

Benzene Quantification

PROZESS
TECHNOLOGIE



APPLICATION NOTES

Analyte: Benzene C₆H₆

Detector: Reveal NIR process analyzer (Near Infrared spectrometer 1550–1950 nm)
– % concentrations

Reveal UV process analyzer (Ultraviolet spectrometer 190–400 nm)
– trace concentrations

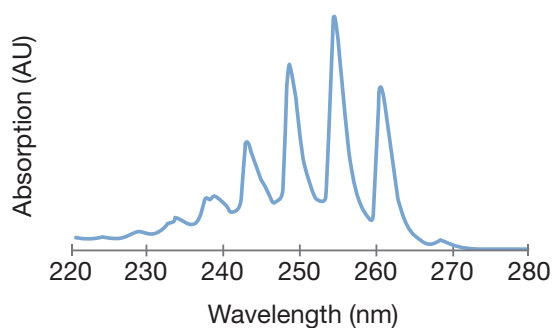


HIGHLIGHTS

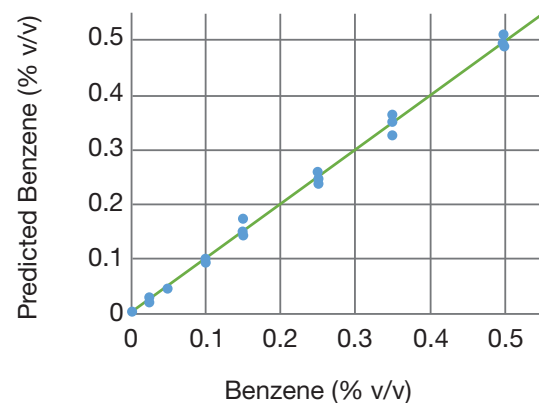
- Millisecond measurement times
- Internal referencing, wavelength and linearity validation for stable, continuous operation
- WiFi, Ethernet, OPC, ModBus, Ethernet/IP communications standard
- Hazardous area enclosure options
- Various sampling options



SPECTRAL ANALYSIS



REGRESSION ANALYSIS



Summary

Real-time, continuous, non-contact quantification of benzene during its extraction and processing can increase production rates and minimize contamination from other hydrocarbons. Prozess Technologie's Reveal platform is ideally suited for benzene measurement, with millisecond measurements, a variety of sample interfaces, and rugged system designs for the manufacturing environment.

Benzene Production

Benzene (C₆H₆) is perhaps the most elementary petrochemical, with many uses across industries. Benzene naturally presents in crude oil, from which it is normally extracted using catalytic reforming processes, then distilled from other aromatic compounds such as toluene and xylene. Benzene is most widely used as a precursor to intermediates in the production of styrenes, from which a number of plastics are manufactured. It is also a primary precursor in the production of Nylon and several adhesives. Benzene has also been used as an anti-knocking agent in gasoline, though recent regulation is limiting its use in this case due to environmental concerns.

Because extracting purified benzene entails many intermediates and a variety of processes, it is often critical that the benzene content in a process stream be quantified to identify production efficiency and contamination by other hydrocarbons. In many cases, sacrifices are made to allow for slow, multiple-minute analytical measurements such as in gas chromatography, or maintenance-laden fast loops with multi-stage preprocessing such as in mass spectroscopy. Fortunately, the aromatic molecular structure of benzene makes it highly photo-active, such that light in the near-infrared (NIR) and ultraviolet (UV) can be used to identify and quantify its presence.

The use of optical analyzers for benzene quantification allows a significant simplification over traditional GC/MS techniques, particularly for on-line process applications where percent-level measurements are required. The optical analyzer is significantly faster with millisecond response times, cheaper and easier to maintain, and can be used in-line without complex preconditioning requirements. The Reveal was engineered from the ground up for industrial installations that utilize these optical advantages, and combine a variety of available sample interfaces for rapid installation and trouble-free operation.

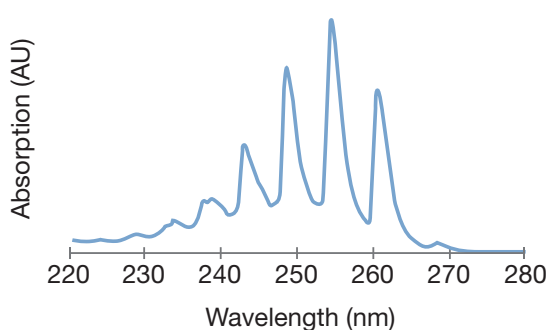


Figure 1: Benzene absorption in the ultraviolet spectrum, as measured on the Reveal, yields a number of distinct features with various optical activity, permitting quantification across a range of concentration levels.

Reveal

The Reveal contains integrated light sources and dispersive spectrometers utilizing linear diode array detectors, with no moving parts for high throughput and maximum stability. The Reveal contains automated internal hardware for lamp referencing and for wavelength and photometric linearity validation, all of which can be performed at user-defined intervals. Standard communications in the system include WiFi, Ethernet, OPC, ModBus, Ethernet/IP for upstream and downstream interface with distributed control systems, computers, or tablets. Sampling options range from flow cells with selectable path lengths, to measuring heads that mate to sight glasses in vessels, to fiber probes for contact or non-contact measurement in various insertion points.

Prozess provides a myriad of engineering solutions to integrate into customers' process streams. Hazardous area enclosures, additional analog and digital inputs and outputs, and sample head integration are just a few of Prozess' competencies to ensure a turnkey and trouble-free implementation. With high stability and genuine real-time measurement, the Reveal is a dependable device for monitoring both continuous and batch processes.

PROCESS MEASUREMENT
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