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Application report
Oxygen consumption of germinating plant seeds

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Matrix: soils and solids

Analytical applications
No. 7

Manometric measurement of the oxygen consumtion of germinating plant seeds with the OxiTop® Control measurement system

1st edition, July 1999

Note: This report was made by using OxiTop® Control. All measuring procedures can easily be transferred to the OxiTop®-IDS system.

Area of application

Determination of respiratory activity of germinating plant seeds in the following fields of activity:

- Plant physiology
- Ecotoxicology.

Measurement principle

Manometric measurement of oxygen consumption with simultaneous absorption of CO_2 in caustic soda solution.

Material

OxiTop®-C measuring heads (WTW, Weilheim, Germany)
OxiTop® OC 110 Controller (WTW, Weilheim, Germany)
ACHAT OC PC communication software (WTW, Weilheim, Germany)

Data transmission cable, type AK 540/B for RS 232 (WTW, Weilheim, Germany)
Measuring vessels MG 1.0 and 1.5 with lid clip (WTW, Weilheim, Germany)
Temperature-controllable room or thermostat cabinet in variants TS606/2....TS606-G4/Var (WTW, Weilheim, Germany)
Personal computer, minimum requirements: 80486 processor, 16 MB RAM, RS232 interface
Windows 3.1 or 3.11 operating system
EXCEL 5.0 spreadsheet program (Microsoft, USA)
Vaseline
Laboratory scales (reading accuracy: min. 0.1 g)
Measuring container (50 mL)
Temperature-controllable room or thermostat cabinet in variants TS606/2....TS606-G4/Var
Volumetric pipette, 50 mL
Measuring cylinder, 50 mL
Caustic soda solution (1 mol/L)
Sand
Plant seed (cress)

Conducting the measurement

Con-sec. no.	Workstep	explanations, comments, notes
1	Sand of average-sized grains is moistened thoroughly with water until an approx. 1 mm film of water remains; it is then drained for a few minutes using a sieve plate until no more excess water flows off.	Further details for conducting the measure-ment of respiratory activity can be found in [1] and [2].
2	100 g of prepared sand is filled into each of two MG 1.0 measuring vessels.	

Con-sec. no.	Workstep	explanations, comments, notes
3	Between 500 and 1000 mg plant seeds (e.g. 200 cress seeds) are placed on the sand of one of the glass vessels; the second preparation remains as a control without seeds	
4	Insert measuring containers, each with 50 mL caustic soda solution (1 M), into the holder of the lid-locking device.	
5	Apply a thin coat of vaseline to the sealing ring of the lid-locking device.	Caution! Do not use silicone grease as this can cause damage on contact with the OxiTop.-C measuring heads.
6	Put on the lid and affix with 4 clamps (4 x 90°)	
7	Insert rubber sleeve	Do not grease this joint! If necessary, trim the rubber sleeve as a seal!
8	Tightly screw on the Oxitop® -C measuring head	Do not use force!
9	Place the test preparation into the constant temperature room or thermostat cabinet.	To ensure constant starting conditions and to prevent incorrect measurements it is advisable to preheat all materials/components.
10	Start recording the measurements using the controller ("Pressure p" mode)	The total measurement time depends on various factors. 7 days are sufficient for examining cress; a general recommendation cannot be given. 360 measurement values are recorded at equidistant time intervals over the entire measuring period
11	To prevent oxygen-limiting measuring conditions arising, the measurement data of the measuring heads are transferred to the controller at regular intervals. If the defined pressure value is undercut or the selected warning pressure of -100 hPa, for example, while processing the affected measuring vessels/samples by ventilating, addition of nutritive solution, sampling, refilling of the CO_2 absorber etc., for instance, call up the instantaneous value before starting and after ending the action and save in the controller (max. 10 instantaneous values, M01… M10).	In the case of manometric/respirometric determination of the respiratory activity, the partial pressure of oxygen in the sealed measuring vessel decreases during the measurement. If a minimum partial pressure of oxygen is maintained, the biological activity of the microorganisms is not affected. The Oxitop® Control measurement system documents the entire pressure progression or the oxygen consumption as a graphic function.

Con-sec. no.	Workstep	explanations, comments, notes
12	If the pressure range mentioned above is undercut, the measuring vessel can be opened and the caustic soda solution replaced.	This procedure can be repeated as often as necessary over the specified time period or over 10 storable instantaneous values without having to restart the measuring head.
13	At the end of the measurement, the data are transferred to a PC using the ACHAT OC software and prepared with EXCEL.	Note: To calculate the specific respiratory activity of the seed, the respiratory activity of the control preparation must be deducted.

Examples of measurement results

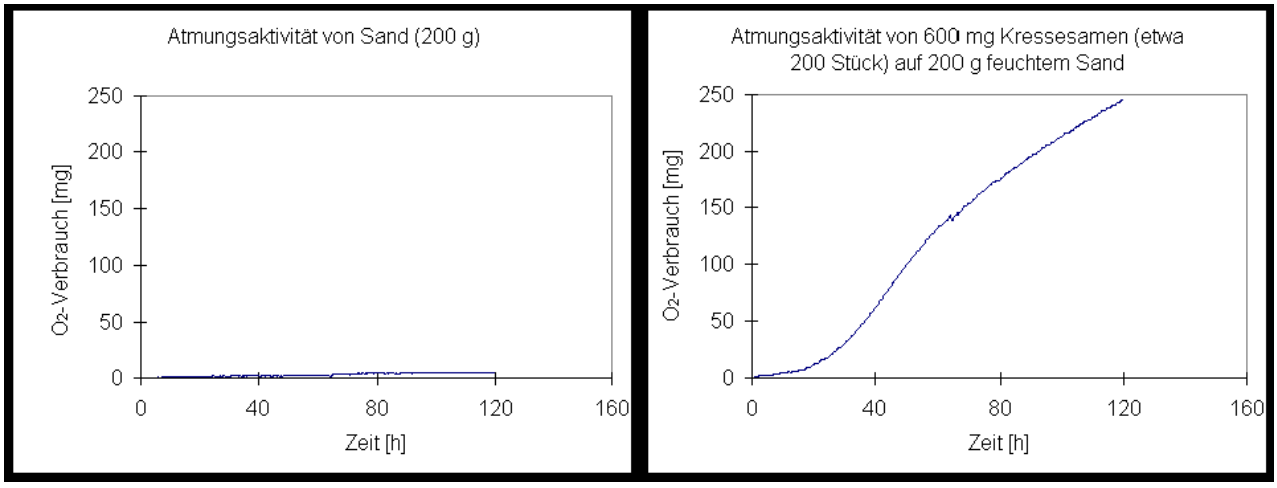

Figure 1:
Development of the respiratory activity of approx. 200 cress seeds on moist sand, measured at 20°C in measuring vessel MG 1.0. A lag phase of approx. 20 hours is clearly visible which then becomes an approximately linear phase. After 70 hours, the measuring vessel was opened once more and the caustic soda solution replaced. The graphic evaluation (applying the tangents) at time t = 50 h or t = 100 h resulted in specific respiratory activities of 620 mg O2/[g*d] or 257 mg O2/[g*d]

Bibliography

[1] AR_BOD_soils+solids, Platen, H., Wirtz, A. (1998), Analytical applications No.1: Measurement of the respiration activity of soils with the OxiTop®-Contol measurement system: Basic principles and process characteristics, Fachhochschule Gießen-Friedberg, Wiesenstraße14, 35390 Gießen. 1st edition

[2] AR_BOD_soils+solids, Platen, H., Wirtz, A. (1998), Analytical applications No.2: Measurement of the respiration activity of soils with the OxiTop®-Contol measurement system: Standard test preparation, Fachhochschule Gießen-Friedberg, Wiesenstraße14, 35390 Gießen. 1st edition

Note

The information contained in our application reports is only intended as a basic description of how to proceed when using our measurement systems. In isolated instances or if there are special general conditions on the user side, exceptional properties of the respective sample can, however, lead to a change in the execution of the procedure or require supplementary measures and may, in rare cases, lead to a described procedure being unsuitable for the intended application.

In addition, exceptional properties of the respective sample such as special general conditions can also lead to different measurement results.

The application reports have been prepared with the greatest possible care. Nevertheless, no responsibility can be accepted for the correctness of this information.

The current version of our general terms of business applies.

Any further questions? Please contact our Customer Care Center:

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