Lehr– und Didaktiksysteme
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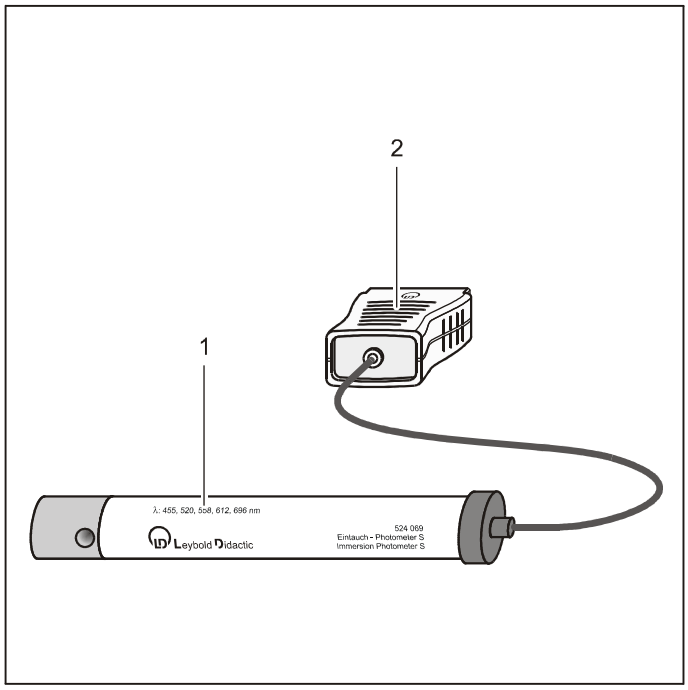

Instruction sheet 524 069

Immersion photometer S (524 069)

1 Immersion photometer
2 Plug

1 Description

The immersion photometer S is used as a sensor in conjunction with the computer-aided measuring system CASSY®. It allows transmission measurements with liquids in five different wavelength ranges of the visible spectrum.

In water samples, it is possible to determine the concentration of the components ammonium, chlorine, chloride, iron, potassium, silicic acid (silicate), copper, manganese, nickel, nitrate, nitrite, phosphate, sulphate, sulphite or zinc after the addition of suitable reagents which cause a specific colouration, or the water hardness can be determined.

In addition, colour-changing reactions can be observed as a function of time or other entities (e.g. de-colouration reactions, oscillating reactions, photometric titrations). In turbid water samples, the degree of turbidity can be directly determined from the transmission; e.g. processes with influence on the turbidity (e.g. yeast fermentation) can be investigated.

Experiment examples are found on the CD of the CASSY Lab software (524 200) or in the download version of the software under http://www.ld-didactic.com or in the manual of the CASSY Lab software (524 201).

2 Measuring principle

After immersion of the photometer in the liquid cylinder inside (Ø = 10 mm), the light is radiated through the liquid from an LED. The LED, and therefore the wavelength of the light, is depending on the measurement, selected manually or automatically. The intensity of the transmitted light is measured by means of photo-elements on the opposite side and displayed as transmission in % or extinction (E = -log T).

Water analysis:

The chemical basis of the photometric determination of a contained substance is based on the fact that the substance to be determined will form, with the added reagent, a colouration or turbidity. The extinction of the occurring colouration or turbidity at a suitable wavelength is therefore a measure of the concentration of the contained substance.

Turbidity measurement:

In a turbid water sample, the extinction is a measure of the turbidity measured in FAU (Formazin Attenuation Unit), and it can be converted directly.

3 Measurement quantities

Quantity	CASSY Lab [1] (524 200)	Mobile-CASSY (524 009)	Measuring range	λ / nm
Transmission (455 nm)	T	T	0.0...100.0 %	455
Transmission (520 nm)	T	T	0.0...100.0 %	520
Transmission (558 nm)	T	T	0.0...100.0 %	558
Transmission (612 nm)	T	T	0.0...100.0 %	612
Transmission (696 nm)	T	T	0.0...100.0 %	696
Extinction (455 nm)	E	E455	0.00...2.00	455
Extinction (520 nm)	E	E520	0.00...2.00	520
Extinction (558 nm)	E	E558	0.00...2.00	558
Extinction (612 nm)	E	E612	0.00...2.00	612
Extinction (696 nm)	E	E696	0.00…2.00	696
Ammonium	c	NH4+	0.00...3.00 mg/l	696
Chlorine	c	Cl	0.00…3.00 mg/l	520
Chloride	c	Cl^-	0.0...25.0 mg/l	455
Iron	c	Fe	0.00...3.00 mg/l	558
Potassium	c	K	0.0...30.0 mg/l	520
Silicic acid	c	SiO2	0.00...6.00 mg/l	696
Copper	c	Cu	0.00…5.00 mg/l	558
Manganese	c	Mn	0.00...4.00 mg/l	455
Nickel	c	Ni	0.00...4.00 mg/l	455
Nitrate	c	NO3	0.00…3.00 mg/l	520
Nitrite	c	NO2	0.00…2.00 mg/l	520
Phosphate	c	PO4	0.00…7.00 mg/l	696
Sulphate	c	SO4	0...500 mg/l	520
Sulphite	c	SO3	0.0...10.0 mg/l	455
Zinc	c	Zn2+	0.00...0.40 mg/l	612
Hardness[2]	GH	GH	0.00…0.50mmol/l	558
Turbidity	Tr	Turb	0…2000 FAU	696

[1] for Sensor-CASSY (524 010), Pocket-CASSY (524 006) or Mobile-CASSY (524 009) at a PC

[2] for hard water (e.g. 3 mmol/l), dilution is necessary

4 Reagents for water analysis

(Reagents for 100 identifications)

Photometry reagent set 1 with case and accessories	666 2600
Photometry reagent set 2 with case and accessories	666 2601
Lined reagent case, empty	666 2602
Photometry reagent set 1	666 2603
Photometry reagent set 2	666 2604

4.1 Contents of the reagents set 1:

Tablet	Catalogue number	For identification of
Ammonia No.1	AQ4512580	Ammonium
Ammonia No.2	AQ4512590	
Chloride T1	AQ4515910	Chloride
Chloride T2	AQ4515920	
Iron LR	AQ4515370	Iron
Nitrate HR No.1	AQ4518000	Nitrate
Nitrate HR No.2	AQ4518010	
Nitrite LR	AQ4512310	Nitrite
Phosphate LR No.1	AQ4513040	Phosphate
Phosphate LR No.2	AQ4513050	
Sulfate T	AQ4515450	Sulphate
Hardcheck P	AQ4515660	Total hardness

4.2 Contents of the reagents set 2:

Tablet/ reagent	Catalogue number	For identification of
DPD No.1	AQ4511060	Chlorine
DPD No.3	AQ4511080	
Potassium T	AQ4515670	Potassium
Silica No.1	AQ4513130	Silicic acid
Silica No.2	AQ4513140	
Copper No.1	AQ4513550	Copper
Copper No.2	AQ4513560	
Manganese LR No.1	AQ4516080	Manganese
Manganese LR No.2	AQ4516090	
Nickel 51 + 52	AQ419033	Nickel
Sulfite LR	AQ4518020	Sulphite
Copper/Zinc LR	AQ4512620	Zinc

5 Operation

5.1 Commissioning or connection of the measuring equipment:

Note:

Normal environmental light will not disturb the functioning of the immersion photometer because the LEDs contained in the sensor during operation are modulated with a frequency of 1 kHz. However, intense sunlight should be avoided.

- Connect the immersion photometer S to the CASSY module.
- After the measurement clean the immersion photometer S by thorough washing with distilled water.
- Protect the immersion photometer plug against moisture.

5.2 Transmission or extinction measurement at a wavelength λ :

Calibration:

- Immerse the immersion photometer S in the reference liquid (e.g. distilled water).

CASSY Lab:

- Select in the dialogue window “Sensor input settings” the desired measurement quantity T(... nm).
- Wait for approx. 30 s until the switched-on LED has reached its operating temperature.
- Then click on the button “100 %”.

Mobile-CASSY:

- Scroll to the upper measurement quantity (e.g. E455) by means of the ▲ key.
- Using the left • key, open the menu “Properties” and there select the menu item “Ranges”.
- Use the keys ▲ or ▼ until the desired measuring range “EXT ... nm ...” is reached and select it with the right-hand • key.
- Wait for approx. 30 s until the switched-on LED has reached its operating temperature.
- Return with the left-hand • key, scroll with the ▼ key until the menu item “Transmission 100%” is reached and press the right-hand • key.

Measurement:

- Immerse the immersion photometer S into the liquid to be measured.
- Read the measured value E or T.

5.3 Water analysis:

Notes:

By diluting the sample (e.g. using the graduated pipette or a graduated cylinder), higher concentrations than stated can also be measured.

The highest possible precision is reached when the solution to be measured is at room temperature (20 °C). A deviation of several degrees will result in measurable deviations.

The best measuring results will be obtained in clear solutions which are not coloured or only very slightly coloured. Suspended substance and turbidity is to be removed by filtration.

Calibration:

- Fill 10 ml of the sample solution into a 25 ml measuring beaker. (Exception: 10 ml distilled water for the ammonium measurement, see section 6)
- Immerse the immersion photometer S down to the bottom of the beaker.

CASSY Lab:

- Select in the dialogue window “Sensor input settings” the desired measurement quantity (e.g. ammonium c (NH_4^+, 696 nm)).
- Wait for approx. 30 s until the switched-on LED has reached its operating temperature.
- Then click on the button “→ 0 ←”.

Mobile-CASSY:

- Scroll to the upper measurement quantity (e.g. E455) by means of the ▲ key.
- Using the left • key, open the menu “Properties” and there select the menu item “Ranges”.
- Use the keys ▲ or ▼ until the desired measuring range (e.g. “NH4+ ...”) is reached and select it with the right-hand • key.
- Wait for approx. 30 s until the switched-on LED has reached its operating temperature.
- Return with the left-hand • key, scroll with the ▼ key until the menu item “Transmission 100%” is reached and press the right-hand • key.

Measurement:

- Fill 10 ml of the sample solution into a 25 ml graduated cylinder by means of a pipette or a syringe (exception: determination of nitrate contents, see section 6).
- Prepare analysis as described in section 6.
- After the specified time, immerse the immersion photometer S until the bottom is reached and read the measured value.

5.4 Turbidity measurement:

Calibration:

- Immerse the immersion photometer S into the distilled water.

CASSY Lab:

- Select in the dialogue window “Sensor input settings” the measurement quantity Tr (696 nm).
- Wait for approx. 30 s until the switched-on LED has reached its operating temperature.
- Then click on the button “→ 0 ←”.

Mobile-CASSY:

- Scroll to the upper measurement quantity (e.g. E455) by means of the ▲ key.
- Using the left • key, open the menu “Properties” and there select the menu item “Ranges”.
- Use the keys ▲ or ▼ until the desired measuring range “TURB ...” is reached and select it with the right-hand • key.
- Wait for approx. 30 s until the switched-on LED has reached its operating temperature.
- Return with the left-hand • key, scroll with the ▼ key until the menu item “Transmission 100%” is reached and press the right-hand • key.

Measurement:

- Immerse the immersion photometer S into the liquid to be measured.
- Read the measured value E or T.

6 Water analysis

Contained substance / concentration	Reagent	Calibration	Measurement
Ammonium (NH_4^+) 0 ... 3.00 mg/l	Ammonium No.1 Ammonium No.2 from Reagents Set 1	Fill 10 ml distilled water into a 25 ml graduated beaker. Add tablet 1, crush with glass rod and dissolve by stirring. Do the same with tablet 2. After 10 min immerse the sensor until the bottom is reached and carry out the calibration.	Fill 10 ml of the sample solution into a 25 ml measuring beaker. Add tablet 1, crush with glass rod and dissolve by stirring. Do the same with tablet 2. After 10 min immerse the sensor until the bottom is reached and read the measured value.
Free chlorine (Cl) 0 … 3.00 mg/l	DPD 1 No.1 from Reagents Set 2	Fill 10 ml of sample water into a 25 ml graduated beaker. Immerse the sensor until the bottom is reached and carry out the calibration.	Fill 10 ml of sample water into a 25 ml graduated beaker. Add tablet, crush it with glass rod and dissolve by stirring. Immerse the sensor until the bottom is reached and read the measured value.
Total chlorine (Cl) 0 … 3.00 mg/l	DPD No.1 DPD No.3 from Reagents Set 2	Fill 10 ml of the sample solution into a 25 ml measuring beaker. Immerse the sensor until the bottom is reached and carry out the calibration.	Fill 10 ml of the sample solution into a 25 ml measuring beaker. Add tablet 1, crush with glass rod and dissolve by stirring. Do the same with tablet 2. After 2 min immerse the sensor until the bottom is reached and read the measured value.
Chloride (Cl^-) 0 ... 25.0 mg/l	Chloride T1 Chloride T2 from Reagents Set 1	Fill 10 ml of the sample solution into a 25 ml measuring beaker. Immerse the sensor until the bottom is reached and carry out the calibration.	Fill 10 ml of the sample solution into a 25 ml measuring beaker. Add tablet 1, crush with glass rod and dissolve by stirring. Do the same with tablet 2. After 2 min immerse the sensor until the bottom is reached and read the measured value.
Iron (Fe^{2+} + Fe^{3+}) 0 … 3.00 mg/l	Iron LR from Reagents Set 1	Fill 10 ml of the sample solution into a 25 ml measuring beaker. Immerse the sensor until the bottom is reached and carry out the calibration.	Fill 10 ml of the sample solution into a 25 ml measuring beaker. Add tablet, crush it with glass rod and dissolve by stirring. After 5 min immerse the sensor until the bottom is reached and read the measured value.
Potassium (K^+) 0 ... 30.0 mg/l	Potassium tab from Reagents Set 2	Fill 10 ml of the sample solution into a 25 ml measuring beaker. Immerse the sensor until the bottom is reached and carry out the calibration.	Fill 10 ml of the sample solution into a 25 ml measuring beaker. Add tablet, crush it with glass rod and dissolve by stirring. After 2 min immerse the sensor until the bottom is reached and read the measured value.
Silicic acid (SiO_2) 0 ... 6.00 mg/l	Silica no. 1 Silica no. 2 Silica PR from Reagents Set 2	Fill 10 ml of the sample solution into a 25 ml measuring beaker. Immerse the sensor until the bottom is reached and carry out the calibration.	Fill 10 ml of the sample solution into a 25 ml measuring beaker. Add tablet 1, crush with glass rod and dissolve by stirring. After 5 minutes add tablet 2 and tablet PR and repeat. After 1 min immerse the sensor until the bottom is reached and read the measured value.

Copper (Cu^{2+}) 0 …5.00 mg/l	Copper No.1 Copper No.2 from Reagents Set 2	Fill 10 ml of the sample solution into a 25 ml measuring beaker. Immerse the sensor until the bottom is reached and carry out the calibration.	Fill 10 ml of the sample solution into a 25 ml measuring beaker. Add tablet 1, crush with glass rod and dissolve by stirring. Do the same with tablet 2. Immediately immerse the sensor until the bottom is reached and read the measured value.
Manganese (Mn) 0 ... 4.00 mg/l	Manganese LR No.1 Manganese LR No.2 from Reagents Set 2	Fill 10 ml of the sample solution into a 25 ml measuring beaker. Immerse the sensor until the bottom is reached and carry out the calibration.	Fill 10 ml of the sample solution into a 25 ml measuring beaker. Add tablet 1, crush with glass rod and dissolve by stirring. Do the same with tablet 2. After 5 min immerse the sensor until the bottom is reached and read the measured value.
Nickel (Ni^{2+}) 0 ... 4.00 mg/l	Nickel-51 Nickel-52 from Reagents Set 2	Fill 10 ml of the sample solution into a 25 ml measuring beaker. Immerse the sensor until the bottom is reached and carry out the calibration.	Fill 10 ml of the sample solution into a 25 ml measuring beaker. Add 2 level no. 8 (black) measuring spoons of the reagent nickel 51 and dissolve by stirring. By means of the 1-ml syringe add 0.2 ml of the reagent nickel 52 and mix by stirring. After 3 min immerse the sensor until the bottom is reached and read the measured value.
Nitrate (NO_3^-) 0 … 3.00 mg/l	Nitrate test powder Nitrate test Nitrite LR from Reagents Set 1	Fill 10 ml of the sample solution into a 25 ml measuring beaker. Immerse the sensor until the bottom is reached and carry out the calibration.	Place 20 ml of the sample solution into the nitrate test tube. Add 1 measuring spoon (integrated in the cap) of the nitrate test powder, close the tube securely and intensively shake for 1 min. Add 1 nitrate test tablet and shake again intensively for approximately 1 min until the tablet has become dissolved. After the reducing agent has settled on the floor of the nitrate test tube, invert the tube again three or four time in order to complete the flocculation of the reducing agent. Then leave the test tube to rest for a further 2 min. Of the clear solution above the sediment, carefully decant 10 ml into the 25 ml graduated beaker or suck out using a pipette. Ensure that no reducing agent is transferred. Add 1 nitrite LR tablet, crush it with glass rod and dissolve by stirring. After 10 min immerse the sensor until the bottom is reached and read the measured value.
Nitrite (NO_2^-) 0 … 2.00 mg/l	Nitrite LR from Reagents Set 1	Fill 10 ml of the sample solution into a 25 ml measuring beaker. Immerse the sensor until the bottom is reached and carry out the calibration.	Fill 10 ml of the sample solution into a 25 ml measuring beaker. Add tablet, crush it with glass rod and dissolve by stirring. After 10 min immerse the sensor until the bottom is reached and read the measured value.

Ortho-phosphate (PO_4^{3-}) 0 …7.00 mg/l	Phosphate LR No.1 and No.2 from Re-agents Set 1	Fill 10 ml of sample water into a 25 ml graduated beaker. Immerse the sensor until the bottom is reached and carry out the calibration.	Fill 10 ml of sample water into a 25 ml graduated beaker. Add tablet 1, crush with glass rod and dissolve by stirring. Do the same with tablet 2. Immerse the sensor until the bottom is reached and after 3 min read the measured value.
Sulphate (SO_4^{2-}) 0 ... 500 mg/l	Sulfate T from Re-agents Set 1	Fill 10 ml of sample water into a 25 ml graduated beaker. Immerse the sensor until the bottom is reached and carry out the calibration.	Fill 10 ml of sample water into a 25 ml graduated beaker. Add tablet, crush it with glass rod and dissolve by stirring. Immerse the sensor until the bottom is reached and read the measured value.
Sulphite (SO_3^{2-}) 0 ... 10.0 mg/l	Sulfite LR from Re-agents Set 2	Fill 10 ml of the sample solution into a 25 ml measuring beaker. Immerse the sensor until the bottom is reached and carry out the calibration.	Fill 10 ml of the sample solution into a 25 ml measuring beaker. Add tablet, crush it with glass rod and dissolve by stirring. After 2 min immerse the sensor until the bottom is reached and read the measured value.
Zinc (Zn^{2+}) 0..0.00.40 mg/l	Copper/Zinc LR from Re-agents Set 2	Fill 10 ml of the sample solution into a 25 ml measuring beaker. Immerse the sensor until the bottom is reached and carry out the calibration.	Fill 10 ml of the sample solution into a 25 ml measuring beaker. Add tablet, crush it with glass rod and dissolve by stirring. After 5 min immerse the sensor until the bottom is reached and read the measured value.
Total hardness (Ca^{2+}) 0 … 0.50 mmol/l	Hardcheck-P from Re-agents Set 1	Fill 10 ml of the sample solution into a 25 ml measuring beaker. Immerse the sensor until the bottom is reached and carry out the calibration.	Fill 10 ml of the sample solution into a 25 ml measuring beaker. Add tablet, crush it with glass rod and dissolve by stirring. After 5 min immerse the sensor until the bottom is reached and read the measured value.

7 Own calibration curves in CASSY Lab

- First of all add appropriate reagents to the sample and determine the wavelength (LED) at which the transmission is the smallest.
- Produce a sequence of samples of known concentration and measure the extinction of each and enter the concentration as the parameter.
- In a new diagram, enter the extinction E on the x-axis and the concentration c on the y-axis.
- Use the free fit functions A*x + B*x^2 to determine the functional relationship for c = f(E).
- This equation must be entered in “Parameter/Formula”.

8 Accessories

Holder for the immersion photometer 6662605

9 Technical data

Average wavelengths:	455, 520, 558, 612, 696 nm
Detector:	silicon photo-elements
Operating temperature:	0...50 ℃
Material:	Duran glass
Volume of sample:	10 ml
Diameter of the liquid cylinder	10 mm
Plug:	Sub-D-15
Dimensions:	200 mm × 26 mm ∅
Weight:	200 g

10 Compatibility

Connect the immersion photometer S to the following CASSY modules:

	Sensor-CASSY (524 010)	Pocket-CASSY (524 006)	Mobile-CASSY (524 009)
with PC	Software CASSY Lab version 1.41 or higher		
without PC	—–	—–	with firmware 1.00 or higher

Being a member of the CASSY family, the sensor has the following properties:

- The sensor may be plugged in at any time.
- The plugged-in sensor will be automatically identified by its ID signal.
- Measurement quantities and measuring ranges are set via menus.

11 Updates

If the software or firmware used is older than that given above, an update of the software or firmware is required. The current version of the CASSY Lab software is available on the internet under http://www.ld-didactic.com.

- Install the current version of the CASSY Lab software and start it.
- Connect all available CASSY modules to the PC one after another.
- As soon as you are prompted, bring the firmware up to date with “Update CASSY Modules” so that it matches with CASSY Lab.

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