

## Principle of Operation

### Analytical Basis

The analytical heart of the instrument **KegControl** is a sensor array. This is a new technology for the fast classification of gases and gas mixtures. Several sensors react on gaseous compound within the sample air. The combination of all sensor signals is called a pattern which is specific for a certain gas mixture that is currently measured. By comparing the pattern stored in a database with pattern from an actual measurement, the system is capable of deciding whether a sample belongs to a trained standard or includes chemical deviations from that.

Using this technology, a new measurement system has been developed for the detection of contaminations in beverage containers directly during the refilling process.



**The major advantage** of the new solution is that only the standard or a few classes of “normal” condition has to be trained. With the capability to detect a very broad range of organic and inorganic gases with high sensitivity (at ca. 1ppm) every chemical deviation from that will be detected as failure – releasing an alarm. It is only little work to train the standard and to initialize the instrument.

### Measurement Results

The result of a measurement is displayed on a display at the front panel. Additionally, it is delivered to the plants logic process control by the use of digital signals. A status report can also be evaluated.

An example of a series of measurement is given in figure 2. This is a series of measurement at a running keg refilling plant. During this series of kegs partially containing residual amounts of beer, some contaminated kegs have been introduced into the process.

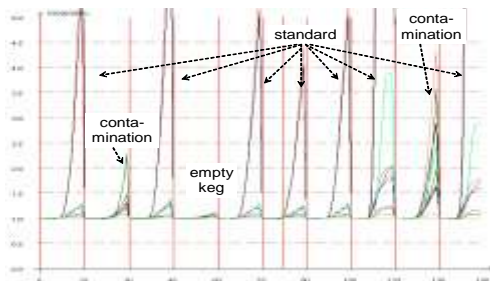


fig. 2: Measurement series with **KegControl**

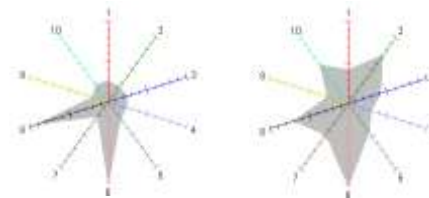


fig. 3.: Examples of pattern: left: keg containing residual beer (standard); right: contamination with gasoline

Drawing all sensor signals from a specific time point during the measurement within a polar plot gives a visual idea of a pattern. Differences of measurement signals from “normal” and from contaminated kegs can be viewed easily this way (fig. 3).

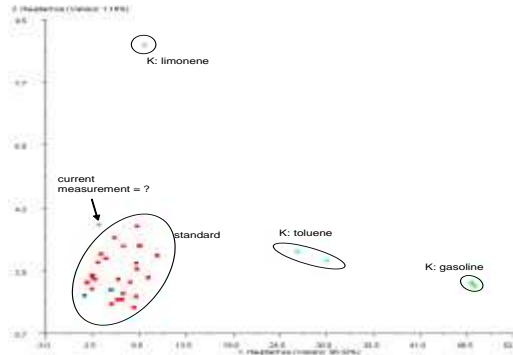


fig. 4: PCA-diagram of measurements

After introducing all pattern into a database and transforming them by the use of the principal component analysis (PCA) all measurements can be displayed within a two dimensional plot (fig. 4). This shows the differences present in the measurement of the standard (no contamination) and contaminated kegs. A classification will detect these differences and release the alarm.

### Setup

The measurement system principally contains two basic components: the separator and the sensor unit.

#### Separator (sampling)

The separator is responsible for the generation of the sample gases out of the process stream. It is directly connected to the process sample line. Via a gas connection the sensor unit can transfer the sample gas by an internal pump.



fig. 5: Separator installed at process sample line the outlet of the

#### Sensor Unit

Within the sensor unit, the control of the whole measurement process, the sensor array and the fluidic system are incorporated. It contains also the central processing unit with communication to the plants process control and to other devices like external PC, etc. A display shows the actual status and the result of the current measurements. Direct options for user interaction are buttons for “start/stop” and “acknowledgement”, a main switch and the Airsense control software running on an external computer. This software enables parameter adjustment, training of pattern database and result calculation.



fig. 6.: Sensor Unit V1.2

### Installation and Setup – Specific Topics

**KegControl** has been set into operation for cooperation with various Keg refilling plants. Small adjustments for the adaptation to specific process parameters can be easily carried out so that the system can be installed at very different plants by the use of its **high flexibility**.

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ANALYTICS

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