

Global Pure Water



BUILT TO LAST A LIFETIME! |

Your solution for a wide range of problems including Iron, Hydrogen, Sulfide, Manganese, Heavy Metals, and more.

Specifications

1 Polyglass tank 12" x 52", 2.5" top with base

2.5" fiberglass tank head, 1" fittings

Clack Company WS1 Bypass valve

Clack WS1 3/4" fitting x 1" PVC solvent elbow assembly

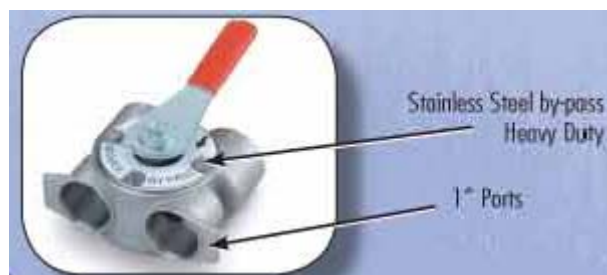
1" x 55" distributor tube with stack basket

6 pounds of KDF media

1 cubic foot of GAC Coconut shell media 12" x 40"

10 lbs of purified fine gravel 1/4" x 1/8"

1 cubic foot of Zeolite media (This is to balance the Ph and is what GE uses in their similar product.)



KDF-55

A KDF-55 filter media consists of finely granulated copper and zinc alloys. The combination of these two

alloys in the media allows the chemical reaction of redox (Oxidation-Reduction) to take place when water passes through the media. Redox involves the transfer of electrons between two molecules, changing these molecules into entirely different elements. In the KDF process, electrons are taken from harmful contaminants like chlorine and microorganisms. This loss of electrons changes contaminants into far less harmful, or even harmless, elements. For example, chlorine-- when it loses an electron in a redox reaction--is changed into the harmless, water-soluble chemical chloride. While there are several different KDF media, KDF-55 is designed to specifically remove or reduce chlorine, heavy metals, and microbiological contaminants.

When a KDF-55 filter media is used during the first stage of filtration (as is the case with the life of the entire filter unit is greatly lengthened. Translation of water contaminants into harmless elements in the first stage reduces the amount of scaling and bacterial growth that will take place on the more expensive carbon filter media of subsequent stages. Also, the preliminary reduction of contaminants allows the adsorptive process of the carbon media to focus on more harmful and elusive contaminants

Coconut-shell carbon

Laboratory and pilot tests indicate that high-quality; coconut-shell carbon may be effective for removal of methyl tertiary-butyl ether (MTBE) in point-of-use/point-of-entry (POU/POE) systems.

Coconut-shell activated carbon that is optimized for MTBE adsorption can remove the gasoline additive to no detect levels in POU/POE applications and can meet the requirements of NSF Standard 53. Control over raw material and activation conditions and a rigorous quality assurance program are required to consistently meet performance standards. In some cases, high-quality coconut-shell carbon may be preferred over coal-based carbon for POU/POE applications.

MTBE is the most common oxygenated fuel additive used in reformulated gasoline. Its health effects are not known, but the US Environmental Protection Agency has classified it as a possible carcinogen. MTBE concentrations in drinking water as low as 2 parts per billion (ppb) can cause odor and taste problems.

MTBE contamination of groundwater and surface water is a growing problem throughout the United States. Recent media attention has increased public awareness of this problem. Consequently, regulations on MTBE in water are becoming more stringent. For example, New York State has proposed a limit of 10 ppb for state water supplies. In California, a new standard of 13 ppb was adopted in April.

Since the discovery of the problem, groundwater remediation practices have included the use of activated carbon adsorption. Even though removal of MTBE from water using activated carbon is effective, its removal is difficult due to its high solubility and to the presence of more strongly adsorbed species.

Other methods for MTBE removal exist, but their capital costs exceed the cost of liquid-phase carbon adsorption. Given that using activated carbons for MTBE removal is effective and less expensive, it is advantageous to optimize carbon and its ability to remove MTBE.

The removal of organics in water that are weakly adsorbed and that are present in trace concentrations (low ppbs) requires an activated carbon with a predominance of high-energy pores (micropores). Coconut-shell activated carbon has traditionally been used for applications such as removal of trihalomethanes (THM). Coconut char is a better raw material for the generation of micropores during the steam activation process.

In addition to isotherm capacity, the retentivity of the carbon for the adsorbate is critical if low effluent concentrations of MTBE are to be maintained. Because MTBE concentrations and background organic concentrations are typically variable, the desorption of MTBE should be considered. Coconut-shell carbons have high retentivity.

Water filter testing

Commercial water filters can be made from two different types of activated carbon: a coconut-shell carbon optimized for MTBE removal and a coal-based carbon that showed good performance in laboratory testing. Both filters used a molded carbon block produced from 80X325 US mesh activated carbon.

Both filters removed MTBE to nondetect levels, well below the current 5-ppb standard for NSF certification for MTBE removal. The filter manufactured from coconut-shell activated carbon lasted longer, indicating a higher capacity for MTBE. Even after 2,8200 gallons of water had been treated, the filter made from the coconut-shell carbon reduced MTBE to below 1 ppb, well below reported taste and odor thresholds. The coal-based carbon filter met the 5 ppb NSF standard for MTBE removal up to 500-1,000 gallons of water treated.

Laboratory optimization of carbons

The carbons used in the filters tested above were selected based on a laboratory development program. This program was initiated to optimize both coconut-shell and coal-based carbon for MTBE adsorption. The focus was to achieve maximum microporosity and, thus, trace capacity.

A wide variety of commercial and developmental carbons were evaluated for MTBE removal using an 8-point isotherm technique based on the ASTM Standard Practice D3860-89a. The carbons included coconut-shell carbons and coal-based carbons that were produced from different raw material sources and activated under different process conditions.

Based on the results of the optimization program, a carbon was selected for its capacity for MTBE in POU/POE applications. The carbon is coconut-shell-based and has a large micropore volume, as determined by nitrogen adsorption.

The equilibrium capacity of this carbon can be compared with a conventional coal-based carbon. The data show that the coconut-shell carbon, designed for MTBE removal, has a capacity two to three times higher than the coal-based carbon. The coal-based carbon reference is a high-quality carbon, considered an industry standard for potable water treatment.

The absolute capacity of carbon for MTBE depends heavily on other contaminants present in the test water. Therefore, the isotherm plots show relative capacities.

Although coconut shell provides an excellent raw material for generating microporosity, the control of the raw material source and activation conditions is critical to assure high MTBE capacity.

The equilibrium capacities for two other coconut-shell carbons can be observed: one from a different raw material source and one produced under different activation conditions. It is important to maintain a well-defined carbon source and a stringent quality assurance program.

A coal-based carbon also was optimized for MTBE removal. There is a variation in MTBE capacity for several of the coal-based carbons evaluated in the lab test program. The carbon selected for its MTBE capacity has a higher micropore volume.

In remediation applications, water generally contains other organics that are more strongly adsorbed than MTBE. Also, the treatment objectives are usually not as stringent as for POU/POE applications. For these reasons a coal-based carbon or a combination of coal-based and coconut-shell carbons are preferred for remediation applications.

The coal-based carbon designed for MTBE removal has been used in numerous remediation projects. Typically, a series of adsorbers is used, with the upstream adsorber used for heavy organics removal and the downstream adsorbers used for MTBE. If very low effluent concentrations are required, a coconut-shell carbon can be used in the final adsorbers as a polishing step.

Some coconut-shell activated carbons can provide the high trace capacity and high retentivity needed to remove low ppb levels of MTBE. However, achieving consistently high MTBE reduction requires a well-defined source of raw material, consistent manufacturing process conditions and a stringent quality assurance program. Water filters manufactured from coconut-shell carbon that has been optimized for MTBE removal can meet the performance standards of NSF 53 and provide good service life.

Mark Stouffer is technical director and J. David Hoerner is a research and development chemist at Barnebey Sutcliffe Corp., Columbus, OH.

REFERENCE

- T. Shih, M. Wangpaichitr, I. Suffet, "Evaluation of GAC technology for the removal of methyl tertiary butyl ether (MTBE) from drinking water," ACS Division of Environmental Chemistry, March 2000.

Calcite

Calcite, which gets its name from "*chalix*" the Greek word for lime, is a most amazing and yet, most common mineral. It is one of the most common minerals on the face of the Earth, comprising about 4% by weight of the Earth's crust and is formed in many different geological environments. Calcite can form rocks of considerable mass and constitutes a significant part of all three major rock classification types. It forms oolitic, fossiliferous and massive limestones in sedimentary environments and even serves as the cements for many sandstones and shales. Limestone becomes marble from the heat and pressure of metamorphic events. Calcite is even a major component in the igneous rocks called carbonatite and forms the major portion of many hydrothermal veins. Some of these rock types are composed of better than 99% calcite. Why would a collector be interested in such a common mineral? Because of its extraordinary diversity and beauty!

With calcite so abundant and so widely distributed it is no wonder that it can be so varied. The crystals of calcite can form literally a thousand different shapes by combining the basic forms of the positive rhombohedron, negative rhombohedron, steeply, moderately and slightly inclined rhombohedrons, various scalahedrons, prism and pinacoid to name a few of the more common forms. There are more than 300 crystal forms identified in calcite and these forms can combine to produce the thousand different crystal variations. Calcite also produces many twin varieties that are favorites among twin collectors. There are also phantoms, included crystals, color varieties, pseudomorphs and unique associations. There simply is no end to the varieties of calcite.

There are several varieties of calcite and it would be impossible to describe them all. However there are a few standouts. Possibly the most well known of calcite's varieties is its most common form, the classic scalenohedron "*Dogtooth Spar*" as it is sometimes called. This variety appears as a double pyramid or dipyrmaid but is actually a distinctly different form. The point of the scalenohedron is sharp and resembles the canine tooth of a dog, hence the name. Beautiful clear colorless or amber-orange examples of this variety are considered classics and outstanding examples come from Pugh Quarry, Ohio; **Cornwall**, England and Elmwood, Tennessee but the variety is found worldwide.

Not necessarily a variety of calcite, cave formations are certainly a unique aspect of calcite's story. Calcite is the primary mineral component in cave formations. Stalactites and stalagmites, cave veils, cave pearls, "soda straws" and the many other different cave formations that millions of visitors to underground caverns enjoy are made of calcite. It is the fact that calcite is readily dissolved that these formations occur. Overlying limestones or marbles are dissolved away by years and years of slightly acidic ground water to percolate into the caverns below. In fact the caverns themselves may have been the result of water dissolving away the calcite rich rock. As the calcite enriched water enters a relatively dry cavern, the water starts to evaporate and thus precipitate the calcite. The resulting accumulations of calcite are generally extremely pure and are colored if at all, by very small amounts of iron or other impurities.

Mexican onyx is a variety of calcite that is used extensively for ornamental purposes. It is carved into figurines and is so popular that almost every child in the USA owns a small onyx animal or two. Carvings such as vases, bookends, plates, eggs, obilisks, pyramids and statues are all popular. It is not the same onyx as the quartz variety of onyx which is a little more precious (it is used in jewelry) and is banded white and black. To avoid confusion it is best to refer to it as *Mexican Onyx*. Mexican onyx is banded with multiple orange, yellow, red, tan, brown and white colors that have marble-like texture. The carvings are quite attractive and affordable; a rare combination!

Another variety is the so called "Iceland Spar", which is basically clear cleaved fragments of completely colorless (ice-like) calcite. Originally discovered and named after Eskifjord, Iceland where the calcite is found in basalt cavities. In rock shops around the world, iceland spar is available in large quantities and at affordable prices and are popular among children. Most of today's iceland spar comes from Mexico. The iceland spar displays the classic cleavage form of calcite, the rhombohedron. Iceland spar was and is used for optical equipment and during World War II it was a strategic mineral as it was used for the sighting equipment of bombardiers and gunners. It is iceland spar that best demonstrates the unique property of calcite called **double refraction**.

- Double refraction occurs when a ray of light enters the crystal and due to calcite's unique optical properties, the ray is split into fast and slow beams. As these two beams exit the crystal they are bent into two different angles (known as *angles of refraction*) because the angle is affected by the speed of the beams. A person viewing into the crystal will see two images ... of everything. The best way to view the double refraction is by placing the crystal on a straight line or printed word (the result will be two lines or two words). There is only one direction that the beams are both the same speed and that is parallel to the C-axis or primary trigonal axis. Rotation of the crystal will reveal the direction in the crystal that is parallel to the C-axis when the line or word becomes whole again. By contrast, the direction perpendicular to the C-axis will have the greatest separation. The extremely high index of refraction of calcite that causes the easily seen double refraction is also responsible for the interference colors (pastel rainbow colors) that are seen in calcites that have small fractures.

Fluorescence, phosphorescence, thermoluminescence and triboluminescence are other important properties of calcite. Although not all specimens demonstrate these properties, some do quite well and this is diagnostic in some cases. One notable case of fluorescence occurs at Franklin, New Jersey where the massive calcite is enriched in a small amount of manganese and fluoresces a bright red under UV light. Some Mexican iceland spar can fluoresce a nice purple or blue color and unique specimens will even phosphoresce (continue to glow) after the UV source has been removed. Triboluminescence is supposedly a property that should occur in most specimens, but is not easily demonstrated. It occurs when the specimen is struck or put under pressure; in a dark room the specimen should glow when this happens.

The best property of calcite is the acid test. Why? Because calcite always will effervesce (bubble) when even cold weak acids are placed on specimens. Even the cement in sandstones will effervesce assuring the geologist of identification of the cementing mineral. The reason for the bubbling is in the formula below:



The carbon dioxide gas (CO_2) is given off as bubbles and the calcium dissolves in the residual water. Any acid, just about, can produce these results, but dilute hydrochloric acid or vinegar are the two recommended acids for this test. Other carbonates such as dolomite or siderite do not react as easily with these acids as does calcite and this leads to differentiating these somewhat similar minerals more readily.

Calcite is intricately tied to carbon dioxide in another way. Since many sea organisms such as corals, algae and diatoms make their shells out of calcite, they pull carbon dioxide from the sea water to accomplish this in a near reverse of the reaction above. This is fortuitous for us, as carbon dioxide has been found to be a green house gas and contributes to the so called "green house gas effect". Environmentally then, calcite is very important and may have been quite important to the successful development of our planet in the past. By pulling carbon dioxide out of the sea water, this biological activity allows more of the carbon dioxide in the air to dissolve in the sea water and thus acts as a carbon dioxide filter for the planet. Environmentalists are now actively engaged in determining if this activity can be increased by human intervention to the point of warding off the "green house gas effect". A significant amount of calcite precipitation in sea water is undoubtedly inorganic, but the exact amount that this contributes is not well known. Calcite and other carbonate minerals are very important minerals in the ocean ecosystems of the world.

Calcite is not the only calcium carbonate mineral. There are no less than three minerals or phases of CaCO_3 . **Aragonite** and **vaterite** are polymorphs (Latin for "many shapes") with calcite, meaning they all have the same chemistry, but different crystal structures and symmetries. Aragonite is orthorhombic, vaterite is hexagonal and calcite is trigonal. Aragonite is a common mineral, but is vastly outdistanced by calcite which is the more stable mineral at most temperatures and pressures and in most environments. Vaterite on the other hand is extremely scarce and rarely seen. Aragonite will over time convert to calcite and calcite pseudomorphs after aragonite are not uncommon.

Calcite is truly one of the best collection type minerals. There are lots of interesting forms and varieties as well as colorful and beautiful specimens to collect. It is generally easy to identify using its rhombohedral cleavage, reaction to acid and double refraction and makes for a great classroom example of these properties. If it is not the significant mineral on a specimen, it might be an accessory to other wonderful minerals and only enhancing their attractiveness. With its many different forms, environments, associations and colors, a collector could *never* have all possible combinations of calcite covered.

PHYSICAL CHARACTERISTICS OF CALCITE:

- **Color** is extremely variable but generally white or colorless or with light shades of yellow, orange, blue, pink, red, brown, green, black and gray. Occasionally iridescent.
- **Luster** is vitreous to resinous to dull in massive forms.
- **Transparency:** Crystals are transparent to translucent.
- **Crystal System** is trigonal; bar $3\ 2/m$
- **Crystal Habits** are extremely variable with almost any trigonal form possible. Common among calcite crystals are the scalenohedron, rhombohedron, hexagonal prism, and pinacoid. Combinations of these and over three hundred other forms can make a multitude of crystal shapes, but always trigonal or pseudo-hexagonal. Twinning is often seen and results in crystals with blocky chevrons, right angled prisms, heart shapes or dipyramidal shapes. A notch in the middle of a doubly terminated scalenohedron is a sure sign of a twinned crystal. lamellar twinning also seen resulting in striated cleavage surfaces. Pseudomorphs after many minerals are known, but easily identified as calcite. Also massive, fibrous, concretionary, stalactitic, nodular, oolitic, stellate, dendritic, granular, layered, etc. etc.
- **Cleavage** is perfect in three directions, forming rhombohedrons.
- **Fracture** is conchoidal.
- **Hardness** is 3 (only on the basal pinacoidal faces, calcite has a hardness of less than 2.5 and can be scratched by a fingernail).
- **Specific Gravity** is approximately 2.7 (average)
- **Streak** is white.
- **Other Characteristics:** refractive indices of 1.49 and 1.66 causing a significant double refraction effect (when a clear crystal is placed on a single line, two lines can then be observed), effervesces easily with dilute acids and may be fluorescent, phosphorescent, thermoluminescence, thermoluminescence and triboluminescent.
- **Associated Minerals** are numerous but include these classic associations: Flurite, quartz, barite, sphalerite, galena, celestite, sulfur, gold, copper, emerald, apatite, biotite, zeolites, several metal sulfides, other carbonates and borates and many other minerals.
- **Notable Occurrences** include Pugh Quarry, Ohio; Rosiclare, Illinois; Franklin, New Jersey; Elmwood, Tennessee; Brush Creek and other Missouri, Wisconsin, Kansas and Oklahoma localities, USA; Andreasburg, Harz Mountains and Saxony, Germany; Brazil; Guanajuato, Mexico; **Cornwall**, Durham and Lancashire, England; Bombay area of India; Eskifjord, Iceland; many African localities as well as others around the world with their own unique varieties.
- **Best Field Indicators** are crystal habit, reaction to acid, abundance, hardness, double refraction and especially cleavage.

Zeolite

What is a Zeolite?

Two Kinds of Zeolites: Natural and Synthetic

Synthetic and natural zeolites are hydrated aluminosilicates with symmetrically stacked alumina and silica tetrahedra which result in an open and stable three-dimensional honeycomb structure with a negative charge. The negative charge within the pores is neutralized by positively charged ions (cations) such as sodium. Over 150 zeolite structural types have been identified.

The simplest synthetic zeolite is the zeolite A with a molecular ration of one silica to one alumina to one sodium cation. The zeolite A synthesis produces precisely duplicated sodalite units which have 47% open space, ion exchangeable sodium, water of hydration and electronically charged pores. These properties lead to the various uses of natural and synthetic zeolites.



Biggest Differences Between Natural and Synthetic Zeolites:

- Synthetics are manufactured from energy consuming chemicals and naturals are processed from natural ore bodies.
- Synthetic zeolites have a silica to alumina ratio of 1 to 1 and clinoptilolite (clino) zeolites have a 5 to 1 ratio.

- Clinoptilolite natural zeolites do not break down in a mildly acid environment, where synthetic zeolites do. The natural zeolite structure has more acid resistant silica to hold its structure together. The clinoptilolite natural zeolite is broadly accepted for use in the [agricultural industry](#) as a [soil amendment](#) and as a [feed additive](#).