 \times 50 \times 5.0$ mm are included. The TTL-shutter can be controlled from any AvaSpec spectrometer, which means the auto-save-dark option in AvaSoft software can be used.

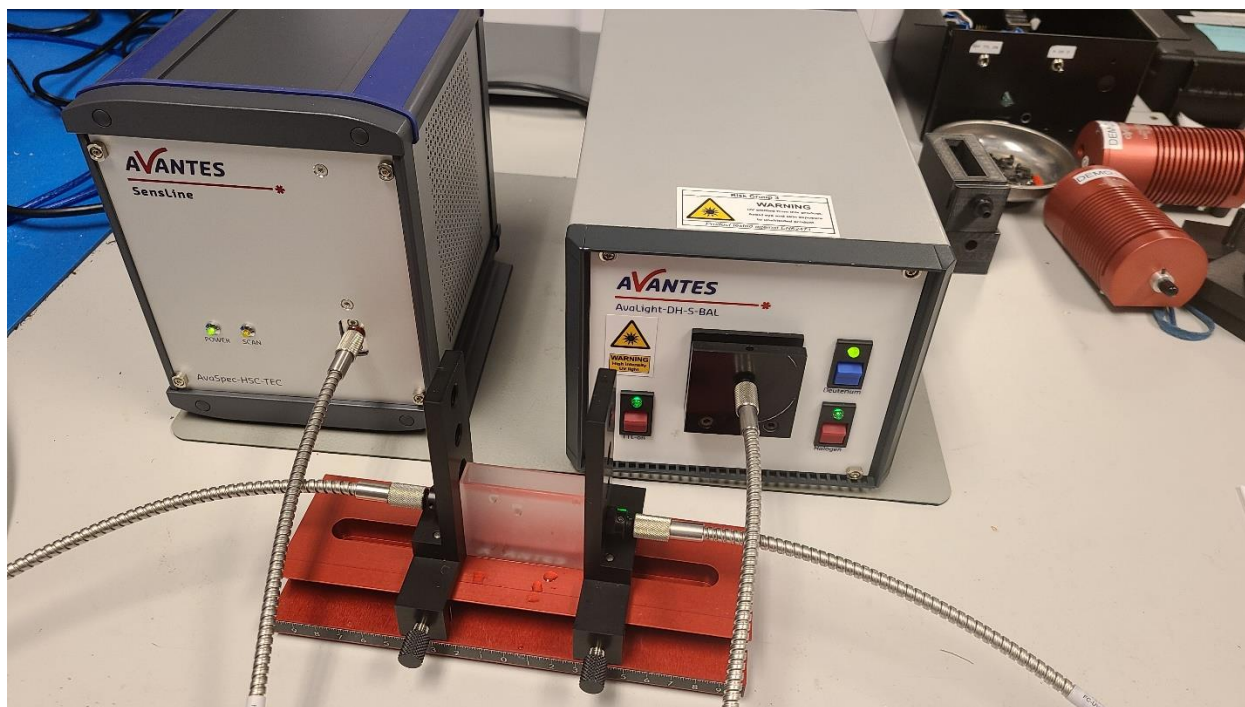


Figure 1: The setup for the experiment.

Description of Methodology:

For this experiment, we will be utilizing the AvaSpec-HERO with an AvaLight-DH-S-BAL to measure samples in a 10mm pathlength cuvette. We will be testing three different solutions of butylparaben in distilled water. The concentrations of the solutions are: 100ppm, 10ppm and 1ppm.

For our data collection, we will be utilizing the absorbance package in the AvaSoft software.

Test Data and Results:

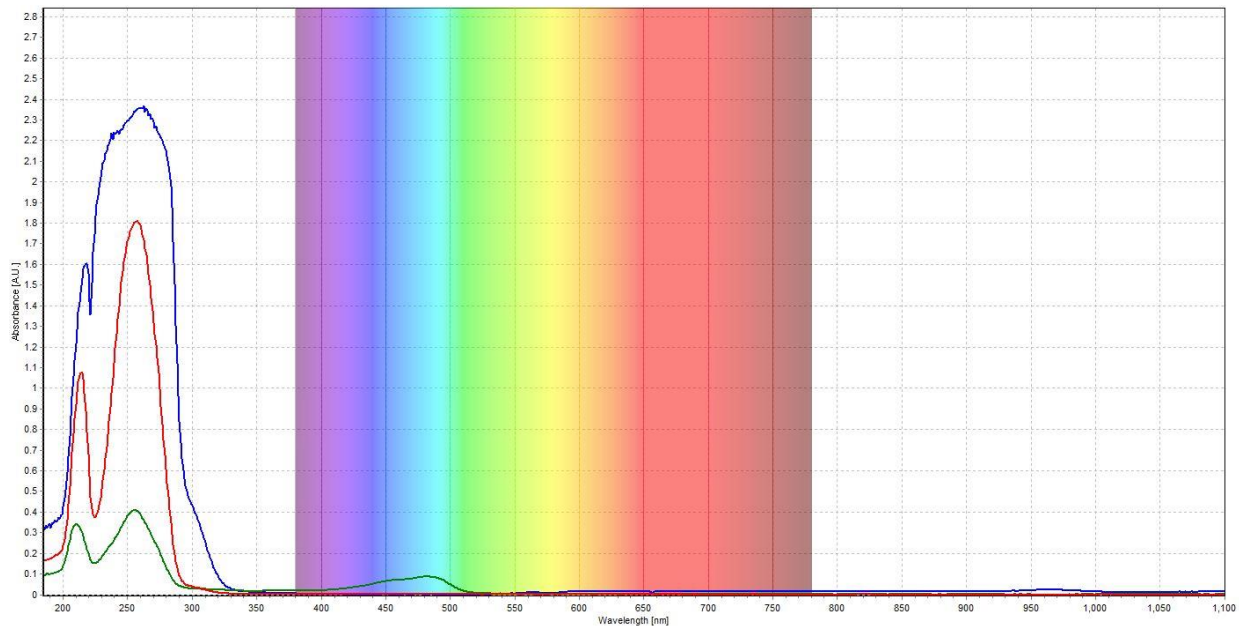


Figure 1: The absorbance spectra for the three concentrations (Blue=100ppm, Red=10ppm, Green=1ppm).

Analysis:

Our setup utilized a long pathlength cuvette (10mm) to ensure the particulates were visible. This proved to be an effective method, as the HERO was easily able to detect the butylparaben in each of the solutions. Cross checking the data with that of known butylparaben absorbance spectra, the absorption peaks at 214 nm and 256 nm are exactly what is expected.

Conclusion:

The spectra from the three solutions proves that the AvaSpec-HERO is truly phenomenal at collection high resolution spectra from samples and applications that require high sensitivity.