Tourmaline

Product Information

The main component used in the Maxspect **Nano-Tech Clear-Cube** is a versatile mineral called **Tourmaline**.

5 x 5 x 2.5cm / 2”x 2” x 1”

Generality

Tourmaline are minerals associated with igneous rocks and metamorphic ones. Tourmaline is formed by a complex group of mineral silicates that shares an identical crystal structure (trigonal) and a different chemical composition. The main components of tourmaline are the boron silicates and aluminum silicate, but because of isomorphism (the solution of an ion with another in the crystal net without changing the mineral structure), have been incorporated in it other minerals, especially sodium, calcium, iron, magnesium and lithium.

Differences in chemical composition are due to both differences in color and chemical-physical property. Because the detergent capacity of tourmaline is never questioned, it holds forth on the chemical and physical mechanisms that give the tourmaline this property.

Physical and chemical properties

Tourmaline as a consequence of their crystalline asymmetric structure and the presence of boron atoms, which has an external electronic structure with an electronic gap, have two characteristic properties, the piezoelectricity and the pyroelectricity.

Piezoelectricity is the electric polarization that is obtained in certain dielectric crystals as a result of a mechanical stress (i.e., lighter). It is also, on the contrary, the mechanical distortion of the two faces of a crystal after applying a given voltage between the faces.

Pyroelectricity is the property of certain crystals that produce a state of electric polarity in response to a change in temperature.

These two properties are known long and well documented by an extensive international literature.

In tourmaline the thermal coefficient due to the polarization of the energy is $1x10^{-7} + 4x10^{-6}$ cal•cm^{-2}•k^{-1}. When changing the temperature and pressure (including micro changes n fractions of °C), they cause a potential difference (voltage). This type of static voltage is higher than 1 million electron volts ($1x10^{6}$ eV) and this accelerates the ionization of air and water surrounding the crystal.

The electrons emitted strike present water and oxygen molecules and turn them into negative ions (formally H_3O_2- e O_3^{2-}), this means that there is an oscillating imbalance of polarity of the crystal which causes a change in orientation of the dipole: negative ions newly formed are forced to leave the surface of the crystal.

In 1986 a Japanese research center showed that even when the tourmaline was turned into dust, in microcrystals remained positive and negative electrodes and these ones did not disappear even if the tourmaline was increased to about 1000 °C. Moreover, when the electrodes were connected to each other was recorded a current of 0.06 mA.

Subsequent studies have provided a check on the effects that mechanical agitation and temperature change have on tourmaline.

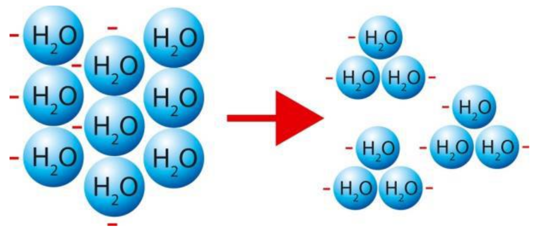
Tourmaline has positive and negative electrodes that generate an electromagnetic wave applied to water of 4 +14 µm (the energy corresponding is 0.004 watts/cm2). As a result, clusters of water are broken generating hydronic ions (H_3O^+) and hydroxyl ions (H_3O_2-). Agitation in water of tourmaline creates friction that increases the production of positive and negative ions. Elba tourmaline contained in the **Nano-Tech Clear-Cube** is a basic tourmaline which mainly issues, naturally, hydroxyl ions ($H_3O_2^-$).

A study by Matsuoka et Al. formulates correlated hypotheses that take into account the several aspects of pyroelectricity of tourmaline and examined their possible consequences. Though not exhaustive, this study provides answers that now mean that the tourmaline in fact, with dozens of patents, contains significant water purification characteristics such as:

1. Increases the ability to dissolve water. Tourmaline atmospheric oxygen increased as the electric charges generated by the tourmaline lead to the overall reaction:
   $6(H_2O) + O_2 + DOM \rightarrow 8(H^+) + 4(OH^-) + 4(O^{2-}) + DOM \rightarrow 4(H_2O) + 4(OH^-) + DOM$

   The first arrow indicates the natural dissociation of the water, the second is a consequence of excess electric charges generated by the tourmaline for the DOM (dissolved organic matter) binds to the OH^- ions constantly shifting the balance towards right.

2. The simple dissociation of water. The electric charges generated by the tourmaline would have the overall reaction:



$3(H_2O) + DOM \rightarrow 2(H_2O) + (H^+) + (OH^-) + DOM \rightarrow (H_3O^+) + DOM + (H_3O_2^-) \rightarrow (H_3O^+ + DOM) + (H_3O_2^- + DOM)$

The first arrow indicates the natural dissociation of water, the second is a consequence of excess electric charges generated by the tourmaline that push towards right the ions H_3O^+ and $H_3O_2^-$ that bind DOM, constantly shifting equilibrium.

3. Direct electrostatic effect. DOM has a surface that is covered also by electrostatic forces (depending on the nature of the DOM). It is likely that the forces generated by electric charges of the tourmaline exceed the electrostatic forces that hold together the particles of DOM, thus the DOM can no longer hold integrity and breaks down.

4. Very low energy activities. The weak energy emitted from tourmaline (4+14 µm) can break down water (water on average is composed of clusters of 36 +38 water molecules, the water passed through tourmaline a 3 +6 water molecules. This allows gas or heavy metals included in the cluster to be released, making water substantially free from impurities.

5. Anti-fungal and anti-bacterial. The content in tourmaline has, together with the ionization of water, an anti-fungal and anti-bacterial properties.

Summary

The ionizing effect of tourmaline have the following benefits for your aquarium:

1. **Breaks down dissolved organic matter (DOM), thus removing the yellow color in an aquarium with higher bio-load.**

2. Long lasting effect, water stay crystal clear for longer.

3. Helps combat cyanobacteria and other nuisance bacteria/fungal in your aquarium.

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