Determination of dissolved oxygen (Winkler method)

Background Information

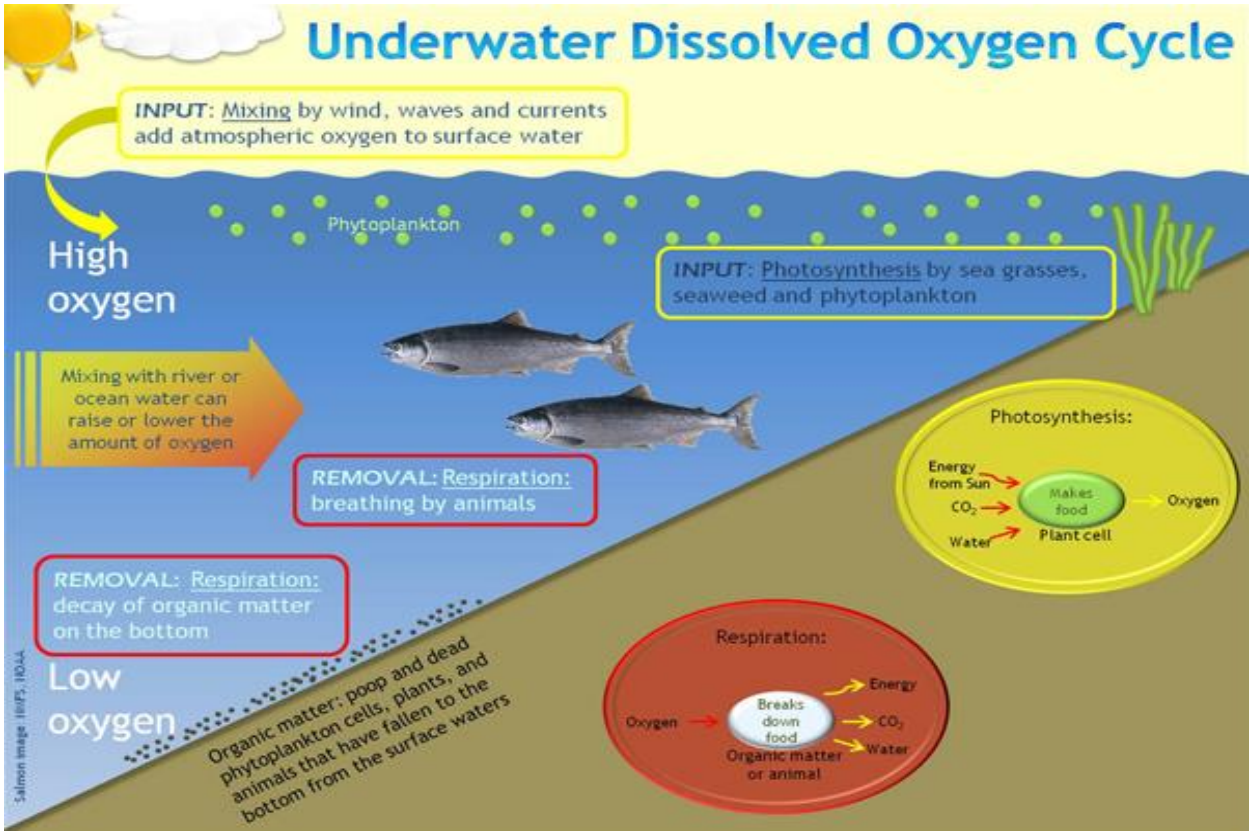
Dissolved oxygen (DO) is the amount of oxygen that is in water and is essential to healthy streams and lakes. The dissolved oxygen be an indication of how polluted the water is and how well the water can support aquatic plant and life. Generally, higher dissolved oxygen (DO) level indicates better water quality. If dissolved oxygen levels are too low, some fish and other organisms may not be able to Survive.

Much of the dissolved oxygen in water comes from oxygen in the air that has dissolved in the water. Some of the dissolved oxygen in the water is a result of photosynthesis of aquatic plants. Other factors also affect dissolved oxygen (DO) levels such as on sunny days high dissolved oxygen (DO) levels occur in areas of dense algae or plants due to photosynthesis. Stream turbulence may also increase dissolved oxygen (DO) levels because air is trapped under rapidly moving water and the oxygen from the air will dissolve in the water.

The maximum amount of oxygen that can dissolve in to water is affected also by elevation of the water testing site (atmospheric pressure) and the salinity (saltiness) of the water, an increase in any of these results in lower concentrations of dissolved oxygen.

Dissolved oxygen (DO) levels in water

DO level (in ppm)	Water Quality
0 – 4 ppm	**Poor** some fish and macroinvertebrate population will begin to decline
4.1 – 8 ppm	**Fair**
8.1 – 12 ppm	**Good**
+12 ppm	**Retest** Water maybe artificially aerated



In addition, the amount of oxygen that can dissolve in water depends on temperature. Colder water can hold more oxygen in it than warmer water. A difference in Do levels may be detected at the test site if tested early in the morning when the water is cool and then later in the afternoon on a sunny day when the water temperature has risen. Deference in dissolved oxygen (DO) levels may also be seen between winter water temperature and summer water temperatures. Similarly, a difference in dissolved oxygen (DO) levels may be apparent at different depths of the water if there is a significant change in water temperature.

Temperature-Oxygen Solubility Relationship	
Temperature (°C)	Oxygen Solubility (mg/L)
0	14.6
5	12.8
10	11.3
15	10.2
20	9.2
25	8.6
100	0

Test procedure For Winkler method

1- Sample collection

When collecting your water sample, here are some important guidelines:

- Collect the water sample away from the bank and below the water surface level.
- Be careful not to get any air bubbles in the sample during collocation, as it may result in false high reading.

- Allow the water to fill the dissolved oxygen (DO) sample bottle from bottom to top.
- Put a lid on the bottle while in under water.

Test the dissolved oxygen (DO) level immediately, As the biological activity in the sample and exposure to air can quickly change the dissolved oxygen (DO) level.

2- Laboratory work

1. Add gently, and just below the surface, 2 ml of $MnSo_4$ reagent and 2 ml of the mixed NaOH-KI reagent. Do not mix the pipettes between reagents, and do not mouth pipette the reagents. Carefully stopper the bottle without introducing any air bubbles and mix vigorously by inverting the bottle repeatedly.

2. Allow the precipitate to settle, then shake vigorously again and allow precipitate to settle to at least the bottom third of the bottle. If the rest of the analysis has to be delayed, the samples will normally keep quite well in this condition.

3. Add 2 ml of concentrated H_2So_4, inserting the tip of the pipette just below the surface of the sample. Carefully re-stopper the bottle, avoiding bubbles, and shake until all the precipitate has dissolved. Samples can also be stored in this condition if protected from light, but the free iodine has a high vapor pressure and tends to escape even from well-capped bottles. Delay of further analysis beyond 8 hours is not desirable.

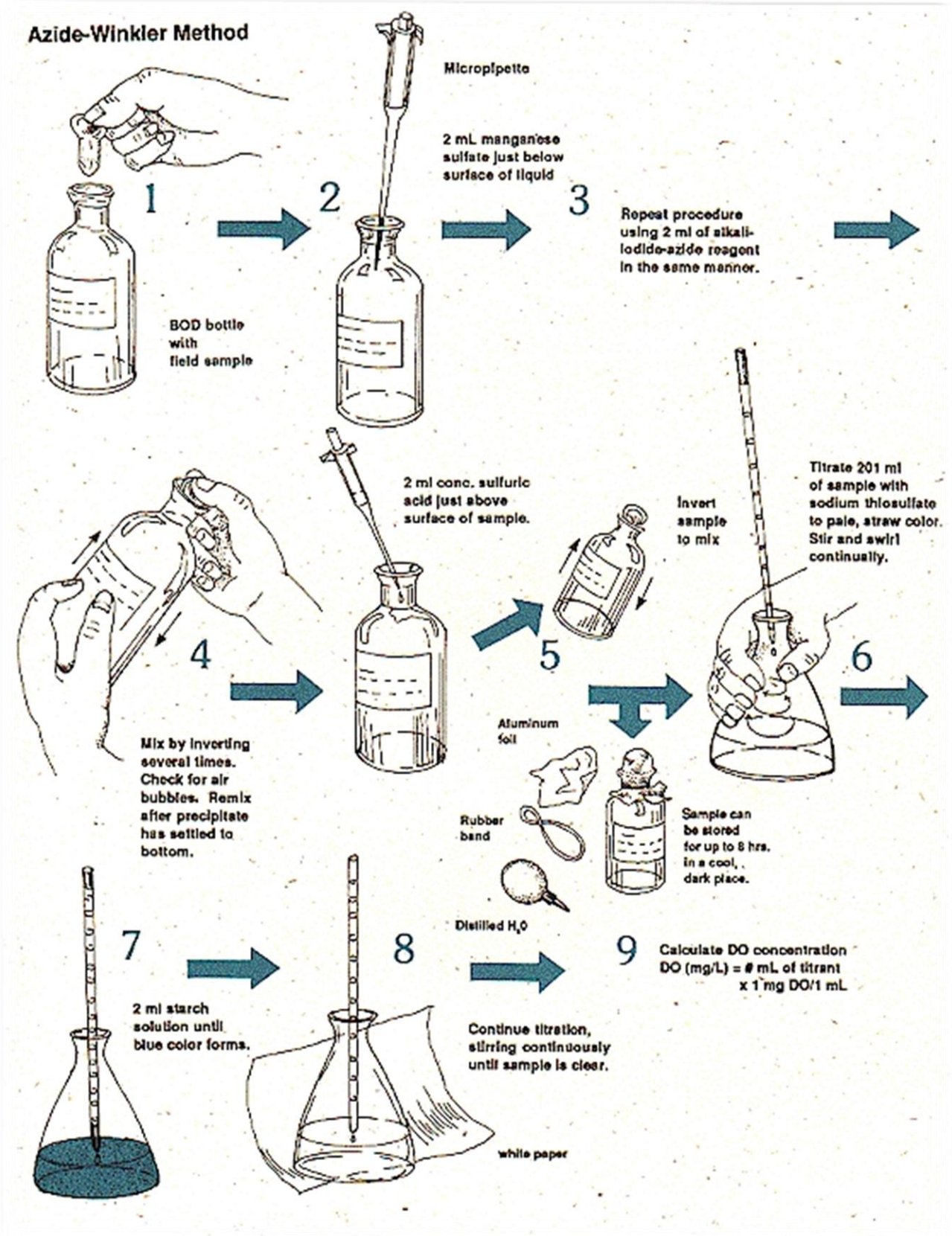
4. Measure 100 ml of the sample with a volumetric pipette and transfer to a 250 ml flask. For accurate delivery, the tip of the volumetric pipette should be touched to the side of the flask during delivery.

5. Using a 50 ml burette filled with 0.025N standardized sodium thiosulfate solution, titrate with mixing until a pale straw

6. Add 2 ml of stabilized starch mixture, mix to get a uniform blue color, and continue titrating carefully but rapidly to a colorless end-point. The blue color should return if the sample is left standing from 15 to 20 seconds, and can be ignored. If the blue color does not return, the end-point has been overshot. Record the volume of titrant used in ml.

7. Calculate:calculate the concentration of DO in the sample using the following formula:

$$\mathbf{DO\ (mg/L)} = \frac{\mathbf{(mL\ titrant\ x\ normality\ of\ titrant\ x\ 8000)}}{\mathbf{Equivalent\ volume\ of\ sample\ titrated}}$$


Azide-Winkler Method
1
BOD bottle with field sample
2
Micropipette
2 mL manganese sulfate just below surface of liquid
3
Repeat procedure using 2 ml of alkali-iodide-azide reagent in the same manner.
4
Mix by inverting several times. Check for air bubbles. Remix after precipitate has settled to bottom.
2 ml conc. sulfuric acid just above surface of sample.
5
Invert sample to mix
6
Titrate 201 ml of sample with sodium thiosulfate to pale, straw color. Stir and swirl continually.
Aluminum foil
Rubber band
Sample can be stored for up to 8 hrs. in a cool, dark place.
Distilled H2O
7
2 ml starch solution until blue color forms.
8
Continue titration, stirring continuously until sample is clear.
white paper
9
Calculate DO concentration
DO (mg/L) = # mL of titrant x 1 mg DO/1 mL