

Water Quality Guidebook



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I . Recommended Readings

Parameters	Type	Recommended Readings
Temperature	Tropical fish	24°C - 30°C
	Coldwater fish	10°C - 20°C
pH	Conventional range	6.5 - 8.5
	Mostly freshwater	6.5 - 7.5
	Tropical fish	6.5 - 8.0
	Saltwater fish	8.0 - 8.4
Salinity	Freshwater tank (with salt)	≤0.3%
	Saltwater tank	3.3%-3.5%
EC	Conventional freshwater tank (without salt)	100-2000us/cm
	Conventional freshwater tank (with salt)	≤6000us/cm
	Saltwater tank	/
TDS	Conventional tank (without salt)	150-500ppm
	Freshwater tank (without salt)	50-800ppm
	SFreshwater tank (with salt)	≤3000ppm
	Saltwater tank	/
SG	Freshwater tank	1.000
	Saltwater tank	1.022-1.025
ORP	Tap water	100-400mV
	Conventional planted tank	250-350mV
	Conventional freshwater tank	200-400mV
	Conventional saltwater tank	300-400mV

Note: 1 PPT=1000 ppm; 1 ms/cm=1000 us/cm;
The unit switches automatically to adapt to the screen display.

II . FAQs

① Why can't I use tap water when configuring pH calibration solution?

A: Since tap water is not pH-neutral, it will result in a large difference in the calibration solution. Therefore, it is recommended to use distilled or pure water for calibration.

② What is the difference between two-point and three-point pH calibration?

A: Three-point calibration has a wider measurement range and accuracy than two-point calibration, so three-point calibration is recommended for daily use.

Note: You can test the monitor with the calibration solutions again after calibration. The calibration is successful if the readings are correct; otherwise, it needs to be recalibrated.

③ Why does pH need to be calibrated regularly?

A: It is usually the amount of electrolyte inside pH probes that determines the lifespan of the probes.

During daily use, the electrolyte inside the probe will be consumed, which will alter its properties. Regular calibration and maintenance are needed to ensure accurate measuring (every 4-6 months).

④ Why do salinity, SG, and EC measurements fluctuate more in a saltwater tank as water flow increases, while the fluctuations in freshwater are insignificant even with salt added?

A: Since TDS, salinity, and SG cannot be analyzed by electronic instruments, it is conventional to measure the conductivity of the water first. Then, convert the conductivity to TDS, salinity, and specific gravity according to scientific algorithms.

As a result, these four parameters are essentially the same. Conductivity is the measurement of the migration rate of conductive ions in water. The TDS, salinity, and specific gravity all change if the concentration of ions changes at constant temperature.

Freshwater has a lower ion concentration, so even with greater flow, conductivity changes are not obvious, and hence there is less fluctuation.

Alternatively, since the concentration of ions in the saltwater tank is high, even a small amount of water flow will cause large fluctuations in conductivity, which in turn will affect TDS, salinity, and specific gravity.

In summary, it is recommended to place the probe in a place where the water flow is obvious if you want to observe indicator changes in a dynamic water environment; however, if you want to make reference to the numerical value, please place it where the water flow is more static.

Note: When comparing with optical or other testing instruments, you can adjust the value directly by pressing the button.

⑤ Why is there liquid in the probe's protective cap, and what is it for?

A: As the probe cannot be exposed to air for a long time, it needs to be covered with a protective cap to keep it moist. When the probe will not be used for more than a week, it is recommended to add pure water or tap water to the protective cap.

⑥ Do I need to disconnect the product when changing the tank water?

A: You can change the water without disconnecting the monitor or probe.

⑦ What should I do when data exceptions occur?

A: Check whether the power supply is stable, and whether the connecting cables are tightened. Re-power the device, or try to restore factory settings. Please contact us if the issue is still not resolved.

⑧ How should I proceed if the probe is ineffective after a while due to a lot of algae attached?

A: The probe should be soaked in a disinfectant solution diluted 1:10 with disinfectant and water for 8 hours. Rinse and calibrate the probe before using it. Please note that the soaking depth should not exceed the maximum water level. Consider using a chlorine-containing disinfectant whose main component is NaClO, with a concentration of about 6%.

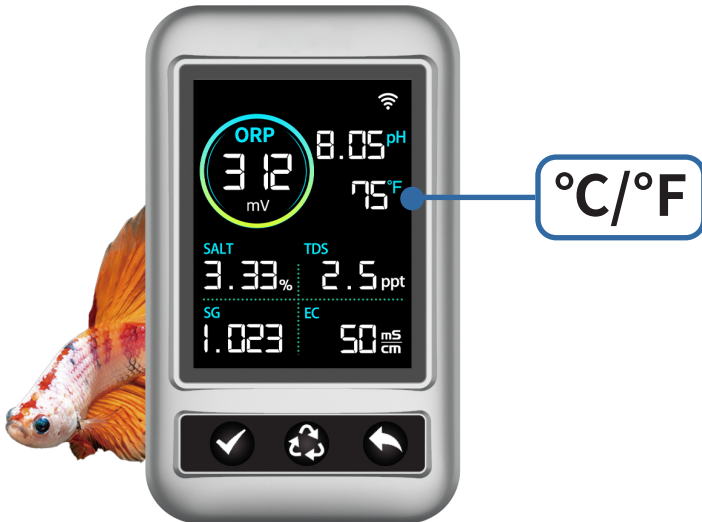
⑨ Why can't the probe be used above the maximum water level or fully immersed in water, like a heater?

A: Excessive water pressure can damage the probe if it is placed over deep. For daily use, please do not exceed the maximum water level line labeled on the probe to extend its life.

⑩ Why is the ORP value lower than the true value but keeps increasing?

A: It generally takes a week for brand-new ORP probes to oxidize.

III. Temperature Measurement: Meaning and Solutions



When it comes to managing fish tank water quality, the temperature is one of the most important parameters. The water temperature has a great influence on the growth, health, and reproduction of aquatic animals and plants. There are different requirements for water temperature for different types of fish. Tropical fish generally require water temperatures between 24 °C and 30 °C. Cold-water fish generally require water temperatures of 10-20 °C. If the water temperature is too high or too low, it will negatively affect the growth and health of the fish.

Water temperatures that are too high will easily deplete dissolved oxygen in the water and cause fish breathing problems. It is easy to cause fish diseases if the water temperature is too low, as it will affect digestion and immune system functions. Therefore, fish tank management requires measuring the water temperature regularly and keeping it stable.

Tip for Water Temperature:

The water temperature can be measured with Kactoil Water Monitors and controlled by adjusting the heater or cooler. At the same time, it can also maintain a stable water temperature through reasonable lighting, filtration and ventilation.

IV. pH Measurement: Meaning and Solutions



The pH value is an index of the concentration of hydrogen ions (H^+) in water, which indicates the acidity and alkalinity of the water. Acidic water has a lower pH; alkaline water has a higher pH; and neutral water has a pH of 7.

It is important to note that different fish species need different pH ranges. The pH of the water can affect the fish's health as well. Low pH levels in water will enhance the toxicity of ammonia, which will have a negative effect on fish health. It is important to note, however, that if the pH value of the water is too high, it will affect the respiratory and digestive functions of the fish, causing them to get sick or even die.

The pH level of water should be between 6.5 and 8.5. Most freshwater fish prefer a pH of 6.5 and 7.5. Tropical fish require a pH value between 6.5 and 8.0. A pH of 8.0–8.4 is ideal for saltwater fish.



Acidity < 7.0

7.0

Alkalinity > 7.0

Tip for High pH:

a. Choose a water source with low pH. If your tap water has a high pH, consider using reverse osmosis or deionized water to minimize pH (filtered or purified water is recommended).

b. Add peat or keep fish that prefer acidic water. Peat is a naturally acidic medium that lowers water pH. Keeping some acid-loving fish species can also help maintain a lower pH.

c. Use pH adjusters. PH adjusters can be used to increase or decrease the pH of the water. However, they should be used carefully to avoid drastic pH fluctuations.

Tip for Low pH:

Increasing the amount of carbonates in the water, such as sodium carbonate or sodium bicarbonate, can raise the pH of the water. However, be careful to add it gradually and monitor the pH change.

a. Use crushed shells or coral sand. Crushed shells or coral sand are sources of carbonates and can help maintain a high pH.

b. Keep alkaline-loving fish. Choose alkaline-loving fish species, which are usually better suited to surviving in high-pH environments.

c. Reduce overfeeding. Overfeeding may lower the water quality, lowering the pH. Ensure feeding in moderation and clean your tank regularly.

When adjusting pH, try to avoid drastic pH changes, as this may adversely affect fish and aquatic life. It is best practice to make gradual adjustments and continuously monitor water quality parameters. This is to ensure that the pH in the tank remains stable within the appropriate range.

V. TDS Measurement: Meaning and Solutions



TDS refers to the total dissolved solids in the fish tank, usually expressed in PPM (parts per million) or mg/L (milligrams per liter).

It is an indicator of the concentration of dissolved substances in water, including dissolved minerals, organic and inorganic substances. The large range is usually displayed in ppt (1 ppt = 1000 ppm), the small range is typically displayed in ppm, and the unit is usually switched automatically to ensure better display.

It is generally recommended to maintain the TDS of the tank between 150-500 ppm to ensure that fish and aquatic plants grow properly. Having a low TDS can result in a lack of essential trace elements in the water; while having a high TDS can result in water that is too dense, which can make breathing and growing difficult for fish.

Therefore, adjusting the TDS value of the fish tank should be done according to the situation.

It is possible for fish to tolerate low nitrogen and phosphorus levels, but not algae. Nitrogen and phosphorus are the main factors in algae formation, and diligent water changes can lower nutrients. For more nutritious aquatic grass mud, due to its better fertility and higher nitrogen and phosphorus levels, it will be prone to algae over time.

It is recommended to use professional instruments to monitor water quality. Then, you can avoid a lot of unnecessary problems by combining your needs to improve water quality.

What is the effect of high TDS on aquatic plants?

Tap water in some countries or cities has a TDS of 300 ppm or higher, and the water is hard.

Hard water tends to be alkaline, the main components of which are bicarbonate and calcium and magnesium ions. Use tap water to grow plants that are susceptible to bristle algae and cyanobacteria. Some cyanobacteria will even produce toxins.

Water is an ecosystem. Generally speaking, aquatic plant enthusiasts prefer pure water to maintain their plants. This is also why pure water is important for corals in marine tanks.

Tip for High TDS:

a. Water change. Lower the TDS by changing a partial amount of water. Please make sure the new water is purified and suitable for your fish.

b. Use reverse osmosis or deionized water. Reverse osmosis or deionized water usually has a lower TDS value and can be used to mix aquarium water to reduce TDS.

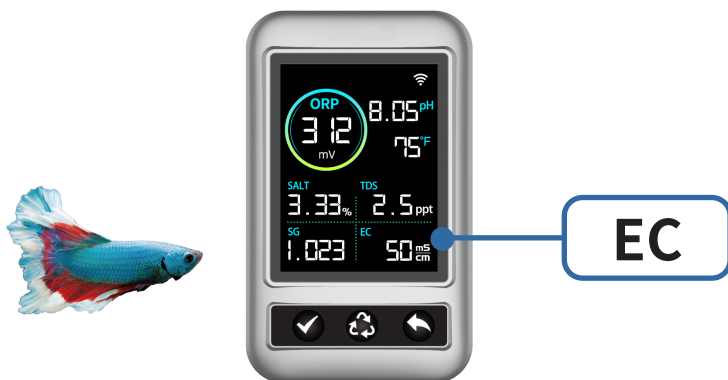
- c. Filtration system.** Use a highly efficient filtration system, such as a reverse osmosis system or ion exchange resin to remove excess dissolved material.
- d. Reduce breeding and feeding.** Increased waste and residue in the water can result from overbreeding or overfeeding, which can raise the TDS.

Tip for Low TDS:

- a. Add salt.** You may need to add some salt to your water to increase the TDS if you have some fish that require higher TDS water quality. Salt suitable for fresh-water fish should be used in freshwater tanks, and saltwater salt should be used in marine tanks.
- b. Water change.** You can increase the TDS by adding water that has a higher TDS. Be careful to ensure the TDS of the new water is suitable for your fish.
- c. Keep fish that can be kept in low-TDS water.** If your water has a low TDS, consider keeping fish suitable for this water quality.
- d. Add minerals.** Add the right amount of water stabilizer or mineral salts if the TDS is low because of a lack of minerals.

It is essential to maintain stable water quality parameters regardless of whether your tank's TDS is high or low. This is because drastic fluctuations in water quality can have a negative impact on your fish. Monitor water parameters regularly and improve the water environment as needed to maintain the right water quality for your fish.

VI. EC Measurement: Meaning and Solutions



The electrical conductivity of fish tank water is determined by the concentration or

content of conductive substances. This indicator measures the ionized substance concentration in water.

Depending on the unit, it's Siemens per meter (S/m) or millisiemens per centimeter (mS/cm). $1\text{mS/cm}=1000\mu\text{S/cm}$, often used to detect the purity and pollution degree of water quality. Electrical conductivity in a fish tank depends on things like the type, quantity, feed, and filtration system of the fish. Generally speaking, tropical fish grow better with water conductivity between 200 and 500 $\mu\text{S/cm}$.

The electrical conductivity of water is a measure of its electrolyte content or the concentration of total dissolved substances (TDS). It is important for monitoring and maintaining the water quality in your fish tank. High or low electrical conductivity can adversely affect the ecosystem in your aquarium. The following methods can be used to deal with high and low conductivity:

Tip for High EC:

a. *Water change.* You can replace some existing water with new, lower-conductivity water. Make sure the conductivity of the new water is suitable for your species.

b. *Use reverse osmosis or deionized water.* Reverse osmosis or deionized water usually has a very low conductivity and can be used to mix tank water to lower conductivity.

c. *Filtration system.* Use a high-efficiency filtration system such as reverse osmosis or ion exchange resin to remove excess electrolytes and TDS.

d. *Check the water source.* If your tap water has high conductivity, you may need to consider using an alternative water source such as rainwater or filtered water.

Tip for Low EC:

a. *Add salt or minerals.* Adding salt or minerals to the water can increase the conductivity of water if you keep fish that require higher conductivity.

b. *Use a suitable water source.* Ensure that the water source meets the needs of your fish species by choosing a source that is suitable.

c. *Check the filtration system.* Ensure that your filtration system does not filter out too much electrolyte and can be adjusted properly.

d. *Check your feeding habits.* Avoid overfeeding or overbreeding, as this may lead to lower TDS.

Maintaining stable conductivity is critical to the health of fish and aquatic life because it is an important parameter of tank water quality. Be sure to monitor water quality regularly and make adjustments as needed to maintain the right water quality for your fish.

VII. Salinity Measurement: Meaning and Solutions



Normally, salt doesn't need to be added to freshwater fish tanks. Freshwater fish and aquatic plants can be negatively affected by salt because it changes the chemical composition of the water. However, you can add salts in some cases, like to treat fish diseases or improve electrical conductivity. Salt should generally not exceed 3000 ppm, or 0.3%, in freshwater fish tanks.

In saltwater tanks, salinity is the ratio of salt in saltwater, which is usually expressed as salinity, but can also be expressed as specific gravity. The unit of salinity is ‰ (one thousandth), while specific gravity has no unit, usually between 1.020 and 1.026.

In saltwater tanks, the density of the water and the amount of dissolved oxygen can be controlled by regulating salinity. Additionally, salinity affects fish physiological activities such as respiration, eating, and metabolism. Therefore, maintaining a proper salinity level is very significant for the health and stable operation of saltwater tanks. Generally speaking, the salinity of saltwater tanks should be controlled between 32‰-35‰ (3.2%–3.5%) to adapt to the survival needs of the vast majority of seawater organisms.

Salinity in an aquarium is the concentration of dissolved salts in the water. This is

an important parameter for saltwater aquariums and some freshwater aquariums. High or low salinity can adversely affect fish and aquatic organisms, and here's how to solve it:

Tip for High Salinity:

a. Water change. Replace part of the water by mixing high-salinity water with fresh or low-salinity water. It is important to replace the water gradually in order to avoid a sudden drop in salinity.

b. Check the salt addition. If you are using a sea salt mixture, make sure it is formulated correctly. You should reduce the amount of salt added if you add it directly to the tank.

Tip for Low Salinity:

a. Add salt. According to the manufacturer's recommendation, gradually add sea salt or table salt to increase salinity levels.

b. Monitor your salinity. Check the salinity regularly, especially after water changes, to ensure it stays within the correct range.

Ensure that the salinity levels for your fish species are appropriate based on their needs. Regular monitoring and proper salinity adjustment are key to maintaining fish tank water salinity. Please avoid drastic salinity fluctuations, as this can adversely affect fish and aquatic life.

VIII. SG Measurement: Meaning and Solutions



The specific gravity of fish tank water is the ratio of its density to that of pure water. It is commonly used to measure salinity or dissolved substances concentration in fish tanks.

The salinity of saltwater aquariums is usually measured using a hydrometer. According to the international salinity standard, the unit of salinity is PPT, and 1 PPT is equal to 1 gram of salt dissolved in 1 kilogram of water.

As a result, specific gravity and salinity have a certain conversion relationship. If the specific gravity of the water is 1.022, the corresponding salinity will be about 30 PPT (3%), which is an ideal range of salinity for saltwater tanks.

It is usually not necessary to measure specific gravity in freshwater tanks because freshwater density is similar to pure water, usually 1.000.

In tank water, the specific gravity refers to the amount of dissolved substances, particularly salt. The specific gravity of a fish tank is especially significant for saltwater aquariums because it directly reflects the quality of the salinity of water in the tank.

High or low specific gravity can adversely affect fish and aquatic life, and here are ways to address high and low specific gravity:

Tip for High SG:

a. *Water change.* Replace part of the water by mixing high SG water with fresh or low SG water. It is important to replace the water gradually in order to avoid a sudden drop in SG.

b. *Use reverse osmosis or deionized water.* Typically, these waters have a very low concentration of dissolved substances and can be used for mixing aquarium water and lowering its specific gravity.

c. *Check the salt addition.* If you are using a sea salt mixture, make sure it is formulated correctly. You should reduce the amount of salt added if you add it directly to the tank.

Tip for Low SG:

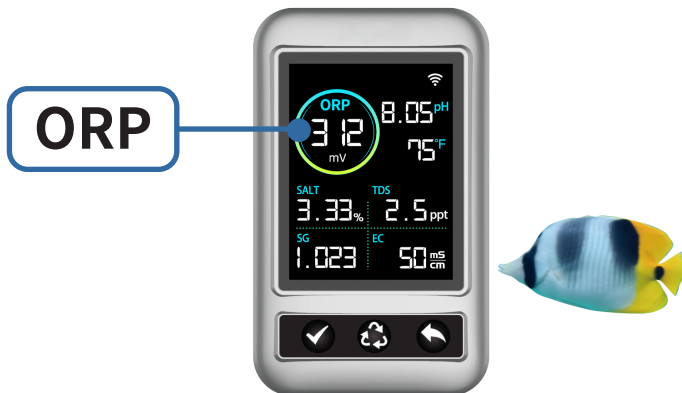
a. *Add salt.* According to the manufacturer's recommendation, gradually add sea salt or table salt to increase SG levels.

b. *Monitor your SG.* Check the SG regularly, especially after water changes, to ensure it stays within the correct range.

Ensure that the SG levels for your fish species are appropriate based on their needs. Regular monitoring and proper SG adjustment are key to maintaining fish tank water

quality. Please avoid drastic SG fluctuations, as this can adversely affect fish and aquatic life.

IX. ORP Measurement: Meaning and Solutions



What is the easiest way to understand redox in a tank?

Imagine that a fish tank is a large tank with many fish and other aquatic beings in it. This tank is like a giant battery. In this tank, there are electrons called ORP, just like electrons in a battery.

ORP is the "energy" of the water: ORP can be considered the "energy level" of water, like electrical energy in a battery. This "water energy" determines how clean and biologically healthy the water is. When the ORP is high, the water is very clean and healthy, like an energized battery. Water with a low ORP is like a dying battery that may need more energy to remain clear and biologically healthy.

Oxidation is the source of "energy" in water: The "oxidation" part of the ORP is like the electrical energy in a battery; it provides the "energy" in the water. This "oxidized" energy helps remove waste, harmful substances, and bacteria from the water.

Reduction is the "reserve" of the water: The "reduction" part of the ORP is like the reserve of electricity in a battery; it maintains and stabilizes the "energy" in the water. This "reducing" reserve helps to maintain water stability.

So, ORP is like the energy level of the water. It is determined by the oxidation and reduction processes taking place in the water. A high ORP indicates that the water is energized, clean, and healthy. In contrast, a low ORP may require more energy to

keep the water clear and biologically healthy. Maintaining a proper ORP level is important for water quality and biological health in your aquarium.

ORP in the fish tank refers to the oxidation-reduction potential in the tank water, also known as the oxidation reduction potential. It is an indicator to measure the redox nature of water, which can be used to reflect the oxygen content and the purity of water.

The ORP value can also be used to measure the concentration of harmful substances in fish tanks, such as ammonia, nitrite, and nitrate. Generally speaking, the ORP in the fish tank should be kept at a positive value. This ensures enough oxygen in the water for fish to breathe. Moreover, a high ORP value can reduce the concentration of harmful substances in the water, which is beneficial for fish and water quality stability.

ORP are usually expressed in units of millivolts (mV). The ORP value is zero when oxidation and reduction reactions in the solution are balanced, indicating that the redox reaction has been terminated. A positive ORP value indicates the presence of an oxidizing agent, whereas a negative ORP value indicates the presence of a reducing agent. Generally, the higher the ORP value, the higher the concentration of the oxidant in the solution. Vice versa, the lower the ORP value, the lower the concentration of the reducing agent in the solution.

During water treatment and water quality monitoring, ORP values can be used as a measure of whether water has oxidizing or reducing substances. Additionally, it can be used to determine the amount of disinfectant in water, the level of organic matter degradation, and the state of microbial growth in water. The ORP value can also be used to regulate redox reactions in water, such as in ponds or fish tanks, improving water quality and promoting fish health by controlling oxygen supply and redox concentration.

The following are some of its key roles:

a. Measurement of water quality and stability. ORP is a measure of water stability and cleanliness. High ORP values usually indicate positive water quality, while low ORP values may indicate poor water quality. Maintaining a proper ORP level helps to ensure stable water quality.

b. Monitor oxygen levels. The ORP is strongly correlated with the oxygen level in the water. A high ORP value often means that the oxygen level in the water is high, which is essential for aquatic organisms to breathe. Keeping an eye on ORP ensures there is enough oxygen in the water.

c. Monitor ammonia and nitrite levels. ORP is also correlated with ammonia and nitrite concentrations. These two substances are harmful to fish and aquatic organisms because they cause ammonia poisoning and nitrite poisoning. It helps control and reduce the concentration of harmful substances by maintaining a proper ORP level.

d. Bacterial control. The level of ORP in the water is crucial to controlling harmful bacteria in the water and reducing the risks of infection among aquatic organisms. High ORP levels usually inhibit harmful bacteria growth, helping to maintain aquatic health.

e. Maintain the health of corals and aquatic plants. For corals and aquatic plants, proper ORP levels are essential for their growth and health. High ORP values can promote coral and aquatic plant growth, while low ORP values may make them unhealthy.

The ORP value of tap water is generally between 150 and 350mV, depending on factors such as the source, treatment, and delivery method. ORP values may differ depending on the source of water and the treatment method used in different regions.

Water in some areas may contain oxidizing substances, such as chlorine and other disinfectants, which will increase the ORP value. In other areas, tap water may contain too many reducing substances, such as sulfides, which lower the ORP. It is ideal to keep the ORP value of the fish tank between 200 and 400 mV to ensure equilibrium between oxidation and reduction reactions. Additionally, it promotes the healthy growth of fish by controlling oxides and organic substances in the water.

An ORP value lower than 200mV indicates the presence of too many reducing substances in the fish tank, such as ammonia and hydrogen sulfide, which can harm fish and negatively affect water quality. At this time, it is necessary to increase oxygen supply in the water or add oxidants to increase ORP values, and at the same time implement appropriate water quality management to ensure fish tank water quality stability.

An ORP value greater than 400 mV indicates too many oxidizing substances in the water, such as chlorine or ozone, which can harm fish, resulting in death or stunted growth. In this stage, the concentration of oxidants or disinfectants in the water needs to be reduced, the ORP value must be lowered, and water quality management must be ensured in order to ensure stability.

Tip for High ORP:

a. Enhance oxygen supply. Make sure the tank water has an adequate supply of oxygen, either by adding air stones or oxygen pumps, or by increasing water circulation.

b. Check the water filtration system. Make sure your filtration system is effective at removing waste and organic pollutants, such as ammonia and nitrogen. An excessive buildup of oxidizing **c.** Limit the addition of oxidizing substances. The ORP can be lowered by reducing the use of oxidizing substances, such as hydrogen peroxide or ozone.

Tip for Low ORP:

a. Enhance oxygen supply. Make sure the tank water has an adequate supply of oxygen, either by adding air stones or oxygen pumps, or by increasing water circulation.

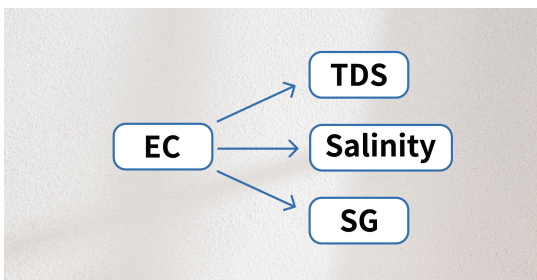
b. Increase plants. As aquatic plants photosynthesize in the light and release oxygen, they can assist in increasing oxygen levels.

c. Reduce organic waste. Reduce overfeeding and clean your tank regularly to reduce organic waste buildup, which can increase ORP.

d. Check the filtration system. Ensure that the filtration system functions properly to effectively remove waste and maintain water quality.

ORP is an important parameter for water quality monitoring and critical to fish and aquatic life health. Please monitor the ORP regularly to ensure it stays within the proper range.

X. Relationship between EC, TDS, Salinity, and SG



Since an electronic tester cannot directly measure TDS, salinity, or specific gravity, the conventional method is to measure the electrical conductivity of the water. This is done by converting the EC into TDS, salinity, or specific gravity. So essentially, all four parameters have the same meaning.

EC measurements are affected by temperature, pressure, and the material used. Normal TDS testers cannot measure saltwater (high salinity). This is due to the fact that it is made of a titanium/aluminum alloy, which passivates directly at high salinity and thus cannot be measured.

Measuring electrical conductivity means measuring the migration rate of conductive ions in water. The conductivity changes when the concentration of ions changes, which changes the TDS, salinity, and specific gravity when the temperature remains constant.

As freshwater has a low ion concentration, the conductivity change will not be obvious even when water flow fluctuates greatly, so the salinity fluctuation will also be small.

Due to the large concentration of ions in saltwater tanks, even a small current can cause large fluctuations in conductivity. This in turn affects TDS, salinity, and specific gravity.

To summarize, if your purpose is to observe the change in parameters of aquatic organisms in a dynamic water environment, it is recommended to place the probe in a place where the water current is obvious. If you are using this as a reference, please try to place the probe where the water flow is more static. Please place the probe in an area with low water flow for normal use.

XI. Tap Water Fish-Keeping Precautions

a. Water quality testing. In fishkeeping, tap water may not be suitable for direct use, so a water quality tester may be necessary to determine parameters such as pH, chlorine, and hardness. Testing results will determine whether or not tap water needs treatment before use.

a. Water quality adjustment. Tap water can be made suitable for fish with water quality regulators based on water quality testing results. For example, use pH adjusters to regulate pH, and use nitrifying bacteria to help degrade ammonia and nitrogen, etc.

c. Dechlorination. Tap water usually contains chlorine, which is harmful to fish and needs to be dechlorinated. This can be done by using a de-chlorinator or by

leaving the tap water for a period of time to allow chlorine to evaporate naturally.

d. Fish selection. You can choose fish that can be kept in tap water since different fish require different types of water.

Note: Tap water usually cannot be used directly, and it is recommended to leave it for a few days before using it for fishkeeping.

XII. Filtered Water Fish-Keeping Precautions

It is common to use filtered water for fishkeeping to provide a clean and safe environment for them to live in. This is done by removing waste, harmful substances, and impurities through a filtration system. The following are some of the more important aspects of using filtered water for fish:

a. Choosing the right filtration system. Different fish species and tank types require different types of filtration systems, such as mechanical filtration, biochemical filtration, and physical/chemical filtration.

b. Filtration media selection. Select filtration media suitable for your filtration system, such as filter sponges, bioballs, activated carbon, and filter stones. The choice of filtration media depends on your water quality and your need for waste treatment.

c. Regular maintenance. Regular maintenance of the filtration system includes cleaning the mechanical filtration, replacing the biochemical filtration media, and replacing the physical or chemical filtration media. A lack of scheduled maintenance can reduce the efficiency of filtration systems and affect the quality of water.

d. Monitoring water quality. Regularly monitor your water quality parameters, such as ammonia, nitrate, nitrite, pH, temperature, etc., to ensure healthy and stable water quality.

e. Avoid overfeeding. This is because excreta and food residues increase waste and ammonia nitrogen production. Feeding should be tailored to the needs of the fish, in small quantities and multiple times. The purpose of this is to ensure that the fish consume the food completely.

f. Avoid overbreeding. Make sure the number and type of fish are appropriate for the size of the tank and the capacity of the filtration system.

e. Provide hiding places. Set up some decorations, plants, and rocks in the tank for the fish to hide behind. By doing so, the fish will feel more secure and will be less stressed.

h.Regular water changes. Maintain your water quality by periodically replacing a portion of the water with new water.

i. Reduce drug use frequency. Try to avoid the use of drugs and chemicals, which may adversely affect aquatic beings, unless it is really necessary to do so.

Monitoring the water quality of your fish tank and maintaining its filtration system are critical to keeping your fish healthy. Proper management of your filtration system will ensure clear water for your aquatic friends and reduce the risk of disease.

XIII. Biochemical filtration Materials

Biochemical filtration materials in fish tanks are an important part of removing waste and harmful compounds in fish tanks. Common biochemical filtration materials include:

a. Biochemical cotton: with a high surface area and porous structure, it can adsorb and decompose organic matter and waste, and facilitate the attachment and growth of bacteria.

b. Activated carbon: capable of removing organic matter, odors, and pigments, and enhancing the clarity of water.

c. Ceramic ring: provides a large surface area, which facilitates the attachment and growth of bacteria.

d. Bio-filter ball: also has a large surface area, favorable for bacterial attachment and growth.

e. Bio-ceramics: used to increase the bioload and bacterial attachment area, promoting organic matter decomposition and ammonia-nitrogen conversion.

Choosing the right biochemical filtration materials requires considering the size and type of a tank, as well as the quality of the water in it. This is to ensure that they are effective in removing wastes and hazardous compounds while posing an appropriate bioburden.

It is recommended to adjust the water flow rate of the filter appropriately according to the size of the fish tank and the performance of the filter to ensure adequate water circulation and smooth water flow.

The filter material also needs to be cleaned regularly to remove harmful substances and bacteria buildup to keep the filter working efficiently.

Filtering water for fish farming can effectively keep the water clean, and reduce

harmful substances to fish. Nevertheless, regular maintenance and cleaning of the filter are necessary to ensure that the filter functions properly and the water quality remains good.

XIV. Ammoniacal Nitrogen Production and Solutions

Ammonia nitrogen ($\text{NH}_3/\text{NH}_4^+$) is a toxic waste usually produced by fish metabolism, urine, and feed residues. A high ammonia nitrogen level is harmful to aquatic life.

Ammonia nitrogen production:

- a. Fish metabolism.** The breathing, feeding, and excretion of fish release ammonia nitrogen.
- b. Urine.** A major source of ammonia nitrogen in a tank is fish urine, which excretes ammonia nitrogen.
- c. Overfeeding.** Overfeeding your fish can lead to the breakdown of food scraps into ammonia nitrogen.

Solutions for ammonia nitrogen:

- a. Regular water changes.** Reduce ammonia nitrogen concentrations by periodically replacing a portion of the water with new water.
- b. Use biochemical filters.** Biochemical filters can house beneficial bacteria that convert ammonia nitrogen to nitrites and then to nitrates, which are less toxic.
- c. Limit the amount of food you feed.** To minimize food residue and ammonia nitrogen production, avoid overfeeding the fish and provide only the amount of food they need.
- d. Water quality monitoring.** Ensure healthy water quality by regularly monitoring water quality parameters, particularly ammonia and nitrogen levels.
- e. Fish tank cycling.** Establishing beneficial bacterial colonies that regulate the nitrogen cycle can help degrade nitrogen.
- d. Water quality monitoring.** Ensure healthy water quality by regularly monitoring water quality parameters, particularly ammonia and nitrogen levels.
- e. Fish tank cycling.** Establishing beneficial bacterial colonies that regulate the nitrogen cycle can help degrade nitrogen.

To maintain the quality of your aquarium and to protect the health of your aquatic life, it is essential to monitor and control the ammonia nitrogen concentrations in your water regularly.

XV. Nitrate & Nitrite Production and Solutions

Nitrate and nitrite are very significant parameters in water quality management, and are directly related to aquatic health.

Nitrate (NO_3^-) is an oxidized product of nitrogen, nitrite (NO_2^-) and nitrate can be converted into each other, and their excessive concentrations may harm aquatic life.

The oxidation of nitrites results in the production of nitrates. The majority of nitrates are derived from the decomposition of fish urine and waste, but they can also be derived from excessive feed residues and decaying organic matter.

You can reduce nitrate by following these measures:

a. Regular water changes. Reduce nitrate concentrations by periodically replacing a portion of the water with new water.

b. Plant more aquatic plants. Aquatic plants are able to absorb nitrates and improve water quality.

c. Use biochemical filters. Biochemical filter media can help break down nitrates into nitrogen.

Nitrite production and solutions:

Nitrite (NO_2^-) is toxic to fish and other aquatic life. Nitrite is an intermediate in the nitrogen cycle, produced when ammonia nitrogen ($\text{NH}_3/\text{NH}_4^+$) is oxidized to nitrate (NO_3^-) by nitrifying bacteria. Nitrite is toxic because it interferes with fish blood systems, reducing hemoglobin oxygen transport capacity.

Symptoms of nitrite poisoning are as follows:

a. Shortness of breath. Nitrites have an adverse effect on fish's respiratory system, which results in them breathing rapidly.

b. Gill lobe discoloration. During nitrite poisoning, fish gill lobes are usually red or brown due to the binding of nitrite to hemoglobin.

c. Abnormal fish behavior. Nitrites can cause fish to behave abnormally, such as inactivity, decreased appetite, or uncoordinated swimming.

d. Death. High concentrations of nitrite can lead to fish death, especially if no remedial measures are taken.

It is imperative to take immediate corrective action if nitrite levels are elevated, such as partial water replacement, cessation of overfeeding, increased oxygen supply, and use of chemical nitrogen compound reducers.

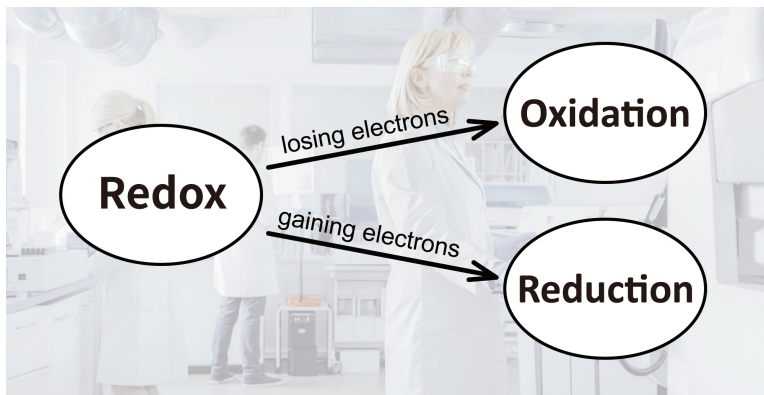
You can reduce nitrite by following these measures:

- a. Regular water changes.** Reduce nitrite concentrations by periodically replacing a portion of the water with new water.
- b. Use biochemical filters.** Biochemical filter media can help break down nitrites into nitrate.
- c. Limit the amount of food you feed.** Avoid overfeeding to minimize the accumulation of ammonia nitrogen.

Monitoring water quality, cleaning up waste regularly, feeding in moderation, and doing regular water tests are all important steps in maintaining your tank's water quality.

XVI. Ammoniacal Nitrogen, Nitrate and Nitrite from a Redox Perspective

Redox reactions are chemical reactions that involve the oxidation and reduction processes. These reactions involve substances losing electrons (oxidation) and gaining electrons (reduction).



In redox reactions in water, the transfer of electrons is usually accompanied by the formation or breaking of chemical bonds between atoms or ions.

Ammonia nitrogen in a fish tank is the amount of ammonia in the water, which is a toxic substance and harmful to aquatic life. The main sources of ammonia nitrogen are fish metabolites and fish food residues. It can exist in two forms, free ammonia nitrogen (NH_3) and ionized ammonia (NH_4^+), and their relative proportions are affected by pH.

Ammonia oxidation of ammonia nitrogen to nitrite: Nitrifying bacteria oxidize ammonia nitrogen to nitrite (NO_2^-) first: $\text{NH}_3/\text{NH}_4^+ \rightarrow \text{NO}_2^-$ which is an oxidation reaction in which ammonia nitrogen loses electrons while oxygen is reduced.

Nitrite oxidation from nitrite to nitrate: Next, nitrite (NO_2^-) is oxidized to nitrate (NO_3^-) by nitrite bacteria: $\text{NO}_2^- \rightarrow \text{NO}_3^-$, which is also an oxidation reaction in which nitrite loses electrons while oxygen is reduced.

Nitrate Reduction: In some cases, nitrate (NO_3^-) can be reduced to nitrite (NO_2^-) or nitrogen (N_2) by denitrifying bacteria: $\text{NO}_3^- \rightarrow \text{NO}_2^- \rightarrow \text{N}_2$. Nitrate gains electrons while oxygen is oxidized, and this usually occurs under low- or no-oxygen conditions.

