

***A Study of Efficiencies of Dissolved Oxygen Test Kits in the Water for Science Laboratories on the Method of Measure***

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**Abstract**

There were two purposes of the study : 1) to development the Dissolved Oxygen Test Kits(DO Test Kits) in the water for Science Laboratories on “The Method of Measure Dissolved Oxygen in the Water (DO)” . The researcher made the Product by using Manganese Sulfate to oxidize oxygen content that dissolved in water and made the solution was high class different color follow oxygen quantity that dissolves in the water. 2) to study satisfy the DO Test Kits of science teachers to measure dissolved oxygen in the water.

The results of the research were as follows:

- 1)The DO Test Kits were able to measure DO of the water range  $DO_0$ -  $DO_8$ . When using the DO Test Kits to measure DO of the water compared with the value measuring DO of the water measured by standardized from DO Meter. It was found that the value DO of water measured by DO Test Kits could be estimated accurately at 98% confidence interval .
- 2) The teachers ‘satisfaction preferring to used the DO Test Kits was at the high level.

Keywords: Dissolved Oxygen Test Kits, DO Test Kits for Science Laboratories , DO Test Kits for Secondary school

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## Introduction

At present, the enrichment of the community has caused water quality problems in the source water pollution. The population has more volume, resulting in a waste contaminating the water was plenty more to follow. As a result, the amount of dissolved oxygen (DO) in rivers and canals down the animals that live in the water to hypoxia and even death. The local residents have been aware of the value. DO of water from their own. It was very important because water quality monitoring as a way to prevent, control and monitoring of water resources was to take the information used in planning and management of water resources for maximum benefit.( 1 )

DO measurement of water use Azide Modification method, which was more complicated to use chemicals and many require a huge budget. In addition, the measure requires the skills of titration. Then the values derived to calculate the answer. But if the measure lacked such skills measurement results will be inaccurate. Alternatively, DO Meter can be used to measure the amount of dissolved oxygen directly but DO Meter expensive schools can not provide for appointment of teaching.( 2 )

The above mentioned problems, the researcher is interested to develop the series DO Test Kits up to lower prices and science teachers can be created manually. To apply for laboratory science. The method for measuring dissolved oxygen in the water. And use it as a tool to do a science project to measure the DO of water resources in the community. This will result to the conservation of water resources to achieve sustainable development in the future. ( 3 )

### Research objective:

- 1) to development the DO Test Kits for science laboratories on “The Method of Measure Dissolved Oxygen in the water (DO)” .
- 2) to study satisfy the DO Test Kits of science teachers to measure dissolved oxygen in the water.

### Research method:

The study was accomplished through two stages of operation;

- 1) The Development of DO Test Kits improved of the Azide Modification Method by the chemical reaction between the solution of Manganese Sulfate with Alkali-Iodide-Azide were added to water samples to measure. The water samples will change colors vary according to the amount of dissolved oxygen in the water.( 4 )
- 2) Brings color of the water samples were DO<sub>0</sub>- DO<sub>10</sub> to create the the color strips standard used to measure the amount of dissolved oxygen in the water. Then remove the color strips standard to determine the similarity with the color of water samples from five people of color experts By the IOC average value of them must be higher than 0.51.
- 3) Trial the DO Test Kits were developed to measure water samples with the DO<sub>0</sub>- DO<sub>10</sub> 20 times / sample measurement compared with standard DO Meter were used to calculate the percentage accuracy of the measurement by setting the criteria to higher than 95%.
- 4) Trial the DO Test Kits were developed to measure the DO of sample water from natural sources, water from the waste water treatment and water from water supply of the Bangkok compared to Standard DO Meter to find out the percentage accuracy of the measurement

- 5) A science teacher with expertise in teaching the dissolved oxygen in the water 20 people used DO Test Kits were developed to measure water samples to study the satisfaction preferring to used DO Test Kits such tools

## Results

The results of the research were as follows:

The DO Test Kits were consisting of 1) the solution of Manganese Sulfate 2) the solution of Alkali-Iodide-Azide 3) the glass bottles, volume 15 ml 2 bottles.4) the color strips standard 5) Manual series DO Test Kits.



Figure 1: This is the DO Test Kits were Development

Preparing the solution of manganese sulfate are as follows: dissolved Manganese Sulfate ( $\text{MnSO}_4 \cdot 4\text{H}_2\text{O}$ ) 410 g into the distilled water, the volume of 1000 ml., And then filtered with a filter paper and then applied to the measurements.

Preparing the solution of Alkali-Iodide-Aazide are as follows: dissolve Sodium Hydroxide ( $\text{NaOH}$ ) 420 g and Potassium Iodide ( $\text{KI}$ ) 100 g into the distilled water volume 1000 ml., And then applied to the measurements.

Manual DO Test Kits were developed a way to measure the following:

- 1) Add water the desired sample measurement into the glass bottles to fill the bottles.
- 2) Drop the solution of Manganese Sulfate in water samples measurement 5 drops.
- 3) Drops of the solution of Alkali-Iodide-Azide into a bottle of water samples measuring 5 drops.
- 4) Then close the lid and shake the jar of water samples measuring about 15 times, then set the bottle for 1 minute.
- 5) Then take a bottle of water samples to determine the color with the color strips standard DO read the measurement and interpret of measurement results from the manual.

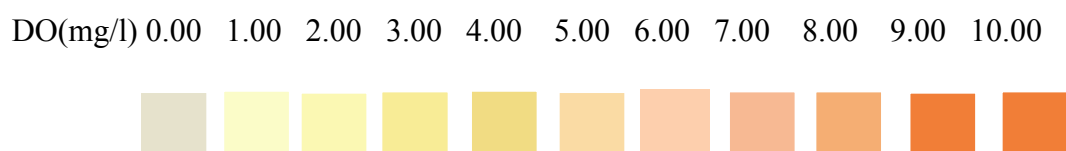


Figure 2: This is the color strips standard was created by the color of the water samples were DO<sub>0</sub>-DO<sub>10</sub>.

Table 1: Shows that the Color expert commentators to determine the similarities between the color of water samples were DO<sub>0</sub>-DO<sub>10</sub> with color strips standard created.

DO mg/l	0.00	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00
Agree	5	5	5	5	4	4	5	5	4		
quite agree					1	1			1	1	
Disagree										4	5
IOC	1.00	1.00	1.00	1.00	0.8	0.8	1.00	1.00	0.8	-0.8	-1.00

Table 1 The commentators color experts have commented that the colors of the water sample were similar to the color strips standard created, but the color strips standard of DO<sub>9</sub> and DO<sub>10</sub> the color that was difference can not be used in detecting DO measurement of the water. So the DO Test Kits of developed can be used to measure the amount of dissolved oxygen in the water its was between DO<sub>0</sub>-DO<sub>8</sub> only.

Table 2: Shows that the percentage accuracy of the measurement of the DO test Kits were developed to test water samples DO<sub>0</sub>-DO<sub>8</sub> compared Standards DO meter.

Water samples	DO of the water sample prepared (mg/l)	N	The average of DO was measured by the DO Test Kits (mg/l)	The average of DO was measured by the DO Meter (mg/l)	The percentage accuracy of the measurement (%)
1	0.00	20	0.00	0.00	100
2	1.00	20	1.00	1.02	98
3	2.00	20	2.00	2.03	98.50
4	3.00	20	3.00	3.08	97.33
5	4.00	20	4.00	4.11	97.27
6	5.00	20	5.00	5.09	98.20
7	6.00	20	6.00	6.10	97.83
8	7.00	20	7.00	7.16	97.71
9	8.00	20	8.00	8.16	98.00
				Total average	98.09

Table 2 The percentage accuracy of the measurement of the DO Test Kits were developed to test water samples DO<sub>0</sub>-DO<sub>8</sub> compared Standards DO meter were as follows: 100%,98%,98.50%,97.33%,97.27%,98.20%,97.83%,97.71%,98.00% and total average 98.09% respectively.

Table 3 Shows that the percentage accuracy of the measurement of the DO test Kits were developed to test water samples from natural sources, water from the waste water treatment and water from water supply of the Bangkok compared to Standard DO Meter.

Water samples	N	The average of DO was measured by the DO Test Kits (mg/l)	The average of DO was measured by the DO Meter (mg/l)	The percentage accuracy of the measurement (%)
water samples from natural sources				
1	20	4	4.05	98.05
2	20	5	5.12	97.60
3	20	5	5.10	98.00
				$\bar{X} = 97.88$
water from the waste water treatment				
1	20	0.00	0.00	100
2	20	2.00	2.05	97.5
3	20	4.00	4.11	97.25
				$\bar{X} = 98.25$
water from water supply of the Bangkok				
1	20	7.00	7.17	97.57
2	20	7.00	7.15	97.85
3	20	8.00	8.20	97.50
				$\bar{X} = 97.64$
			Total average	97.92

Table 3 The percentage accuracy of the measurement of the DO test Kits were developed to test water samples from natural sources, water from the waste water treatment and water from water supply of the Bangkok compared to Standard DO Meter. and total average were as follows: 97.88%, 98.25 %, 97.64% and 97.92 % respectively.

The satisfaction of the series DO Test Kits were developed a science teacher with expertise in teaching the dissolved oxygen in the water was divided into five areas: 1) ease of used 2) performance measurement 3) created by yourself and low prices 4) high safety for users 5) can be used for the experiment Science Laboratories on the Method of Measure DO in the water Assessing issues such as Rating Scales 5 levels using the following:

- 1 = very low
- 2 = low
- 3 = medium
- 4 = high
- 5 = very high.

Table 4 Shows that the satisfaction preferring to used DO Test Kits of the science teacher with expertise in teaching the dissolved oxygen in the water

Areas	N	1.00	2.00	3.00	4.00	5.00	$\bar{X}$	Levels
ease of used	20			1	16	4	4.35	high
performance measurement	20				15	5	4.25	high
created by yourself and low prices	20				13	7	4.35	high
high safety for users	20			1	14	5	4.20	high
can be used for the experiment Science Laboratories on the Method of Measure DO in the water	20			1	12	7	4.30	high
						Total average	4.29	high

Table 4 The average satisfaction preferring to used DO Test Kits of the science teacher with expertise in teaching the dissolved oxygen in the water was divided into five areas: ease of used, performance measurement, created by yourself and low prices, high safety for users and can be used for the experiment Science Laboratories on the method of measure DO in the Water and total average were as follows: 4.35 high, 4.25 high, 4.35 high, 4.20 high, 4.30 high, and 4.29 respectively.

## Conclusion

The DO Test Kits were developed with the following property:

- 1) The DO Test Kits were developed by using a simple method of measuring students and the general public can be used to measure the DO of water. Because the determination of the solution to reaction only two kinds Compared to DO Test Kits consist of the Pollution Control Department of Thailand reaction solution in three types and components used Sulfuric Acid , which was harmful to the user.( 5 ) ,created by yourself and low prices estimate 3 US dollars per set.
- 2) The DO Test Kits were developed able to measure DO of the water range  $DO_0$ - $DO_8$ . When using the Dissolved Oxygen Test Kits to measure DO of the water compared with the value measuring DO of the water measured by standardized from DO Meter. It was found that the value DO of water measured by DO Test Kits could be estimated accurately at 98% confidence interval. It had efficiency enough to measure DO of water for public and secondary school students and can used as an experimental series for finding the DO of water.
- 3) The teachers 'satisfaction preferring to used the DO Test Kits was at the high level. Shows that the DO Test Kits were developed appropriate to be used for teaching in the water for Science Laboratories on "The Method of Measure Dissolved Oxygen in the Water.( 6 )

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