Oxygen Sensor DT222A

(for EcoLog XL)

The Oxygen sensor is a galvanic oxygen electrode, capable of measuring % O_2 in air.

The Oxygen sensor can be used to perform a wide variety of experiments to determine changes in % O_2 in air especially in photosynthesis and respiration of plants and monitoring human respiration.

The sensor consists of a galvanic oxygen sensitive electrode with a processing unit (oxygen adaptor, equipped with a calibration knob).

The Oxygen sensor has to be calibrated before every measurement.

The electrode is warranted for 12-months to be free from manufacturing defects and to meet specifications. These electrodes have been known to last for years with proper storage.

Typical Experiments

- Monitoring human respiration
- Monitoring changes in oxygen during photosynthesis and respiration of plants
- Demonstrating how oxygen is removed from the air by re-breathing the sample of air in a paper bag using different patterns of breathing
- Measuring respiration of animals, insects, geminating seeds
- Measuring consumption of oxygen by yeast during respiration of sugars
- Discovering the change in oxygen level during combustion – using a candle burning in a bell jar

How it Works

The galvanic dissolved oxygen electrode consists of polarized platinum and lead electrodes, with the electrolyte separated from the sample by a Teflon/silicone gas permeable membrane. The external portion of the electrode is constructed of delrin. The internal portion of the electrode is constructed of 316 L stainless steel. A thin Teflon/silicon membrane provides for efficient sealing of cathode/anode and electrolyte within the cylinder. The membrane is permeable to oxygen but impermeable to water and electrolytes.

Oxygen diffuses across the electrode membrane and is reduced to hydroxyl ions at the platinum cathode according to the reaction:

(1) $O_2+2H_2O + 4e^- = 4OH^-$

The electrons necessary for this process are produced by a reaction at the lead anode. Because the electrolyte contains hydroxide ions, this reaction occurs as:

(2) $2Pb + 4OH^- = 2Pb(OH)2 + 4e^-$

At any given temperature, the current flow between cathode and anode is directly proportional to the level of oxygen.

Sensor Specification

Range:	0 – 25 % O_2
Accuracy:	±7 % over entire range
Resolution:	0.025 %
Temperature Compensation:	No
Response Time:	90% response in less than 30 seconds
Default Sample Rate:	10 samples per second
Membrane:	Teflon
Cathode:	Platinum
Anode:	Tubular lead
Electrolyte:	Sodium Hydroxide solution

Features:	Equipped with an offset calibration knob
Sensor Storage:	Store with protective vinyl cap

Contents

Adaptor & Oxygen electrode set	DT222A
Adaptor only	DT222
Oxygen electrode	DT118

5 x 1 ml thick membrane

30 ml Galvanic O_2 fill solution

Syringe

Nitrogen powder

Equipment Setup

1. Connect the electrode to the adaptor.
2. Connect the adaptor to the data logger's input.

Technical Notes

- If the calibration knob is on maximum but the signal does not reach the maximum level, change the membrane and the electrolyte.

  Note: The output signal may not reach the maximum if the ambient air temperature is less than 15 °C.

- The Oxygen electrode is supplied with a protecting cap that covers the membrane. Before using the electrode for the first time remove the protecting cap.

Electrode Preparation

The electrode is shipped filled with electrolytes and with the Teflon membrane in place. Upon receiving the electrode, remove the protective vinyl cap and inspect for damage.

Using the Oxygen Sensor with Ecolog XL and EcoLab Software

Calibration

1. Connect EcoLog XL to the computer.
2. Connect the Oxygen sensor to the Ecolog XL's sensor input The sensor is automatically recognized by the EcoLab software.
3. If EcoLog XL is running in one of its stand-alone modes, press the **Stop** button on the EcoLog XL front panel.
4. Launch EcoLab.
5. In the **Setup** window deactivate the internal sensors by clicking the button next to the sensors' icon and program the EcoLog XL's sample rate to be 5 samples per second and set the recording time to be 3 minutes.
6. Choose **Table** display on the main tool bar.
7. Hold the electrode in the air.
8. Click **Run** to start recording and turn the knob on the Oxygen adaptor until a value of **20.9%** is shown.
9. Wait the reading to stabilize on **20.9%**.
10. Click **Stop** on the main tool bar.
11. Start using the Oxygen sensor.

Note: This method is not recommended when air temperature changes (for example, when the air conditioner turns on and off or if it is windy).

Set a Measurement

1. Calibrate the electrode using one of the methods described (see **Calibration** above).
2. Program the data logger's sample **Rate** and the **Recording** time.
3. Click **Run** on the main toolbar to start the measurement.
4. You can stop recording at any time by clicking **Stop** on the toolbar.

To conduct remote recording

For remote logging it is necessary to send the setting to Ecolog XL before disconnecting from the computer.

1. In the Setup window deactivate the internal sensors by clicking the button next to the sensors' icon and program the EcoLog XL's sample **Rate** and the **Recording** time.

2. Click **Send Setup**  on the main tool bar, wait until you will see the following message on the EcoLog XL screen:

3. Disconnect the EcoLog XL from the computer, place the EcoLog XL at the desired recording location and press the **Go**  button on the EcoLog XL front panel.

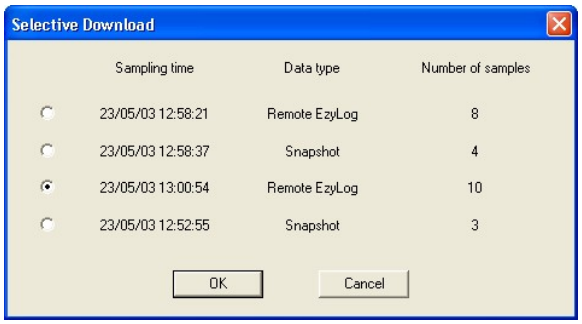
To download data that was recorded offline

EcoLog XL always stores the last four experiments. To download data that was recorded offline, or while EcoLog XL was not connected to the computer:

1. Connect the EcoLog XL to the computer and if EcoLog XL is collecting data, click **Stop**  to end collecting and to return to the main menu.

2. Launch EcoLab.

3. Click **Download**  on the main toolbar to open the **Selective Download** dialog:



The dialog contains details of the stored experiments: the starting time and date, the logging mode and the number of samples taken.

4. Click an option to select the experiment you wish to download, and then click **OK**. This will start the Post-experiment Data Transfer communication mode. Once the transfer is complete, the data will be displayed automatically in the graph window and in the table window.

Maintenance and Storage

After the electrode has been used for a period of time the following cleaning method is recommended:

1. Carefully unscrew the cap from the body.
2. Rinse the inside of the membrane cartridge with DI water.
3. Soak the lead anode in 0.1N HCL (8.3 mL concentrated HCl in 1000 mL DI water) for 15 to 20 minutes. Rinse the lead anode with DI water, blot dry with tissue paper. Screw the lead anode back onto the body.
4. Dip the platinum cathode in aqua regia (a mixture of 3 parts HCl and 1 part HNO_3 five times, 30 seconds each. After each dip, clean the platinum surface with tissue paper.
5. Rinse the soaked portions thoroughly with DI water. Blot dry with tissue paper.
6. Fill the cap with electrolyte to a level just above the membrane cartridge using the syringe provided. Hold the electrode in an upright position and gently screw the cap back onto the body.
7. Inspect the membrane for tears or leakage. The membrane should be uniformly stretched across the inner body. Replace the membrane if any damage has occurred.

Membrane Replacement

The membrane should be examined routinely after each fermentation cycle and replaced if any deterioration is evident. See Figure 1 below.

1. Carefully unscrew the cap from the body.
2. Using the membrane tool provided, pop the membrane cartridge from the cap.
3. After the membrane cartridge is removed from the cap, inspect all of the O-rings. If the O-rings appear to be damaged, please replace them with the spare O-rings provided.
4. Inspect the platinum cathode. Gently wipe it with tissue paper and see if there are any cracks or damage.
5. Take a new membrane out of the plastic package and insert into the cap. Push it down inside until firmly seated inside the outer cap using the membrane tool provided.
6. Fill the cap with electrolyte to a level just above the membrane cartridge, using the syringe provided.

7. Hold the electrode in an upright position and gently screw the cap back onto the body. Inspect the membrane for tears or leakage. The membrane should be uniformly stretched across the inner body.

Troubleshooting

If the calibration knob is on maximum but the signal doesn't reach 100%, change the membrane and the electrolyte.

Note: The output signal may not reach 100% if the ambient air temperature is less than 15 °C.

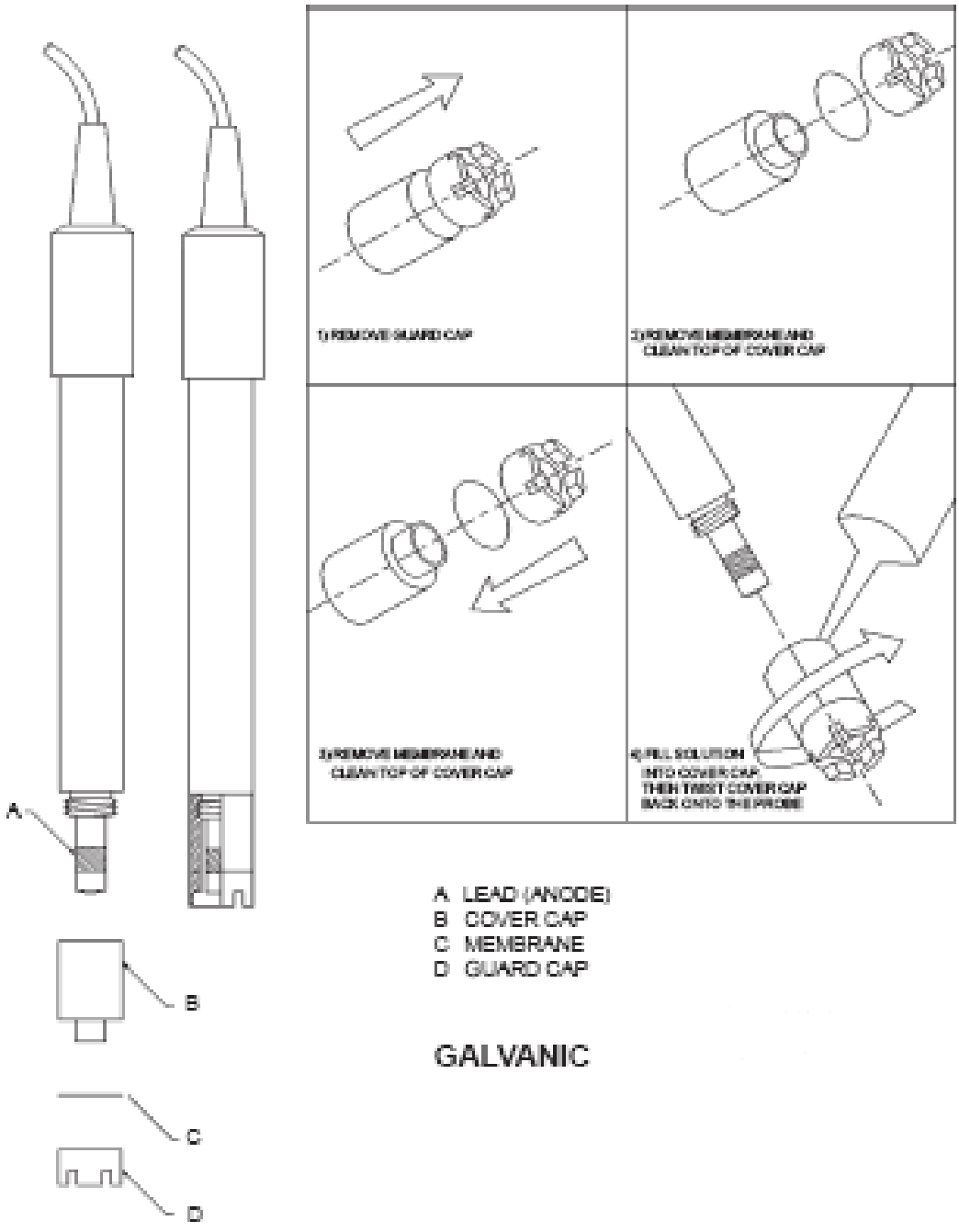


Figure 1: Membrane replacement

An Example of using the Oxygen Sensor

Catalytic Decomposition of H_2O_2 by the Enzyme, Catalase: Effect of Enzyme Concentration

In this experiment we follow changes in Oxygen in Air vs. Time (as a result of release of oxygen) at different concentrations of catalase. Under saturating substrate concentrations, the rate of enzyme catalysis is directly proportional to the concentration of the enzyme. Figure 2 below displays the change in Oxygen in Air vs. Time (as a result of release of oxygen) at different catalase concentrations.

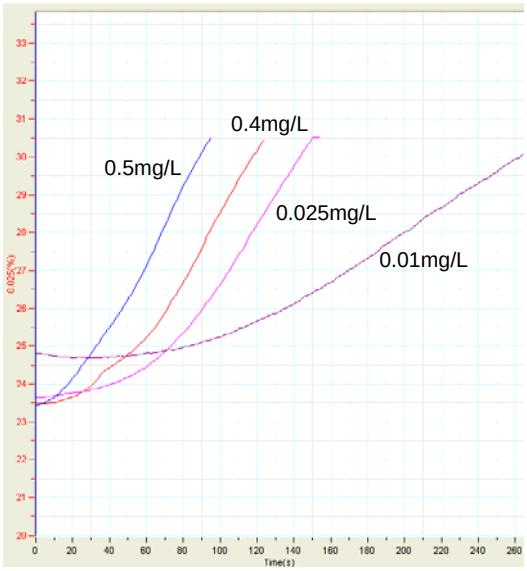


Figure 2: Oxygen in Air *vs.* Time

Technical Support

Please contact Fourier technical support as follows:

Web: http://www.fourier-sys.com/support_support.html
Email: support@fourier-sys.com

Consult the FAQs before contacting technical support:
http://www.fourier-sys.com/support_faq.html

Copyright and Warranty

All standard Fourier Systems sensors carry a one-year warranty, which states that for a period of twelve months after the date of delivery to you, it will be substantially free from significant defects in materials and workmanship.

This Warranty does not cover breakage of the product caused by misuse or abuse.

This Warranty does not cover Fourier Systems consumables such as electrodes, batteries, EKG stickers, cuvettes and storage solutions or buffers.