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Gas Concentration Analyzers Based on Tunable Diode-Laser Spectroscopy (TDLS), Manufactured by Axetris AG, Provide High Sensitivity, Fast Response and Highly Specific Measurements of Several Gases.

ABSTRACT - Masterthesis

Gas concentration analyzers based on tunable diode-laser spectroscopy (TDLS), manufactured by Axetris AG, provide high sensitivity, fast response and highly specific measurements of several gases.

For field applications outside the laboratory practical limitations are important. At ambient mixing ratios below a one parts-per-million spectrometers become more and more sensitive towards noise, interference, drift effects and background changes associated with low level signals.

To maintain optimal sensor performance a high quality-level of optic and optomechanical components is required. Lasers used in these devices, as light source, must meet certain quality requirements to stable operating in long-term and also in various environmental conditions. Therefore a test method is required to measure, analyze and assess the key performance indicators (KPI) with respect to the sensor quality.

This work provides a development way of diagnostic methods to test quality parameters of the laser assembly and its entourage and sort out laser with insufficient quality before integration into the spectroscope for the gas detection.

Based on the analysis of the product database, error categories and its frequencies are defined. In each error groups are identified and discuss the assessment criteria of the laser performance that can effect on the efficiency of the gas analyzer. An analysis of sorted out laser modules include an understanding of the failure mode. The production positions of the spectrometer assembly, in which an early determination of the suitability of the laser is possible, determined and discuss.

A pre-integration measurement processing strategy and a concept for measurement system to identifying laser performance applicability for tunable diode-laser spectroscopy described and discuss.

A functional demonstrator developed to perform measurements over laser to obtain laser operating parameter and performance characteristics. To meet the requirement of quality assurance for monitoring applications procedures to check the linearity are described and some measurements are presented and discussed. The correlation of the results from the demonstrator and the performance of the complete assembled gas analyzer as well as an assessment of the acceptability of the developed measuring system are done.