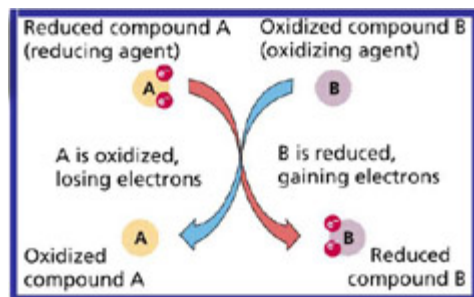


REDOX (REDOX POTENTIAL) BASICS (OXIDATION POTENTIAL, ORP):



Although not a well known process among many aquarists, the implications of Redox for a healthy aquarium are quite far reaching, and thus important for any aquarist considering moving from basic aquarium (or pond) keeping to advanced to understand. As well even the average aquarist should consider this water parameter when all other parameters check out, yet fish continue to be susceptible to disease this may be an important parameter to consider (as growing research in human disease resistance, and even plant growth also shows, yet the aquarium keeping community still seems to be in the dark ages as

per this research)

Redox, also known as Redox Potential, oxidation potential, & ORP (oxidation reduction potential) describes the ability for the loss of an electron by a molecule, atom or ion to the gain of an electron by another molecule, atom or ion. Without this ability to gain electrons many minerals cannot be absorbed and properly assimilated. So it is very important to keep a healthy Redox Balance via proper dissolved oxygen levels, UV Sterilization, and proper positively charged mineral levels (such as Calcium and Magnesium).

***Oxidation** describes the loss of an electron by a molecule, atom or ion.

Another way to look at this is to lose or cause to lose hydrogen atoms.

Example: Redox processes such as the oxidation of carbon to yield carbon dioxide.

***Reduction** describes the gain of an electron by a molecule, atom or ion.

Another way to look at this is remove oxygen atoms or add hydrogen atoms.

Example: The reduction of carbon by hydrogen to yield methane (CH₄).

Another example: Calcium (Ca²⁺) or Magnesium (Mg²⁺) which initially are composed of two positively charged ions immersed in a sea of movable electrons may have given up all possible electrons to cells under oxidation. It is for this reason, then, that calcium and magnesium supplies must be constantly renewed; without this "fresh" calcium, etc. your Redox balance will suffer.

Think of it this way; a storage battery "works" only when a positive and a negative electrode are present to maintain an electrical current. When the positive plates become exhausted, the battery is no longer any good (even though the metal plates and other "ingredients" for the battery are still present; so it is that your GH or Calcium Test may show adequate minerals, but these minerals have been oxidized and thus rendering the test inaccurate as per positively charged calcium ions).

The above are over simplifications of the process, so please read on as I will go into further depth as the article progresses, especially as Redox relates to aquatic health.

Oxidized Water: Oxidized water with its Redox potential of +700 to +800 mV is an oxidizing agent that can withdraw electrons from bacteria and kill them. The oxidized water can be used to clean hands, sterilize utensils, and treat minor wounds.

Here are a few oxidizers: ozone (O₃; Oxidation potential= +2.1), hydrogen peroxide (H₂O₂; Oxidation potential= +1.82), chlorine (Cl₂) and chloramines (NH₂Cl).

Reduced Water: Reduced Ionized with a Redox Potential of -250 to -350 mV

REDUCERS/ OXIDIZERS

Element:	Electron (V)
F	+2.87
Co	+1.82
Au	+1.50
2Cl	+1.36
O2	+1.23
Br	+1.07
Cu	+0.34
Ni	-0.25
Co	-0.26
Ti	-0.34
Fe2	-0.44
Zn	-0.76
Al	-1.66
Mg	-2.37
Na	-2.71
Ca	-2.87
K	-2.92
Li	-3.05

readily donates its electrons to unusual oxygen radicals and blocks the interaction of the active oxygen with normal molecules. Substances which have the ability to counteract active oxygen by supplying electrons are called scavengers. Reduced water, therefore, can be called scavenging water. Reduced water inhibits excessive fermentation by reducing indirectly metabolites. *Please note that the oxidizers have a plus and the reducers have a negative in the chart to the left.*

Here are a few reducers, in other words, elements or processes that transfer electrons to another substance; Magnesium, Calcium, Sodium, and the process of Photosynthesis involve both oxidation and reducing.

As one can see from the graph that elements such as most metals, as well as essential elements for aquatic life: Calcium and Magnesium are major reducers however because of this they are also most easily depleted (the elements at the top and the bottom of the graph are most easily depleted in their oxidation or reducing properties).

What is important to note, is that although oxidation is a necessary part of biochemistry for fish and all animals (such as for energy production), the normal healthy state is one of reduction. During normal biochemical processes molecules that are normally reducers give up their electrons (in much the same way a car battery does until re-charged), so without a recharging via the addition of new minerals that are high in these electrons or even processes such as UVC sterilization (or even High PAR Lighting), your aquatic biochemistry will suffer and eventually so will your fish!

As per UVC energy, Wolfgang Ludwig (a physicist and advisor to World Research Foundation,) made this quote:

"Water quality can also be evaluated by the amount of ultraviolet light it absorbs; "poor" quality water will absorb higher amounts of UV light, while "good" quality water absorbs low amounts."

One more basic generalization to consider before moving on in more depth is this: Water that is of low pH (acid), in general, measures high ORP while water of high pH (alkaline) measures low ORP. However, in natural water (generally spring water), acidity of minus ions and alkalinity of plus ions can coexist.