Particle monitoring of heavy fuel oil through NIR spectroscopy

Current situation

Burning heavy fuel oil results as side effect organic substances that are damaging to the environment and motors. Asphaltenes are harmful substances that not only have a significant impact on the service life of marine technology, but, when released, also wreak devastating effects on the environment.

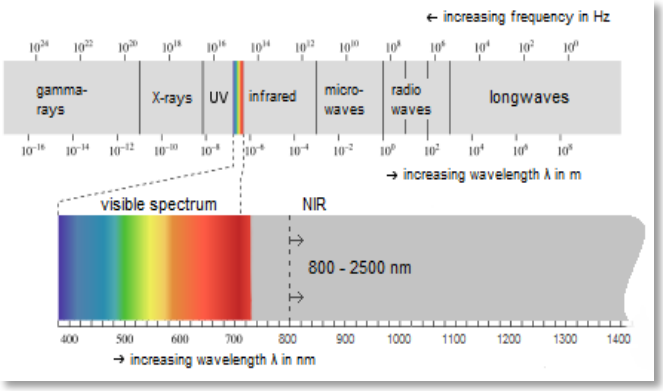
With the introduction of new standards and international regulations for reducing and monitoring such emissions, the search for new solutions is becoming increasingly challenging for manufacturers from the marine industry. The globally permitted concentration of sulfur in fuels, for example, is expected to be reduced from 3.5 % to 0.5 % in 2020. The regulations regarding emissions and combustion of heavy fuel oils in marine technology are managed and controlled by the IMO (International Maritime Organization).

The raw material's characteristics will make this future requirement to monitor heavy oils very difficult to meet. Some heavy fuel oils only become truly liquid at around 300 °C.

Heavy fuel oils are usually heated to 85–100 °C on their way to the combustion chamber in the motor. At these temperatures, heavy fuel oils are viscous enough to reach the motor. However, if the raw materials cool down during this process, residues will form on the measuring tools and pipes, which could later obstruct flow and measurement accuracy.

The solution

Near-infrared spectroscopy (NIRS) is an efficient way of permanently monitoring the components of heavy fuel oils. It focuses on the absorbance measured in the near-infrared range of the electromagnetic spectrum (800–2500 nm or 12500–4000 cm^{-1}).



Integrating a spectrometer through a measuring cell at the point where the heavy fuel oil is fed into the motor enables inline measurements to be recorded and monitoring to take place in real time.

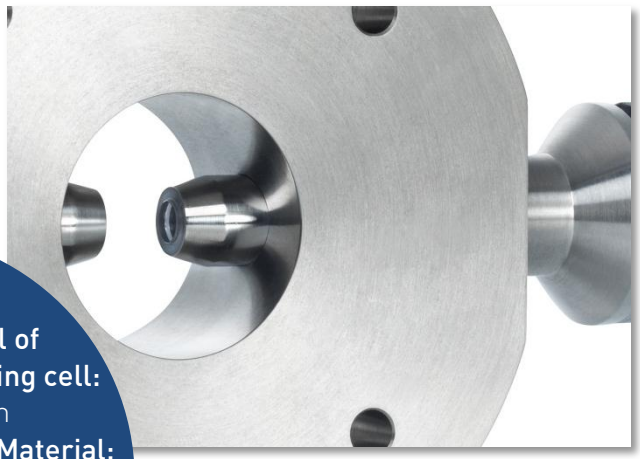
The heavy oil would flow through the measuring cell at a temperature of approx. 85–110 °C (185–230 °F) and a pressure of approx. 120 mbar (17.4 PSI). As such, the integrated measuring cell must also be able to withstand these conditions.

The measuring cell and measuring window material should repel particles that could adhere to it which prevents blocking of the measurement beam.

The Hellma Analytics measuring cell 663.516 with sapphire windows has performed particularly well in tried and tested applications with similar parameters. Sapphire windows were chosen due to their ability to withstand high temperature and pressure and due to the fact that it is difficult for particles to adhere to sapphire surfaces. Using measuring cells to gather continuous results from inline measurement allows monitoring to take place in the control station in real time.

Advantageous to other conventional measuring methods, inline measurement eliminates the complex and time consuming procedure of collecting and testing the samples.

Measurement results recorded at second- or minute-long intervals ensure that the particle concentration, as well as other parameters, such as additive concentration, temperature and pH value, can be monitored closely. Online measurements can be recorded around the clock to enable any deviations and trends to become immediately visible, allowing the process to be interrupted and adjusted accordingly at any time.



Material of Measuring cell:
Titanium
Optical Material:
Sapphire

Special features:
- Resistant to high pressure + high temperature
- welded windows

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