

Activated Carbons: An Interview with Leo Morin, Ph.D.

The following is a series of questions asked of Leo Morin, Ph.D., by Bruce Hallman on December 28, 1995.

BH> Is the use of activated carbon in aquarium filtration worth the risk?

LM> I think the benefits far outweigh the risks, particularly in non-reef aquaria. Even in a reef aquarium, it is possible to use carbon and minimize the risk by selecting the right carbon and pre-soaking it in DI water for several days to leach out the majority of the leachable phosphate.

BH> Do we need to worry about buying activated carbon which has been washed with phosphoric acid?

LM> That question is based on the common misconception that phosphate in carbon arises from acid washing with phosphoric acid. I know of no major carbon today that is acid-washed in phosphoric acid.

Acid-washed carbons are preferable because they contain less, not more, leachables such as phosphate. Acid washing is usually done with hydrochloric or sulfuric acids, not phosphoric acid. The phosphate in carbon arises from the organic or "once living" source of all carbons. All such materials will be rich in phosphate because all living matter is rich in phosphate. DNA, RNA, energy transfer molecules, and a host of other important biological compounds are phosphates.

BH> Do the "premium" activated carbons leach less phosphate as a rule than the "budget" activated carbons?

LM> That is not a blanket rule. Acid-washed carbons leach less phosphate than others and these are usually more expensive. Coconut carbon leaches less than coal based carbons, but that is because coconut carbon is microporous and has a slow rate of adsorption as well as leaching in water, since it is engineered mainly for gas filtration rather than water filtration.

BH> Should I buy "brand name" activated carbon, or is "generic/bulk" OK?

LM> Again, that is hard to answer. What is important is identifying a good carbon. Brand or generic doesn't really matter.

BH> How much should I use? How often should I change it?

LM> I prefer to use little and change it frequently rather than more and changing it infrequently. I recommend around 100 mL for each 20-40 gallons and changing it at least once a month or sooner.

BH> An "expert" told me that I should use coconut shell carbon in my filter because that's the best. Is that good advice?

LM> That "expert" wasn't very expert. Coconut carbons are microporous and are excellent for gas filtration, but do poorly with water filtration. Water filtration, particularly aquarium filtration, requires a macroporous carbon. The easiest way to judge that is the carbon density. The lighter weight the carbon is for a given volume the better. You will find that coconut carbons are comparatively dense.

BH> But how can I practically choose a "good" activated carbon? A package of carbon costs typically less than \$10, but a phosphate test kit costs more than \$20!

LM> I agree that personal testing of carbons can get a bit expensive and time consuming.

Phosphate leaching is one parameter for carbon evaluation, but is not the most important. Since most aquarium carbon suppliers do not give specifications for their carbon, selection usually requires some detective work. Our (Seachem) carbon gives all important specifications on the label. I would suggest the following guidelines:



1) If the labels gives key specifications (porosity, density, ash and phosphate content) then the supplier likely has nothing to hide and the carbon is likely a good one.

2) If the carbon boasts no phosphate, then the supplier is either lying or doesn't know any better. Neither is very reassuring.

3) Compare weight and volume. The less weight for a given volume, the greater the porosity and the better the carbon, all else being equal. You can usually do this without buying the product first. After buying the product, this parameter will be reflected by the carbon's ability to float and fizz.

4) In terms of porosity suitable for aquarium filtration, coal based carbons are best, followed by wood based. Coconut or other nut shell based carbons are least suitable. This information may be available on the label.

5) In terms of ash and phosphate content, acid washed carbons are better than non-washed carbons. Acid washed carbons have had much of their ash and phosphate washed out. Ash is important because it is responsible for "pH shock". Some carbons can increase pH to over 10 in a very short time. An acid washed carbon will barely increase pH to 7 over several days. Carbons that do not alter pH are usually the same carbons that will not leach much phosphate. Ash content may be available on the label, but sometimes it is unreliable. The store owner may be familiar with what the carbon does to pH.

6) Soaking in DI water and testing for phosphate is impractical, but may be necessary if phosphate is considered an important parameter. In my view, it is important only for reef aquaria.

7) Some physical characteristics that should be evident before buying should be considered. Particle size should be about pin-head. Powdered carbons offer no real advantage and are difficult to handle. Large particle sizes become impenetrable by water and so only the outer 1-2 mm of the particles are adsorbent, making as little as 20% of the carbon useful. Spherical shape is ideal hydrodynamically for unimpeded water flow and inability to pack, and is therefore superior to random granular shapes. To my knowledge, the only spherical carbon available is sold by Seachem.