Fish and Fisheries Lab, ZOOA-DSE(B)-6-2-P

Estimation of SALINITY:

Chlorinity

The salinity of seawater was traditionally estimated from Cl^- concentration by the Knudsen equation:

Salinity = 1.80655 Cl^-

where Cl^- (chloride concentration) is in grams per liter. Kits that allow chloride concentration to be measured by titration of water samples with mercuric nitrate are available. Salinity can be estimated accurately from chlorinity in the ocean and in estuaries, but in freshwaters and inland saline waters, the ratio of Cl^- to total dissolved substances often differs greatly from that of seawater.

Density:

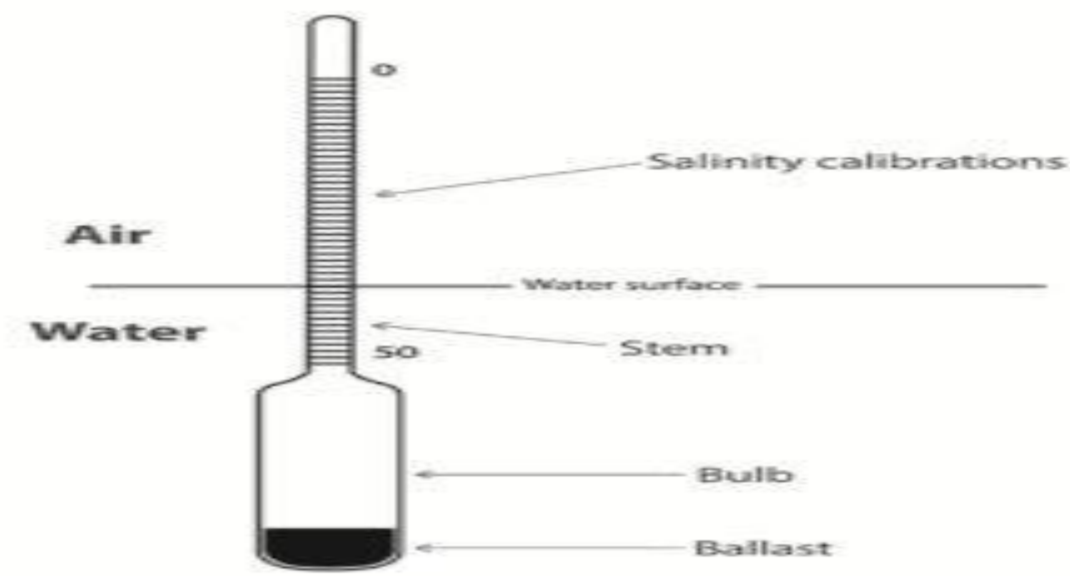

Fig. 2: A density hydrometer.

The density of freshwater is about 1 g/mL. Dissolved ions are denser than water and 1 gram of ions displaces less than 1 mL water. As a result, density increases with greater salinity (Table 1). The density of water can be measured with a hydrometer (Fig. 2). A traditional hydrometer is a cylindrical, air-filled bulb, cone-shaped at its bottom with a graduated stem protruding from its top. The bulb contains ballast causing the hydrometer to float upright. The distance that the stem extends above the surface depends upon water density, and the greater the density, the higher the stem rises above the surface. Hydrometers for determining salinity have stems calibrated in salinity units.

Boyd, salinity pt. 2, Table 1

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Degrees-C	Salinity (0 g/L)	Salinity (10 g/L)	Salinity (20 g/L)	Salinity (30 g/L)	Salinity (40 g/L)
0	0.99984	1.0080	1.0160	1.0241	1.0321
5	0.99997	1.0079	1.0158	1.0237	1.0316
10	0.00070	1.0075	1.0153	1.0231	1.0309
15	0.99910	1.0068	1.0144	1.0221	1.0298
20	0.99821	1.0058	1.0134	1.0210	1.0286
25	0.99705	1.0046	1.0121	1.0196	1.0271
30	0.99565	1.0031	1.0105	1.0180	1.0255
35	0.99403	1.0014	1.0088	1.0162	1.0237
40	0.99222	0.9996	1.0069	1.0143	1.0217

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Table 1. The density of water (g/cm3) of different salinities at selected temperatures between 0 and 40 degrees-C.

Refractive index

Light travels faster through some media than through others. According to Snell's law, if the first medium is less dense than the second, light decreases in velocity upon entering the second medium causing it to refract towards the normal. The opposite occurs when light travels faster in the second medium than in the first. The index of refraction is the ratio of the speed of light in a vacuum to the speed of light in a second medium. The refraction of light by water is evident when one views from the side a drinking straw placed in a clear container of water (Fig. 3).

Fig. 3: Visual evidence that light is refracted by water.

The refractive index of water increases as a function of density, and is influenced also by wavelength of measurement, atmospheric pressure, and temperature. A good quality, handheld, salinity refractometers (Fig. 4) measure salinities of 1 to 60 mg/L to one decimal place.

They are widely used to measure salinity at aquaculture facilities supplied with inland, saline water, estuarine water, or seawater.

Salinity and aquaculture:

- Some aquaculture species such as ictalurid catfish, pangasius and common carp grow best at salinities of <5 g/L;
- species such as Atlantic salmon, tilapia and rainbow trout grow well up to 20 g/L salinity;
- estuarine species such as penaeid shrimp grow well at salinities of 2 to 40 g/L.
- Marine and estuarine species can be farmed in inland saline water, but they may not survive and grow well in spite of adequate salinity.
- This results from ionic imbalance caused by low concentrations of K^+, Mg^{2+}, and Ca^{2+} or a combination of these cations.
- Mineral supplements are applied to increase concentrations of major ions.

Table 1: Water Salinity

Salinity Status	Salinity (%)	Salinity (ppt)	Use
Fresh	< 0.05	< 0.5	Drinking and all irrigation
Marginal	0.05 – 0.1	0.5 – 1	Most irrigation, adverse effects on ecosystems become apparent
Brackish	0.1 – 0.2	1 – 2	Irrigation certain crops only; useful for most stock
Saline	0.2 – 1.0	2 – 10	Useful for most livestock
Highly Saline	1.0 – 3.5	10 – 35	Very saline groundwater, limited use for certain livestock
Brine	> 3.5	> 35	Seawater; some mining and industrial uses exist

Source: Department of Water. Government of Western Australia.

Fig. 4. A handheld, salinity refractometer.

Boyd, salinity Pt. 2, Table 2

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Salinity	Food energy recovered as fish growth (%)
0.5	33.4

Salinity	Food energy recovered as fish growth (%)
2.5	31.8
4.5	22.2
6.5	20.1
8.5	10.4
10.5	-1.0

Showing 1 to 6 of 6 entries

Table 2. Effect of salinity on recovery of food energy as growth in the common carp.
Source: Wang et al. (1997).

- Some freshwaters have very low concentrations of dissolved ions (low salinity), but ion concentration can be increased by liming and adding certain mineral salts.
- The only practical way of reducing salinity is by adding water of lower salinity to culture systems.
- This is sometimes done in ponds in arid regions or during prolonged drought.

- In fish and shrimp hatchery vessels, it is possible to regulate salinity by adding commercially available sea salt mixes of specific salts.
- Concentrated brine solutions from coastal, seawater evaporation ponds have been added to freshwater to allow inland culture of marine species.

Salinity:

Salinity refers to the total amount of soluble salts dissolved in a kilogram of water collectively. The salts in water include such common ions as Ca2+, Mg2+,K+, Na+, C1-, SO2-, HCO- and CO2,. These ions occur either naturally or added as pollutants to the environment. The ionic composition of water affects the distribution of animals and plants in water. And depending on whether organisms can tolerate wide fluctuations in salinity or not, they have been classified as euryhaline and stenohaline animals respectively. Many marine organisms are intolerant of dilution of sea water which happens due to the flow of rivers into than causing estuarine condition. These organisms fail to survive in estuaries. However, there are also certain marine organisms which can tolerate the diluting effect.

In this Lab exercise you will learn the method of estimation of the salinity of water samples by a titrimetric method. The titrimetric method can be regarded as accurate enough, although the method assumes that the percentage composition of chloride in sea water is constant in relation to all other dissolved minerals present. In many laboratories the titrimetry has becn replaced by conductivity measurements since salinity relates to the total dissolved salts. However, we confine ourselves to the salinity measurement by chloride estimation.

Objectives:

At the end of this lab exercise you should be able to:

1. define the terms chlorinity and salinity of water samples.

2. Estimate the salinity of the water samples by volumetric method.

3. Relate the salinity of the water to the life of the organisms.

MATERIALS REQUIRED:

1. 100 ml. conical flasks-2

2. 10 ml. pipettes-2

3. 50 ml burette.

4. 0.05 N silver nitrate solution ($AgNO_3$,)

5. 5% potassium chromate solution.

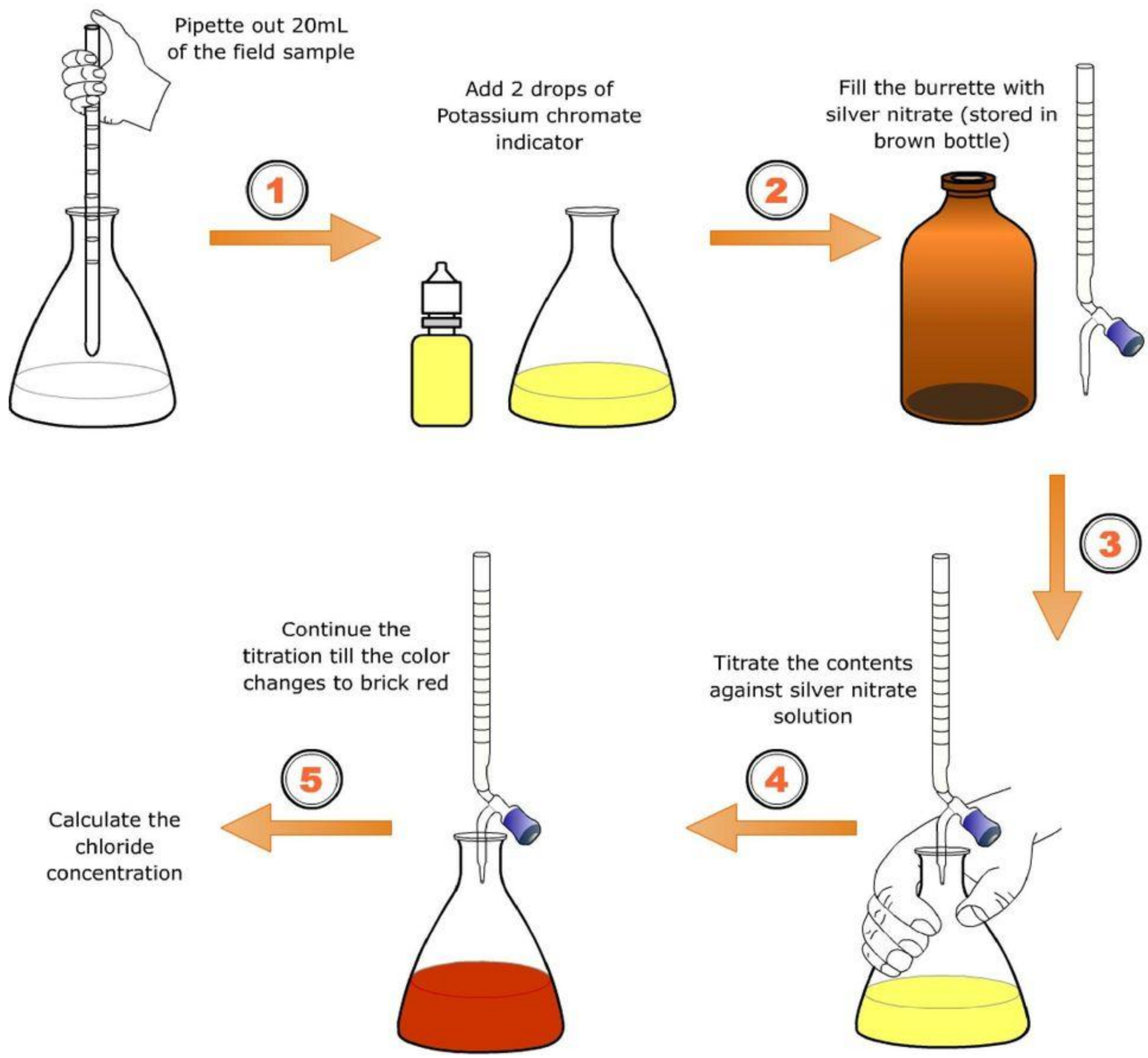
6. Water samples-(2 different water samples such as well water and river water)

PROCEDURE:

1. Fill burette with 0.01 N AgNO, solution.

2. Take 10 ml. of water sample A in a conical flask and add a few drops of 5% potassium chromate solution.

PROCEDURE CHART



3. Titrate the water samples against AgNO, solution. The end point is the appearance of brick red colour.

4. Titrate the sample until the concordant value (2/3 similar reading) are obtained. You may have to titrate a minimum of two times.

5. Record your results in the form of following table in your record note book.

S. No.	Volume of water sample	Burette reading Initial	Burette reading Final.	Volume of AgNO,consumed.
1.	10 ml			
2.	10 ml			
3.	10 ml			

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6. Repeat the experiment with sample B.

CALCULATIONS :

Calculate salinity of the water sample using following formula :

Chlorosity of Water = Estimation of Salinity of Water Samples

Chlorosity of Water=

Volume of AgNO, consumed x Normality of AgNO,

Volume of the sample.

Chloronity of Water = Chlorosity of water/density of water.

(For practical purposes, the density of water can be takes as 1.)

- **Salinity of Water = 0.03 + (1.805 x chlorinity of water)**

= .... Parts per thousand(ppt)

Calculate your results with the help of above formula and report the salinity of the samples.

❖PRECAUTIONS:

Check that' your burette is properly filled without leaving any air column. For this you may have to open the stopcock of the burette and let some AgNO, run down. Make sure you fill the burette with AgNO, solution to read zero.

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