

## Accurate CO<sub>2</sub> measurements ensure efficient fermentation



measurements are generally taken from a secondary line, which enables removing undesired elements such as foam or excess humidity from the exhaust gas.

The carbon dioxide concentration of the enzyme production process is typically from 0 to 5% of CO<sub>2</sub>, in exceptional cases concentrations as high as 10% of CO<sub>2</sub> can be measured.

In a fermentation process where mold is elevated, the carbon dioxide concentration is typically around 1 or 2% of CO<sub>2</sub>. The oxygen concentration of the exhaust gas also depends on the metabolism. Often the metabolism consumes O<sub>2</sub> as much as it produces CO<sub>2</sub>. The relation of the volume of CO<sub>2</sub> released to the volume of O<sub>2</sub> consumed is called the respiratory quotient (RQ).

### Reliable humidity and carbon dioxide measurements to streamline fermentation process

The humidity of the fresh air blown into the bioreactor can be reliably measured with Vaisala humidity instruments.

Carbon dioxide can be monitored with the [Vaisala CARBOCAP<sup>®</sup> Carbon Dioxide Probe GMP251](#).

Vaisala instruments are accurate, reliable and require minimal maintenance. They help to minimize the downtime of the fermentation process.

### Critical measurements in the production of enzymes

Enzymes are produced in the biological process of fermentation. Careful monitoring of the fermentation process is essential and it starts with measuring pH-value, temperature, dissolved oxygen, and carbon dioxide in the fermentor broth. The oxygen and carbon dioxide levels are measured from the exhaust gas. The gas temperature is typically 25 °C - 30 °C and the relative humidity is around 100%. The exhaust gas may also contain ammonia, since the substance is used to control the pH levels of the fermentor broth.

### Process control with continuous CO<sub>2</sub> monitoring

Also the humidity of the fresh air blown into the fermentor is measured. The demanding surroundings require reliable measurement instruments. The CO<sub>2</sub> concentration of the enzyme production process is monitored in order to get a picture of the state of the process. The level of CO<sub>2</sub> is an indication of the metabolic activity of the mold or bacteria, and the information is used to control the feed of new nutrient pulses to the process.

The correct level depends on the microbial strain and the fermentation process itself, and it is a matter of experience to know when a new nutrient pulse should be fed into the process. It is essential to ensure that fresh air supply to the bioreactor is sufficient to keep the fermentation process on-going. Exhaust gas

