

Application report:

Glucose/Lactate (in small bioreactors)

Method: Dialysis

Measurement range: Glucose 0.5 – 20 g/L, Lactate 0.25 – 10 g/L



INTRODUCTION

Glucose is by far the most important substrate for microorganisms and animal celllines in bioprocesses. In over 90 % of all microbial cultivations and in many animal cell cultivations it is used as carbon source. Lactate is a metabolic product of various microorganisms and a very important byproduct in animal cell cultivations.

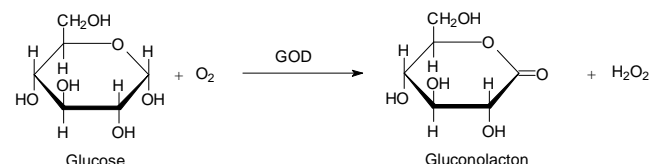
The online analyser TRACE C2 Control allows a rapid and precise determination of Glucose and Lactate concentrations inside the bioreactor.

Today it is possible to measure Glucose and Lactate with the TRACE dialysis probe in small bioreactors with a filling volume of 6 cm (figure 1, left picture). But it was difficult to use the probe in smaller bioreactors, especially if they were used with a low liquid level. In this case the surface of the membrane was not covered completely with liquid.

MEASUREMENT PRINCIPLE

Glucose

The enzyme glucose oxidase (GOD) is used for the detection of glucose.

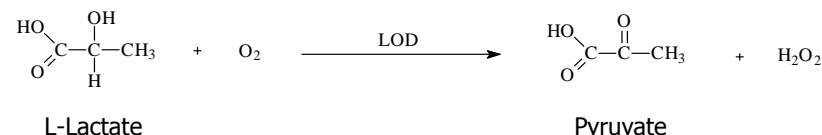


In presence of oxygen, glucose oxidase catalyses the transformation of β -D-Glucose to D-Glucono- δ -lactone and hydrogen peroxide. The Glucose content is measured indirectly via the formed peroxide, which is re-oxidized to oxygen during the amperometric measurement. The resulting electrical current at the electrode is directly proportional to the amount of oxidized Glucose.



Lactate

The enzyme lactate oxidase (LOD) is used for the detection of lactate.



In presence of oxygen, lactate oxidase catalyses the transformation of L-Lactate to Pyruvate and hydrogen peroxide. The Lactate content is measured indirectly via the formed peroxide, which is re-oxidized to oxygen during the amperometric measurement. The resulting electrical current at the electrode is directly proportional to the amount of oxidized Lactate.

USE IN SMALL BIOREACTORS

A membrane with half area was designed (figure 1, middle). With this membrane it is possible to measure inside small bioreactors (e.g. the single-use vessel DasGIP BioBlu 0.3f) filled with only 90 mL liquid (figure 1, right). By using a standard membrane a minimum filling of 140 mL liquid is required.



Figure 1: Left: Small DasGIP/Eppendorf vessel. Middle: New membrane with half area for minimal immersion depth. Right: TRACE Dialysis probe inside a small vessel.

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SYSTEM PERFORMANCE

These data were compiled in order to give an overview of the system- and sensor-performance in the normal concentration range using the dialysis sampling method with the new membrane (half area for minimal immersion depth).

Linearity

By comparing the actual value with the set value a regression coefficient R^2 of not less than 0.9995 will be obtained (Figure 2).

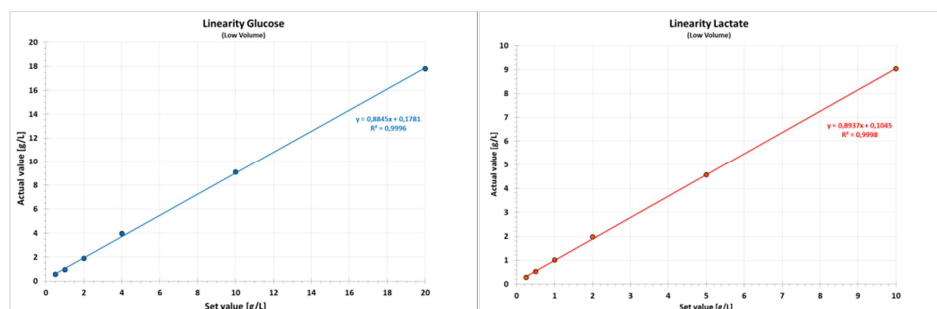


Figure 2: Linearity of Glucose ($R^2=0.9996$) and Lactate ($R^2=0.9998$)

Precision

The typical variation about the mean value is below 1.5% (Figure 3), except for the low concentrations ($< 2.5\%$).

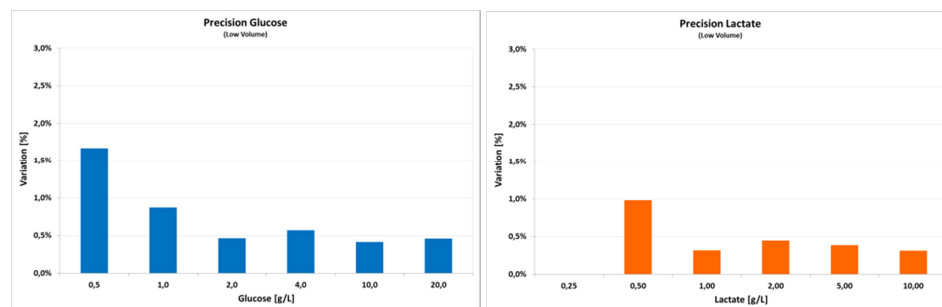


Figure 3: Precision of Glucose and Lactate

Recovery

The recovery of the glucose and lactate values is shown in figure 4.

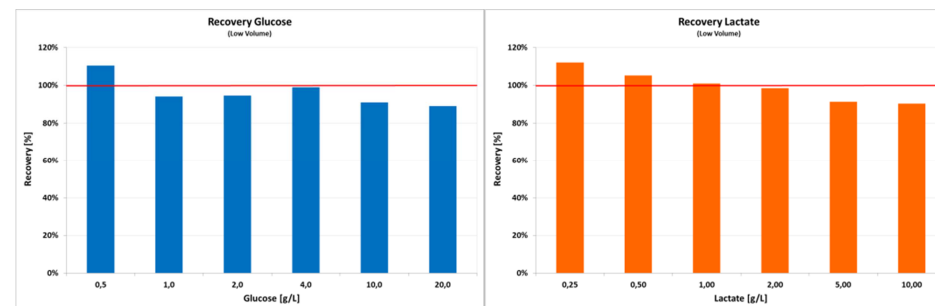


Figure 4: Recovery of Glucose and Lactate

Operational stability

Long term stability for the application Glucose/Lactate is guaranteed for 5.000 measurements or 14 days.

Shelf life

Glucose-/Lactate-Sensors have a shelf life of at least 12 months at room temperature.

Consumables

Consumables for the application Glucose/Lactate are listed in the following table:

Part	Part number
Tubing set dialysis (Glucose/Lactate)	130.200.000
Transport buffer 20x, for cell cultivations (Glucose/Lactate)	850.300.135
Transport buffer 5x, for microbial cultivations (Glucose/Lactate)	850.300.102
Calibration Standard 0,5 g/L Glucose, 0,25 g/L Lactate	850.305.000
Calibration Standard 2 g/L Glucose, 1 g/L Lactate	850.305.002
Calibration Standard 10 g/L Glucose, 5 g/L Lactate	850.305.004
Membrane 5x (for minimal immersion depth)	860.211.080
Cleaning solution	850.300.710