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General Information on Peat

Early in 1958 I prepared a small article on the Use of Peat and Peat moss in Aquarium Keeping and sent it to a few foreign aquarists with whom I cooperated in the Killie question. Well, I certainly mailed all copies and did not reserve any for the possible production of more copies and as more aquarists since then have joined us in the mailing of eggs and keeping of killies, possibly more information of the peat as a whole might be of interest. Recently I made a small article on Peat for Dansk Akvarieblad as an opening of a series of articles on this particular question in the common aquarium keeping and in particular for aquarists who want to establish a so-called rainforest aquarium.

Peat and Peat moss is a mass formed by more or less decomposed and stabilized remains from sphagnum mosses and/or other mosses and bog-vegetation. In this way nature stores rather many valuable nutritious matters that soon or mostly later might be used by plants. Peat contains many plant nutrients which in the free form are only present in limited amounts in nature, such as carbon (C), nitrogen (N), phosphor (P), sulfur (S), and potassium (K) and also the unlimited nutrients hydrogen (H) and oxygen (O). Normally peat has 55-56% carbon, 33% oxygen, and 3-6% nitrogen. Iron (Fe), calcium (Ca), and magnesium (Mg) are found in the peat also. Peat normally also might contain lots of trace elements once taken up by the living plants or later by the peat itself such as silver, gold, beryllium, zinc, cadmium, scandium, thallium, germanium, tin, lead, arsenic, manganese, cobalt, and nickel. The contents of metallic elements vary greatly depending on the conditions under which the peat has been formed and the later contact with the surrounding waters.

Peat and peat moss in nature contain some anti-biotics such as penicilin, streptomycin, aureomycin, and alike and the rather strong bacteria killing (or inhibiting) power which is ascribed to peat and bog waters might come from such anti-biotics. After all, in my opinion, the anti-bacterial power very often increases during the use of a certain peat sample as bottom layer in tanks (in 1950 I set up my first rainwater tank, since then more and more of my tanks were changed into this type and since 1954 all 40-60 tanks are of this type (except one pit-coal tank in use since 1954). This might lead to the conclusion that certain anti-biotics producing organisms establish themselves in the bottom layer and are sending anti-biotics out into the water. In my opinion, the brown color of the aquarium water also has only a minor influence on the bacteria inhibiting power, but also that something points in the direction that the bacteria inhibiting power is removed together with the brown color if you use active charcoal in filters for removing of the brown color of the water. Also some hormones are present in the natural peat and possibly certain sexual

hormones present in the peat (oestrogenes etc.) might be of great importance in the breeding of certain rainforest fishes such as *Nannostomus trifasciatus*, *Carnegiella strigata*, *Acanthophthalmus kuhli*, etc. Did you ever read the interesting articles of Profesor Stolck in the Dutch aquarium magazine "Het Aquarium"? Stolck added urine from pregnant women to the water of the tank in which he had pairs of very difficult rainforest fishes (0.5 ccm per liter) and after some time the females were ripe and he had good spawnings when he removed the breeding pair to urine free waters. No doubt certain sexual hormones are formed during the decomposition of leaves etc. on the dry ground before the rainy season and these are washed out from the decomposing vegetable matters by the rain and force the female fish to produce eggs just at the right time for breeding. Good breeding results in rainforest tanks might, in some way, be brought about by some hormones in the peat.

Vitamins are also present in peat: A, B, D, F, K, etc. I do not know if they play any role in connection with the aquarium keeping.

Just like active charcoal, peat will willingly take up certain high molecular compounds by absorption. Most of the dyes commonly used against diseases in fish, such as trypaflavine, acriflavine, euflavine, rivanol (all are acridin compounds) and also gentianviolet and methyleneblue are absorbed very quickly, making the treatment of many common diseases in fish very difficult or impossible in rainforest tanks. No doubt also quinine is taken up in just the same way. All these dyes are nominal "cations" as they are "chlorides", "sulfates" or "lactates". No doubt some of the waste products from the fishes are taken up and stay fixed to the peat for some length of time before they decompose into more simple compounds that cannot be fixed by the peat.

Peat has a more or less pronounced power of exchanging ions. The cation exchanging power reminds one of the so-called "weak cation exchanging resins" which might be buffered to a certain pH value. Peat that in nature is not in contact with natural surface waters seems to be charged with many hydrogen ions and therefore will make the aquarium water very acidic. Peat (like the common Danish form) that in nature has been in contact with the surface waters (alkaline) a long time ago has exchanged the hydrogen ions for higher metallic ions and therefore such peat will not change the pH of the aquarium water. "Discharged" peat might be "regenerated" in the way as cation exchanging resins. The cation exchanging capacity is rather limited compared with the resins. The anion exchanging power is present, but not very well known.

Peat takes up any copper that comes into the water and the taking up takes place very quickly. This might be taken into consideration, for example, when you use copper against hydra or oodinium (velvet). The taking up of this cation no doubt takes place in some ion exchanging action (Cu normally has two positive charges). In this way peat is a protection against most poisonous metals that come into the water - for example, from corrosion of the stainless steel or other metals in contact with the water. This taking up of the heavy metallic ions is limited. If the water in such tanks later on is made more acidic probably poisonous ions might enter into solution. Therefore perhaps such peat should be taken out of the tank and given a "regeneration" using some strong mineralic acid (10% hydrochloric acid HCl).

Peat in contact with water very soon will give away some brown color that will make the water more and more brownish. If you add peat to 3 samples of water: first using distilled water, second using common

hard tap water and third using distilled water with soda added, you will find that after a certain time the first one will be less colored than the second and the second one less colored than third one. The brown color comes from certain humates in which metallic ions play a certain role. Humates from calcium and magnesium (Ca^{2+} and Mg^{2+}) are less soluble than humates from potassium and sodium (K^+ and Na^+). Also the pH of the water (or the presence of salts from carbonic acid) play a certain role in the way that alkaline waters will be colored much more than acidic waters. Once I used to boil samples of peat with a rather strong solution of soda ($Na_2CO_3 \times 10\ H_2O$) and that way I got a solution which was as brown as a good coffee. This solution has been used by aquarists and dealers who have added the black liquid to their tanks and claimed to have good results in common "sand-tap water-tanks". A sample of peat treated like this will, after some washing to remove the soda, give less coloring when used in a tank as bottom layer. The brown color of the water in the rainforest tank is very stable and not easily removed. If you have a good supply on distilled or demineralized water, perhaps the best way will be to change the water if it gets too brown. You might use a filter filled with activated charcoal, but do control the outflow when starting the filter. If the pH of the outflow is too high (often above 8..2!!) you will have to wash the charcoal (we use the common alkaline tap water for these washings and have the tap water very slowly running through the filter for about 24 hours). Charcoal takes up the brown color rather slowly, but after some days of filtering you will realize good results and all color might be removed using this material. Such filters on the other hand have very high capacities indeed. I also tried the "Decolourite", a particularly weak anion exchanging resin made by the Permutit Co. that might be regenerated using a weak solution of soda in water. However I did not find this material to be superior to the common activated charcoal, but it is still in use in a column placed after the outflow of a weak cation exchange resin (Amberlite IRC 50) where it is used to remove any color (and high molecular compound) present in "old aquarium water" which is treated because of too high pH values. Decolourite has a particularly high capacity when the water is acidic. Many years ago I also used activated aluminium oxide (the gamma modification commonly used for chromatography) to take up the brown color. This material I regenerated using hot hydrogen peroxide (H_2O_2) but also this material (very expensive too and not easily supplied) is not superior to charcoal.

Aquarists normally will not permit the water in their tanks to become too brown because this color to a very high degree steals away the light and plants will suffer. Also the brown color will decrease the green and blue colors of the fish, whereas in a pleasant way it sets off the yellow-orange-red colors of the fish. And after all as the brown color possibly does not play any important role in the rainforest tank, why not remove it.