Home Water Plant

PHASE 2 TREATMENT
ENHANCED CATALYTIC CARBON FILTRATION
SPECIFICATIONS
SCIENCE AND TECHNOLOGY

CONTAMINANTS REMOVAL

The second phase of home water plant water treatment is contaminants removal via filtering through Aquasorb, *The Home Water Plant* enhanced catalytic carbon proprietary media.

The contaminants listed below are commonly found, in greater or lesser amounts, in treated water released from municipal water plants and entering your home. The city has done its job, purification. Your job, the job of *The Home Water Plant*, is ensuring in-home water quality: enhanced safety, and drinking, bathing, and dishes, silver, glassware, and clothing aesthetics.

Aquasorb effectively reduces or eliminates these contaminants:

Suspended solids, silt, sand and dirt, greater than 10 µm[1]
Humic substances (organic matter)
Tannins and lignin (humic and fulvic acid) brownish colors (disinfection byproducts)
Hydrogen sulfide (rotten egg odor)
Chlorine (city water plant purification, swimming pool smell)
Chloramines (with dangerous, largely unregulated, disinfection byproducts)
Trihalomethanes (THM's) city water plant chlorine disinfection byproducts
Phenols and p-nitro phenol (industrial chemicals from surface waters or the aquifer)
Heavy metals (inorganics)

[1] A µm, a micron, equals 39 millionths of an inch; a red blood cell is 6-8 µm.

certified to ANSI/NSF standard 61

CARBON FILTERING IN GENERAL

Carbon has been used to rid water of contaminants for hundreds of years. In the days of long passages under sail, water barrels were charred to keep water fresher, longer. (Carbon is also used in air filtration, industrial gas processing, respirator masks, and other applications.) Carbon filtering media are made from a variety of carbon sources: bituminous coal, wood, coconut shell, and others. Wood carbons have macro-pores, mostly suitable for de-colorization and removal of large organics. Bituminous coal has an intermediate portion size. Coconut shell carbons have micro-pores; in addition to the capabilities of the other carbons, coconut shell carbons can remove smaller organics and disinfection byproducts.

Nowadays, virtually all carbon filtration uses at least "activated carbon," made by thermal activation of the charcoal media, which improves pore volume, surface area and carbon structure. Activated carbon has a slight electro-positive charge, making it attractive to negatively-charged chemicals and impurities. Activated carbon works in two ways to remove impurities. First, it removes organic compounds by adsorption, i.e., adhesion of the impurities to the carbon surface. The second way is catalytic reduction: negatively charged impurities are attracted to the positively charged activated carbon. Impurities of significant concern, such as chlorine and chloramines, are negatively charged — but the ability of simple activated carbon to eliminate chlorine and, particularly, chloramines is limited.

The two types of activated carbon generally sold in the United States are granular activated carbon, known as GAC, and carbon block, also known as powdered carbon block. GAC is generally loaded into tanks on top of a bed of gravel. Carbon block is made by compressing powdered carbon into a dense block, enclosed in a mesh. Carbon block has a larger ratio of activated carbon surface area to the water, and the block form is denser than GAC, so water travels through it more slowly. Due to additional processing, carbon block is more expensive than GAC.

Generally, the two keys to effective filtration are the media surface area ratio to the quantity of water being treated and contact time, i.e., the amount of time the water being treated is effectively in contact with the media.

A significant step above simple activated carbon, either GAC or block, is what is known as "catalytic carbon": activated carbon with modified surfaces, creating more sites on the carbon surface for decomposition of impurities. Chloramines, generally chlorine combined with ammonia, are removed by catalytic carbon far more efficiently than by simple activated carbon. (This paper discusses chloramines in quite a bit more detail below; they constitute a major,

emerging health hazard.) The potential of a specific carbon filter to remove chloramines can be tested by measuring its ability to catalyze the decomposition of hydrogen peroxide. Catalytic carbon has been shown far superior to simple activated carbon in this test. 1 gram of catalytic coconut shell activated carbon powder will reduce hydrogen peroxide concentration by 95% in 10 minutes, compared to a 25% reduction for 1 gram of standard coconut shell activated carbon.

THE HOME WATER PLANT AQUASORB MEDIA

Aquasorb is an enhanced catalytic coconut shell carbon. Aquasorb's macro-pores increase surface area (think of the coastline length difference between a straight coastline and one featuring bays and estuaries). Aquasorb has a surface area of 2000 – 2500 m2/g — uniquely high.

Aquasorb is treated with a ferric hydroxide coating 20-50 µm (microns) thick. This coating covers both the outsides and the insides of the media micro-pores (not only the straight coastline but the bays and estuaries), imparting a particularly strong positive charge and especially adhering chloramines and THMs.

In addition to adsorption, catalytic carbon eliminates contaminants by hydrophilic action, the attraction of contaminant molecules to the media surface and subsequent dissolving (as distinguished from adsorption). The amount of oxygen on media surfaces is key to hydrophilic reactions, and the ferric hydroxide (oxygen containing) coating on Aquasorb and greater surface area facilitate this reaction.

The Home Water Plant contains 30 pounds of Aquasorb.

THE PHASE 2 TREATMENT TANK

Most water treatment tanks are down flow: water enters the top of the tank, flows downward through packed media then exits the bottom of the tank and up through a tube to a top outlet. At the bottom of the tank there lies packed media or packed media on top of gravel (the gravel is intended to hinder the media from consolidating too tightly).
One of the keys to effective water treatment is contact time: the amount of time water molecules are effectively in contact with treatment media. In the *Home Water Plant* tank, water to be treated flows upward (see figure 1). This upward flow maximizes contact time.

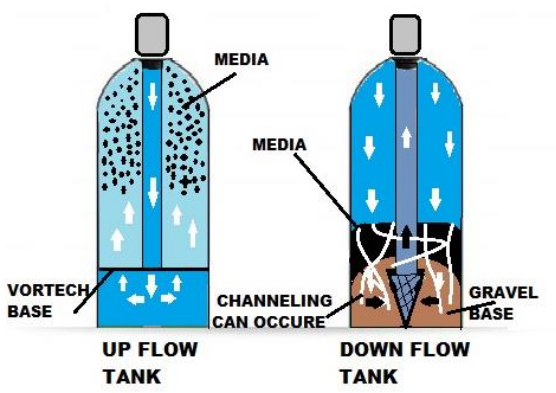

Figure 1

Upward flow also avoids channelization, not uncommon in competing technologies, and a serious impediment to contact time.

CHLORAMINES AND TRIHALOMETHANES

The Home Water Plant second phase treatment removes a broad spectrum of contaminants. Among these are chloramines and trihalomethanes. City water plant chlorine purification generates a host of disinfection byproducts, mostly combinations of chlorine and organic matter, called trihalomethanes. These are carcinogenic. As a result, they are increasingly regulated by the EPA. In part to get around these regulations, city water utilities increasingly disinfect their source water with chloramines, a combination of chlorine and ammonia. Chloramines also have the advantage, from the utilities' point of view, of persisting longer in the municipal piping system than chlorine. Unfortunately, chloramines also generate disinfection byproducts, and these are not only dangerous but, as yet, largely unregulated.

Chlorine → Chloramines → THM's → Cancer

The Home Water Plant's Aquasorb is specifically tailored to remove chloramines and trihalomethanes. Just by way of example, a leading carbon media seller claims to treat 500,000

gallons of water before media replacement or re-bedding. But the capacity of that system to adsorb chloramines is exhausted at about 17,000 gallons; their media will continue to adsorb other contaminants, but after 17,000 gallons chloramines simply pass through, into your drinking and bathing water. Chloramines are much harder to treat than chlorine —*The Home Water Plant* has been specifically designed to attack these dangers head on.

REGENERATION

Most carbon treatment, tank systems require periodic media replacement or re-bedding, or entire tank replacement. At the least, this requires backwashing into utility room floor drains (if the homeowner actually has them); it is a mess, and time-consuming and expensive. *The Home Water Plant* avoids all this mess, time and water wastage, and expense.

Home Water Plant media is easily regenerated to 99% of its original effectiveness by annually depositing a packet of desorption media into an aperture on the tank valve. Harmless effluent is run, say, from a hose bib or bathtub faucet for 15 or 20 minutes. If desorption is performed by a *Home Water Plant* dealer as part of annual maintenance, Aquasorb is warranted for 10 years.

TECHNICAL SPECIFICATIONS

Tank
Dimensions — 9” x 48”
Effective Flow Rate (gpm) — 8
Max/Min Pressure — 100 psi/30 psi
pH level — 6.0-9.5
Plumbing Inlet/Outlet Size — 1”

Media
Appearance — course granule
Particle Size — 0.6-2.4 mm
Surface Area (BET) — 2000-2500 m^2g
Moisture Content — 5% (max.)
Ball Pan Hardness — 98% (min.)
Bulk density — 630-640 kg/m^2
pH — 9.5 (max)
Multiple Regeneration