

*Training module # WQ - 12*

***How to measure dissolved oxygen (DO)***

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# 1 Module context

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This module concerns laboratory determination of dissolved oxygen in water. Modules in which prior training is necessary to complete this module successfully and other available, related modules in this category are listed in the table below.

While designing a training course, the relationship between this module and the others, would be maintained by keeping them close together in the syllabus and place them in a logical sequence. The actual selection of the topics and the depth of training would, of course, depend on the training needs of the participants, i.e. their knowledge level and skills performance upon the start of the course..

No.	Module title	Code	Objectives
1	<i>Basic water quality concepts</i>	WQ -1	<ul style="list-style-type: none"><li>• Discuss the common water quality parameters</li><li>• List important water quality issues</li></ul>
2	<i>Basic chemistry concepts</i>	WQ -2	<ul style="list-style-type: none"><li>• Convert units from one to another</li><li>• Discuss the basic concepts of quantitative chemistry</li><li>• Report analytical results with the correct number of significant digits.</li></ul>
3	<i>How to prepare standard solutions</i>	WQ -4	<ul style="list-style-type: none"><li>• Select different types of glassware</li><li>• Use an analytical balance and maintain it.</li><li>• Prepare standard solutions.</li></ul>
4	<i>The chemistry of dissolved oxygen measurement</i>	WQ -11	<ul style="list-style-type: none"><li>• Appreciate significance of DO measurement</li><li>• Understand the chemistry of DO measurement by Winkler method</li></ul>

## 2 Module profile

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<b>Title</b>	:	How to measure dissolved oxygen (DO)
<b>Target group</b>	:	HIS function(s): Q1, Q2, Q3, Q5
<b>Duration</b>	:	One session of 150 min
<b>Objectives</b>	:	After the training the participants will be able to: <ul style="list-style-type: none"><li>• Measure dissolved oxygen in water samples</li><li>• Collection and store samples with all precautions.</li></ul>
<b>Key concepts</b>	:	<ul style="list-style-type: none"><li>• Winkler method</li><li>• Sampling procedure</li><li>• Effect of storage</li></ul>
<b>Training methods</b>	:	Demonstration and laboratory exercises
<b>Training tools required</b>	:	<ul style="list-style-type: none"><li>• Chemicals and glassware required to conduct DO analysis as per SAP</li><li>• DO sampler</li><li>• Support of a chemistry laboratory</li></ul>
<b>Handouts</b>	:	As provided in this module
<b>Further reading and references</b>	:	<ul style="list-style-type: none"><li>• Chemistry for Environmental Engineering, C.N. Sawyer, P.L. McCarty and C.F. Parkin. McGraw-Hill, 1994</li><li>• Standard Methods: for the Examination of Water and Wastewater, APHA, AWWA, WEF/1995. APHA Publication</li></ul>

# 3 Session plan

No	Activities	Time	Tools
1	<p><b>Preparations</b></p> <ul style="list-style-type: none"> <li>• Use your ToT-1 checklist.</li> <li>• Prepare all DO reagent solutions according to SAP in advance, including the primary standard and sodium thio-sulphate titrant.</li> <li>• Prepare sufficient volume of samples in buckets as follows:               <ul style="list-style-type: none"> <li>– Sample A: tap water stored overnight.</li> <li>– Sample B: tap water stored overnight and contaminated with sewage or sullage at the rate of 10 mL/L on the day of the experiment.</li> <li>– Sample C, Pond water with some algae in it.</li> </ul> </li> <li>• Prepare siphoning tubes of 6 to 10 mm dia. flexible tubing attached to small lengths of glass tubing at each end, one each for the three samples.</li> </ul>		
2	<p><b>DO determination</b></p> <ul style="list-style-type: none"> <li>• Allow participants to read SAP for measuring DO</li> <li>• Explain/summarise the Winkler method</li> <li>• Explain reagents used and the steps involved</li> <li>• Demonstrate DO determination</li> </ul>	<b>30 min</b>	Handout, glassware and reagents OHS
3	<p><b>Practice</b></p> <ul style="list-style-type: none"> <li>• Describe the exercise</li> <li>• Divide the class in working group of two persons each</li> <li>• Let participants siphon samples in BOD bottles</li> <li>• Half the class will store the sample C bottles in dark and the other half in light, sunshine if possible</li> <li>• Let all participants standardise sodium thio-sulphate and measure DO. Sample C bottles should be analysed in the last.</li> </ul>	<b>90 min</b>	Handout
4	<p><b>Wrap up</b></p> <ul style="list-style-type: none"> <li>• Ask participants to write report</li> <li>• Discuss measurement results</li> <li>• Summarize main points of DO measurement</li> </ul>	<b>30 min</b>	

# 4 Overhead/flipchart masters

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## OHS format guidelines

Type of text	Style	Setting
Headings:	OHS-Title	Arial 30-36, Bold with bottom border line (not: underline)
Text:	OHS-lev1 OHS-lev2	Arial 26, Arial 24, with indent maximum two levels only
Case:		Sentence case. Avoid full text in UPPERCASE.
Italics:		Use occasionally and in a consistent way
Listings:	OHS-lev1 OHS-lev1-Numbered	Big bullets. Numbers for definite series of steps. Avoid roman numbers and letters.
Colours:		None, as these get lost in photocopying and some colours do not reproduce at all.
Formulas/ Equations	OHS-Equation	Use of a table will ease alignment over more lines (rows and columns) Use equation editor for advanced formatting only

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# Measuring dissolved oxygen (DO)

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1. Standard Analytical Procedure
2. Demonstration
3. Exercises
4. Reporting

# **Measuring DO: Standard Analytical Procedure**

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Read Standard Analytical Procedure



# Exercise: determine DO of samples

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- Work in pairs
- Reagents provided
- Measure DO in samples A, B & C
- Use siphon to fill bottles
- Record findings
- Calculate
- Report

# Exercise: record findings

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- Normality of primary standard =
- Volume primary standard taken for titration =
- Volume of sodium thiosulphate titrant used =
- Therefore, morality of sodium thiosulphate =

# Report findings

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Sample	Volume titrated, mL		Volume thiosulphate used, mL		DO, mg/L	
	initially	after storage	initially	after storage	initially	after storage
A						
B						
C						

# Exercise: report

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- Dissolved oxygen (DO) in water samples
- Effect of storage of sample on DO value
- Possible reasons for change in DO value during storage

# **5 *Evaluation***

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# 6 *Handouts*

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## Measuring dissolved oxygen (DO)

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1. Standard Analytical Procedure
2. Demonstration
3. Exercises
4. Reporting

### 3. Measuring DO: Standard Analytical Procedure

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Read Standard Analytical Procedure

#### Exercise: determine DO of samples

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- Work in pairs
- Reagents provided
- Measure DO in samples A, B & C
- Use siphon to fill bottles
- Record findings
- Calculate
- Report

#### Exercise: record findings

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- Normality of primary standard =
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- Therefore, morality of sodium thiosulphate =

#### Report findings

---

Sample	Volume titrated, mL		Volume thiosulphate used, mL		DO, mg/L	
	initially	after storage	initially	after storage	initially	after storage
A						
B						
C						

#### Exercise: report

---

- Dissolved oxygen (DO) in water samples
- Effect of storage of sample on DO value
- Possible reasons for change in DO value during storage



# ***7 Additional handouts***

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These handouts are distributed during delivery and contain test questions, answers to questions, special worksheets, optional information, and other matters you would not like to be seen in the regular handouts.

It is a good practice to pre-punch these additional handouts, so the participants can easily insert them in the main handout folder.

# 8 *Main text*

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		Contents
1.	Aim	1
2.	Method	1
3.	Observations & calculations	1
4.	Report	2
	SAP for Dissolved oxygen	3

# How to measure dissolved oxygen (DO)

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## 1. Aim

- 1.To determine dissolved oxygen (DO) in water
- 2.To study the effect of storage on the DO content of a water sample

## 2. Method

- a. Collect two samples from each of the buckets marked A, B and C in 300 mL DO bottles. For filling the DO bottles use a siphon holding the exit end near the bottom of the bottle to avoid aeration. Allow about 50 mL sample to overflow before stoppering the bottles in each case. Avoid entrapment of air bubble while stoppering.
- b. Standardise sodium thiosulphate titrant and determine the DO in one bottle of each sample, according to the Standard Analytical Procedure for Dissolved Oxygen, soon after collection. Store the other bottle for a period of time and determine the DO as directed by the instructor.

## 3. Observations & calculations

### **Standardisation of sodium thiosulphate:**

Normality of primary standard =

Volume primary standard taken for titration =

Volume of sodium thiosulphate titrant used =

Therefore, molarity of sodium thiosulphate =

### **DO determination in samples:**

Sample	Volume titrated, mL		Volume thiosulphate used, mL		DO, mg/L	
	initially	after storage	initially	after storage	initially	after storage
A						
B						
C						

## 4. Report

Write your report in which the following aspects should be addressed:

- Need for frequent standardisation of the secondary titrant used
- Care in sampling for DO measurement
- Effect of storage of sample on DO value
- Possible reasons for change in DO value during storage
- What is the biochemical oxygen demand (BOD) of a water sample and on what factors does it depend?



