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Dissolved Solids and Minerals in Water - Aquaculture Context

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SUMMARY

Most of the weight of dissolved solids in water is made up of a small number of main ions. The fundamental issue with dissolved solids is keeping the TDS concentration in a range that enables successful osmoregulation by culture organisms. The amount of suspended solids is typically estimated from the water clarity as measured with a Secchi disc. Suspended solids are made up of mineral soil particles, living microorganisms (particularly phytoplankton), and decomposing organic materials. Light transmission and photosynthetic depth are both constrained by turbidity. However, high plankton turbidity results in low dissolved oxygen concentrations at night in fertilized ponds or unaerated ponds with feeding. In mechanically aerated ponds with feeding, turbidity caused by suspended soil particles may be advantageous because it reduces light penetration for phytoplankton growth, but soil particles suspended by aeration settle, resulting in zones of organically-enriched sediment. Such silt may produce anaerobic regions, where microbial respiration results in the production of hazardous compounds.

INTRODUCTION

In an aqueous solution, the particles whose diameter is lesser than 10^{-9}m form the true solution. In other words, it can be said that, at this particle size, they get themselves dissolved in water. On the other hand, the particles whose diameter is greater than 10^{-9} m, form the suspended or particulatematter in an aqueous solution. However, the usual definition of solids refers to the matter thatremains as residue upon evaporation and drying at 103°C to 105°C. The total concentration of dissolved solids in a water body is a general measure of edaphic relationship that contributes to the productivity of water.

Dissolved Solids and Minerals

Spring waters possess a high content of mineral matter, which includes Epsom salt ($MgSO_4$), lime, magnesium, iron, silica, fluorine and carbonic acid. These minerals in water generally create the hardness and alkalinity and their range from 50 mg/I to 300 mg/l is considered to be optimum for a better primary production.In freshwaters, dissolved solids are composed mainly of carbonates, bicarbonates, chlorides, sulphates, phosphates and nitrates of calcium, magnesium, sodium, potassium, iron and manganese. The combined ionic strength of carbonates and bicarbonates ions create the alkalinity in a water medium while the total concentration of divalent metallic cations like Ca^{++} and Mg^{++} is referred to as water hardness. The total solids content of freshwaters usually ranges from 20 mg/l to 1000 mg/l while the dissolved solids content varies from 10 mg/l to 500 mg/l and as a rule, hardness of water increases with the increase in the level of total and dissolved solids.

Salinity(PSU or ppt or $^0/_{oo}$)

Salinity is measured in gm Kg^{-1} or parts per thousand (ppt). The symbol for salinity is S; $^0/_{oo}$stands for 1ppt Salinity includes both the6rganic ions in solution and the organic compounds. Thus,a reading of 35 ppt thenormal value for sea water, is an expression of all dissolved solids and ions

Chlorinity

It is a measure of the halogen concentration in a sample of sea water. The relationship with salinity is as $S^0/_{oo} = 1.80655(Cl\ ^0/_{oo})$

Chlorosity (Chlorinity)

The halogen concentration of sea water is expressed as chlorosity. orchlorinity. It is expressed in grams per litre instead of grams per kilogram (ppt). Chlorosity is defined as the total amount of chlorine, bromine and iodine in grams contained in 1.0 litre of sea water at 20°C assuming that the bromine and iodine have been replaced by chlorine.

Chlorosity reading will be 2% - 3% greater than chlorinity determinations made on the same sample because a litre of sea water has a greater mass than a litre of fresh water.

Density and specific gravity

The density of water refers to its mass per unit volume and is expressed as grams per ml or cubic centimeter. On the other hand specific gravity is the ratio of a given volume of sea water and an equal volume of distilled water at 4°C. Specific gravity, being a ratio, has no units; it is dimensionless. The density ofwater varies with changes in temperature and salinity. It affects density because the mass of water increases when ions are added to it. Increasing the salinity by $1^0/_{oo}$. for example increases the density by about $0.8^0/_{oo}$.Salinity is the most reliable means of measuring the dissolved solid concentration in sea water. Density and specific gravity measurements (the later requiring temperature correction) are less reliable. The normal chlorinity of sea water is considered to be $19^0/_{oo}$which equals a salinity of $34.325^0/_{oo}$. The normal specific gravity of sea water is considered to be 1.024 at a salinity of $34^0/_{oo}$and a temperature of 20°C.

Hardness

Hardness and alkalinity together constitute the minerals in water. Hardness is a term limited to freshwater. It gives a measure of the total concentration of divalent metallic cations like calcium, magnesium and strontium and is expressed in mg/1. Other cationsfreshwater have a negligible effect. Sodium and potassium do not contribute to hardness because of their high solubilities.

Alkalinity

It is sum of negative ions reaction to neutralize hydrogen ions when an acid is added to water to water. Carbonate and bicarbonate ions are the most important. Alkalinity is normally expressed in mg/l. The alkalinity of freshwater is lower and more variable than sea water.

Classification of waters on the basis of dissolved solids present in water medium

Total solids are always more than biochemical oxygen demand (B.O.D.) in an aquatic system. Biologically active solids can be determined by estimating B.O.D. load. Biologically inert solids can be calculated as follows:-

Biologically inert solids = Total solids - Biologically active solids (B.O.D.)

Based on the nature and quantum of solids available in waters, they can be classified as follows:-

Freshwater i.e. such water in which concentration of dissolved solutes is lesser than 0.5 ppt. Freshwater can be further sub-divided into two categories.

- Soft water in which carbonate and bicarbonate ions dominate.
- Hard water in which sulphate ions dominate.

Saline water i.e. such water in which concentration of dissolved solutes is more than 0.5 ppt. Saline water can be further sub-divided into three categories.

- **Brackishwate**r in which salinity is 0.5 ppt to 30 ppt
- **Sea water** in which salinity is 20 not ppt.
- **Metahaline water** or brine in which salinity is >37ppt

Acidic water, It relates to such water which is dominated by the compounds of iron, aluminium and sulphur waste water or polluted water. There are two categories under this type, they are

Sewage: It is the combined liquid wastes discharged from domestic and industrial sources within a given area.

Effluent: It refers to industrialwaste water.

CONCLUSION

Aquaculture will satisfy the demand for fishery products as the supply from inland culture starts to dwindle, which is consistent with having a significant impact on food security. As was already mentioned, the goal of the current regulations and standards is to protect the aquatic systems. The implementation of management practices and strategies was required by this development in order to raise the water quality to an

acceptable level based on other water criteria. Some of the management techniques include adding lime, aerating the water mechanically, adding additions such acidic salts, incorporating filters, etc.

REFERENCES

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