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DRINKING WATER AND WATER TREATMENT SCAMS

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INTRODUCTION

The primary objective of this article is to make the reader more aware of the various types of scams associated with drinking water, how to recognize a potential scam, and how to deal with scams.

What is a Scam?

Scams associated with drinking water and water treatment are numerous and are no different than other scams. Their purpose is to separate people from their money through the use of false or misleading information. Scams often involve the use of pseudoscience to absolute nonsense or even pure trickery. Another name for scam is fraud and fraud is a crime. Because a scam is a crime does not stop people from doing it.

Who is Susceptible to Being Scammed?

Everyone is susceptible to being scammed regardless of age, sex, race, religion, education or professional background. Those who lack a basic understanding of scientific principles are easier prey for scam artists, but many people are

susceptible to scams simply because they want to believe in miracles.

WHAT ARE THE MOST COMMON DRINKING WATER SCAMS?

Drinking water scams range from false claims associated with bottled water to a large variety of health quackery scams, water testing scams, and water treatment scams. Fraudulent companies are promoting packaged water with unusual formulations and selling devices that supposedly produces water that has special health benefits. Others are offering devices that supposedly save energy and are capable of eliminating any and all types of nuisance and health related contaminants in either public or private water supplies.

Bottled Water Versus Tap Water

Bottled water is a booming business that receives a lot of hype. It is being sold in containers that range in size from 8 ounces to five gallons or more. Most bottled water is perfectly healthy and safe to drink. Scams occur when companies or their salespeople misuse information or use outright lies to sell bottled water. For non-biased

information on bottled water, which is regulated as a food product by the U.S. Food and Drug Administration (FDA), go to FDA's web address (<http://www.fda.gov/>) and search the site for 'bottle water'. For information on the federal regulations that apply to various types of bottled water as characterized by FDA, go to the web address for FDA's Center for Food Safety and Applied Nutrition (<http://www.cfsan.fda.gov/~dms/botwatr.html>). Numerous commercial sites also have information on bottled water but this information may not be as reliable as that from FDA (http://www.water.com/learn_about_water/swg1160_typofwat.asp). Most large companies marketing bottled water are members of the International Bottled Water Association (IBWA). The IBWA provides a lot of information on bottled water from their Internet site (<http://www.bottledwater.org>).

Advantages and Benefits of Bottled Water

Convenience of Bottled Water. The primary advantage bottled water has over tap water is that you can take it with you wherever you go. Bottled water has its place and that is why Pepsi has introduced Aquafina and Coke has countered with Dasani. Both companies charge as much or more for their plain water as for their sugar water. So why not buy a bottle of the desired size and refill it with your city's finest unnaturally filtered yet delicious tap water. It's much cheaper and may be safer to drink.

Diet Drink Benefits of Bottled Water. Bottled water is an excellent diet drink because it rehydrates the body without the added sugar associated with most soft drinks and the calories associated with many other bottled beverages and fruit drinks. If you are trying to lose weight, drink more water. What other digestible food or drink items are not only fat free but also sodium free, cholesterol free and caffeine free? Some research now indicates that not drinking enough water may

lead to an increase in body fat and drinking water regularly can serve as an appetite suppressant.

Misleading Claims and Disadvantages of Bottled Water

The Tap Water Scare. If companies or their representatives resort to use of inaccurate information about tap water (scare tactics) to promote their bottled water supply, this could be classified as a scam. The chlorine issue in tap water is often used to promote the sale of bottled water and special treatment units. The common pitch is usually about how chlorine gas was used as a chemical warfare agent during World War I because of its killing power. This is true, and that is why chlorine is such an effective water disinfectant at an extremely low concentration. Sales reps using the chlorine issue usually fail to point out the fact that chlorination of drinking water has saved more human lives than most medical advances combined. Removing residual chlorine from chlorinated drinking water can reduce potential chemical health risks, but at the same time, may increase biological health risks.

The Quality Difference Between Bottled Water and Tap Water. The quality of bottle water is not any better than average tap water and could even be tap water according to a study of 103 brands of bottled water conducted by the Natural Resources Defense Council (NRDC) and reported on their web site in March of 2001. The NRDC also conducted a blind taste test of New York City residents the same year and found that 75% of them preferred the taste of their local tap water to some of the highly promoted bottled waters on the market. To see the executive summary of NRDC's report on bottled water, go to their Internet site at <http://www.nrdc.org/water/drinking/bw/exesum.asp>.

The International Bottled Water Association (IBWA) will quickly respond to any comments about bottled water not being of equal quality to tap water. Most of it probably is. The standards

for chemical contaminants reveal that the U.S. Food and Drug Administration's bottled water quality standards are essentially the same as the Environmental Protection Agency's tap water standards. However, tap water is monitored much more frequently for any bacteria or chemical contaminants. For example, bottled water plants must test for bacterial contamination once per week, while most city tap water is tested over 100 times per month. The URL for the IBWA is <http://www.bottledwater.org/>.

The Cost Difference Between Bottled Water and Tap Water. Americans now spend more than \$7 billion per year on bottled water, paying 120 to over 7,500 times as much per gallon for bottled water as for tap water. In 2002, bottled water prices ranged from 75 cents to over \$6.00 a gallon (depending on name brand) and tap water prices ranged from about 80 cents to \$6.40 per 1000 gallons. For these prices, some feel that bottled water should be much safer to drink than average tap water.

Bottled Water to Enhance Athletic Performance

There are a number of bottled sports drinks on the market that contain salts, sugars and special electrolytes dissolved in water. These drinks are designed to enhance athletic performance by replacing fluids, electrolytes and sugar burned up during athletic activities. These sports drinks however are not considered to be bottled water.

Bottled Super-Oxygenated Water

There are a number of oxygenated bottled water scams that range from the use of pseudoscience to pure nonsense. They are based on the idea that you can increase oxygen content in drinking water and that this will lead to an increased oxygen uptake in the blood to promote all sorts of special benefits. Super-oxygenated water is one of the latest bottled water sports scams. This oxygen-enhanced sports drink that contains up to seven times the oxygen as normal tap water is supposed

to boost athletic performance. It is aimed especially at the sports community because coaches are always on the lookout for that little advantage that can make the difference. There is no credible evidence that it does. Scientists at several major universities have studied this water and found no benefit. According to Steven K. Lower, a retired faculty member from the Chemistry Department of Simon Fraser University in British Columbia, Canada "unless you have gills, drinking oxygenated water is just an expensive burp."
(<http://www.chem1.com/CQ/oxyscams.html>)

THE FACTS ON OXYGENATED BOTTLED WATER: Plain water at room temperature when exposed to the atmosphere at sea level will contain about 8 milligrams per liter of oxygen as dissolved gas. Pressurizing bottled water with oxygen will increase the dissolved oxygen level. With each additional atmosphere of pressure (about 14.7 pounds per square inch), about 40 mg/L of additional oxygen will dissolve in the water. However, as soon as the bottle is opened, most of this extra oxygen escapes. If the water is chilled so the oxygen gas escapes slower and you drink it quickly you can get a higher level of oxygen into your stomach. Whether any oxygen that does not get burped out actually gets absorbed into the blood stream through the stomach or intestinal wall is just a guess. Your lungs are designed to get oxygen into you bloodstream not your digestive system. Breathing one extra liter of air at sea level would pump 146 mg of oxygen into your lungs; the organs designed to put oxygen into your blood. Research has shown that inhaling pure oxygen gives a short energy boost that dissipates within seconds after the oxygen canister is removed, so how can drinking water with extra oxygen be expected to have any lasting effect?

Health Quackery Scams

The Internet may be the "information superhighway" to some, but to others it is an easy way to market junk science. One of the primary

market areas on the Internet is alternative medicine, including all sorts of special water that is supposed to have medical healing and general health benefits. There are literally thousands of web sites promoting such products. Many of these supposedly special effects of water are based on the theory that subtle changes made to water's internal structure have health benefits and that this structural memory is retained through extremely low dilutions of this formulated water. This is called homeopathy and is pure nonsense but people succumb to these crazy schemes. You can read all about homeopathy from thousands of sites on the Internet, including web sites set up to expose such scams designed primarily to separate people from their money. A good web site for facts about homeopathy is provided by the National Council Against Health Fraud (NCAHF) <http://www.ncahf.org/pp/homeop.html>. Another good homeopathy web site (<http://www.homeowatch.org/>) has been organized by Stephen Barrett, a medical doctor.

The Highly Oxygenated Water Scam

Highly oxygenated water was mentioned earlier in reference to a bottled water sports drink. The oxygenated water scam however, has not stopped with the simple idea of dissolving more oxygen in bottled water to enhance athletic performance. There are hucksters who now claim they have found ways to bond extra oxygen to water molecules or entrap oxygen in water molecules to provide a stable and molecularly bonded source of oxygen in drinking water that doesn't dissipate as soon as you remove the cap. Some "super water" is said to contain stabilized oxygen in microencapsulated water clusters that keep the oxygen from escaping until the water is absorbed into the body cells. There are even claims of shrinking water molecules so they can more quickly penetrate into the cells, and therefore hydrate your body faster and more efficiently.

Some company web sites are promoting the use of their stabilized oxygenated water for all sorts of

health benefits. They stress the importance of protecting human cells from oxygen deprivation and the role oxygen plays in removing or destroying garbage, toxins, refuse or anything useless in cells so it can be carried out of the body. Just like a clean house that holds little interest to passing flies, when you get rid of all this junk and have an oxygen-rich body, the disease causing organisms pass you by. THE REAL FACT is that oxygen is a cell-poison and oxygen-consuming organisms have developed special protective mechanisms inside their cells to isolate oxygen's decomposition intermediates from the rest of the cell. Oxygen does not travel in the blood as a freely dissolved gas anyway but as a complex with hemoglobin, and this is a uniquely evolved mechanism, which controls the amount of oxygen delivered to cells.

Some oxygenated water has been sold under the name of "Vitamin O." This product is supposed to contain electrically activated oxygen and increase physical energy when drunk. It has also been promoted for retarding aging, improving mobility, improving circulation, improving mental clarity, and enhanced heart and lung function. The Federal Trade Commission (FTC) has fined at least one company for false advertising in relation to this type of scam.

There are also false claims associated with formation of "nascent" oxygen to represent plain oxygen atoms or ionized oxygen atoms with positive and negative charges instead of the regular diatomic oxygen molecule. There are supposedly all sorts of health benefits associated with drinking water that contains this form of oxygen. Ionic forms of oxygen are known to have a transient existence in the upper atmosphere but these species react with themselves very rapidly to form diatomic O₂ molecules. THE FACT is that any form of single oxygen atom would be so reactive within living organisms that it would cause instant death to any living body tissues it touched.

A web search for “oxygenated water” will reveal numerous companies marketing such a product. The source for some of this special water is supposedly remote mountain streams and others are prepared products. Some companies market their water as a natural dietary mineral supplement in order to bypass the product and safety requirements of true bottled waters. Because it says natural does not mean it is safe to drink or that it has any health benefit. A good web site addressing many of the false claims of oxygenated water is retired chemistry professor Stephen K. Lower’s site (<http://www.chem1.com/CQ/oxyscams.html>).

Alternative Structural Forms or Clustered Water

There are numerous commercial products on the market that claim to alter the structure of water in order to help maintain or restore health, youth and vigor. This is nothing but crackpot chemistry being used to promote these products to consumers whose lack of scientific training leaves them unprotected from such exploitation. Claims about the nature and action of structure-altered waters that improve personal health are fictional, although some commercial scams make them sound like high quality science.

The structure-altered water scams fall into two categories; 1) water clusters are absolutely essential for good health but absent from most drinking water sources or 2) water clusters are bad for you and you need to eliminate them from your drinking water supply. More companies appear to be promoting the beneficial aspects of clustered water.

On the health side, these structurally elusive forms of water are simply used to promote homeopathy and will cure whatever ails you. The commercial ads will usually say something like “a scientist has found this form of water in healing springs or has found any one of several ways to re-create and bottle it for sale”. For a \$20 to \$50 charge on your credit card you can purchase some form of a

“concentrate”: a few drops added to a glass of water is all it takes to work its magic.

THE FACTS: Chemists have long recognized that one of the special properties of water is its ability to form short-lived ever-changing polymeric units that are sometimes referred to as “clusters.” There is no support from the scientific communities of chemistry, physics, biochemistry, or physiology that clusters of water molecules, which last on the order of billionths of a second, can be controlled nor that such clusters play any role in human health and nutrition. The only places you are likely to see these views advocated are in literature and web sites intended to promote the sale of products for the “alternative” health care market.

Will drinking water that is “clustered” or altered in structure make you feel better, younger or more vigorous? It very well could. Studies have shown that placebos can relieve the symptoms in about 40 percent of those who suffer from a variety of chronic ailments. If you believe in “alternative medicine” and that it helps, you are more likely to find your beliefs confirmed.

Highly Clustered Water Found Somewhere in Nature. According to the promotions and hype by some water vendors, there are special forms of water to be found in nature if you know where to look. Supposedly, these specially clustered forms of water are different from ordinary water and have all sorts of healing power and medical benefits. Some are advertised as containing primordial water, a special form of ancient water that has retained a type of energy associated with the beginning of the universe and the source of life itself.

Polymer Water from Special Mountain Springs. There are claims of special polymer water being found in remote springs around the world. These treasured springs are usually from some high mountainous region, where the people drinking water from these sources, enjoy healthy lives to a

ripe old age. Like other medical mumbo-jumbo, this magical water will energize your body because it improves cell hydration with increased nutrient transport into cells and increased transport of toxics out of cells.

Hydride Ion Water from Glaciers. There are hundreds of water vendors offering a special form of water that is supposed to contain micro-clustered colloids. According to promotional schemes, these oxide-containing colloids have the ability to trap ions and particularly hydride ions (negative hydrogen ions) by altering local water structure around them. This hydride ion water is supposedly found only in special glacier waters in specific mountainous regions of the world. Its primary claim to fame is anti-aging benefits due to its activity as an antioxidant. There are other claims related to increased nutrient uptake by cells and elimination of free radicals. THE FACT is that no one has found hydride ions to actually exist in water.

Clustering with Magnetism. There are numerous claims about how alternative medical practices are more effective in healing than conventional medicine. Some of these claims deal with healing benefits of magnetism to include unique forms of water that have been generated by some specially designed magnetic treatment device. You can read things like colloidal groupings of water molecules to form small icebergs. This type of water is often called “liquid crystalline water”, “structured water” or “micro-structured water”. It is easy and cheap to produce this uniquely structured water because no external power source is needed. It can be generated with the simple use of powerful magnets. This type of water is supposed to improve ion exchange in cell membranes, improve vitamin and mineral absorption, result in better removal of toxic wastes, and have free radical scavenging and anti-oxidant action. This type of structured water contradicts the need for using structured water to enhance oxygen uptake by a cell.

There are a number of companies pedaling special water magnetizing machines that are supposed to modify the structure of water or create a very active micro-structured water. There is much promotional hype as to what the water produced by these machines can do. Water produced by some machines is supposed to have a hexagonal structure and ‘energy memory’, which is advertised as being good for all living organisms. Special magnetic filters can supposedly produce water that is eight times as effective as most unstructured water in terms of health benefits. If you cannot afford a magnetizing machine, you can purchase a magnetic drinking mug or magnetic stirring rod that will do the trick.

Clustering with Electrical Energy. Electrical energy can be used to produce magnetism and supposedly the magnetically clustered water mentioned in preceding paragraphs. Vendors are also peddling machines that use electrical energy applied through electrodes in what is like an electrolysis chamber to create active micro-clustered water. Some claims are that this surpasses all other structured waters. A similar process is used to create what is called ionized water or water separated into its acidic and alkaline components. The acidic component is promoted as being excellent for cleaning while the alkaline component is excellent for drinking.

Alkaline, Ionic and Ionized Water. One pseudoscientific health claim is that as the body ages it collects acidic waste products, a process called acidosis. An easy way to rid your body of all these acidic wastes is to drink pure ionic water. The key claim of ionized water or ionic water is the separation of water into acidic and alkaline components, both of which have special properties. Drinking the alkaline component is supposed to have all sorts of health benefits and is especially effective in washing away all the acidic wastes that accumulate with age. There are numerous companies selling this type of water and the machines to make it.

Incredible Water Machines. There are a number of incredible water machines on the market that make use of electricity to do magic to water. Some vendors claim that their special distillation machine creates beautiful crystalline structured dodecahydronal (12-plane) water clusters at room temperature. These large water clusters supposedly have more electrons per active cluster than ordinary water and are very effective virus killers. They are also promoted as having other proprietary medical applications.

There are vendors who go into thermodynamic theory and how environmental factors increase entropy in the human body and how this increased entropy kills normally healthy cells. Ordinary water cannot lower this entropy but water created by a special machine with the formula of $H_{30}OH$ can. Drinking this water is supposed to make adult diseases like cancers and tumors disappear. The only problem here is that this is the hydronium-hydroxide ion pair that has the fastest chemical decomposition rate ever measured in chemistry. Therefore, unless you can drink this type of water within less than a billionth of a second from when it is made, it will not do you any good.

Clustering with Light Energy. There are claims by vendors that treating water with specific wavelengths of light energy gives the water a special structure and all sorts of magical properties. This perfect clustering, which is also called Platonic Solid Inversion Geometry, gives this water added molecular vibration energy and a special healing power. By drinking water that is loaded with life supporting vibrational energy, humans can go to the next level of development where an unconditionally loving heart outshines the need to survive in negative and destructive ways that are built into our genes as a primitive trait. Drinking this water will help people control any addiction: tobacco addiction (nicotine), over eating addiction, alcohol addiction, drug addiction, gambling addiction and even sex addiction.

Clusters from Catalyst-Altered Water. There are claims of using a variety of special catalyst to alter the structure of water to form beneficial clusters. Some claims relate to production of supercharged water, where only a very tiny amount of the elixir, when added to regular water, can give it mystical properties. Some of the things claimed are so weird, magical and goofy, it's hard to believe that anyone would believe what special catalysts can do to water and the power given to this now altered but once ordinary water. Internet sites now expose some of these magical claims for what they are, scams. If interested visit Quackwatch on the Internet at <http://www.quackwatch.org>.

Reducing Clusters to Improve Water. There is an alternative view that ordinary water is too "clustered" and that the clusters are too large. This type of water is not beneficial for you because these large clusters impede the flow of water molecules into and out of individual cells. Water vendors promoting this scam say that ordinary water tends to behave like one giant cluster and "un-clustering" is the way to go to improve the hydrating capacity of water. Sound waves and electrolysis are some of the technologies that these "un-clustering" devices use to supposedly break up and reform water into much smaller, more beneficial clusters.

A good reference to structured-water scams is retired chemistry professor Stephen K. Lower's web page titled "Water Cluster Pseudoscience" (<http://www.chem1.com/CQ/clusqk.html>). For scientific information on the real properties of water due to water structure and behavior, visit the London South Bank University web site at <http://www.lsbu.ac.uk/water/>.

Light Wave Energy Water

This is pseudoscientific nonsense at its best. This water product is advertised as containing minerals, which are used to hold and carry electrically charged light-energy signals to different areas of the body. This scheme mentions

26 formulations of water, each with different energy wave characteristics that trigger different responses throughout the body. Of course you will need the complete supply to keep all body systems functioning at maximum efficiency. Persons who believe this nonsense are probably beyond listening to credible scientific reasoning.

Water Testing Scams

There are two primary types of water testing scams. The first is where an individual representing a company takes a sample of your water directly from the tap or gets you to bring a sample to a meeting to demonstrate all that is wrong with it. A fresh-from-the-tap demonstration is usually most effective. The second type of scam is where an individual takes a sample of your water and sends it to a laboratory and then helps you interpret the results. Company representatives have also been known to even fabricate lab results.

On-site Demonstration Tricks

With this scenario, a sales representative comes to your house, usually non-invited, and proceeds to demonstrate why you need special water treatment equipment that his company sells. It does not matter if you are on a public water system or have a private well system, these people can produce visible results that convince many people to purchase expensive water treatment devices. Some of these devices may not work while others may work fine but are not really needed. Two of the most popular on-site schemes are the chlorine scare and the invisible chemicals trick. If you have chlorinated water, one trick is to show you how this extremely toxic chemical is rapidly absorbed into your body when you stir a glass of water with your finger. The sales rep may or may not include the issue of how chlorine produces trihalomethanes, known cancer-causing chemicals, in drinking water. THE FACTS: residual chlorine from a glass of fresh tap water

actually dissipates into the air in a matter of minutes with a little stirring.

Another huckster trick is the use of a small battery powered device that colors your water, without the apparent addition of chemicals, to show you the invisible chemicals hiding in your water. THE FACTS: When a direct current is applied to water containing any salts through two relatively inert electrodes, some of the water will begin to decompose by electrolysis. However, if the electrode serving as the anode contains iron, some of this iron will go into solution as electrons flow from the iron to the electrode serving as the cathode. The result will be formation of ferric hydroxide in the glass of water. The insoluble ferric hydroxide will give water an ugly yellow-orange appearance in a matter of minutes. The iron being released from the electrode reacts with hydroxyl ions in water to form this insoluble precipitate.

An article by Dr. Joe Schwarcz on the Quackwatch web site (<http://quackwatch.org/01QuackeryRelatedTopics/filter.html>) titled “The Night I Bought a Water Filter” discusses both of these on-site demonstration tricks. These invisible chemicals can also be easily produced when they are added to a water sample in tablet form or as drops, which are supposed to be test reagents.

Misinterpretation of Laboratory Results

It is not uncommon for water test results to be misinterpreted or even faked to sell unsuspecting consumers water treatment devices they do not need. This is why the U.S. Environmental Protection Agency and state environmental agencies have certification programs for water testing laboratories. If a company that sells water treatment equipment is responsible for analyzing a sample of your water and interpreting the results of that analysis for potential treatment needs, you should get a second opinion before purchasing any water treatment device. When a company’s

profits and the commission of sales representatives depend on how many water treatment systems they sell, you cannot count on everyone always being perfectly honest.

Water Treatment Scams

There are two primary categories of water treatment scams. The first type applies to the sale of merchandise that actually works, where the scam is convincing people to purchase items they do not really need or items they may not even want. In the second category, consumers end up purchasing all sorts of devices that have no proven benefit for improving water quality. We have federal laws to help protect against consumer fraud, but people still spend billions of dollars on faulty equipment, including water treatment equipment, that has no proven benefit.

Consumers Sold Treatment Units/Systems Not Needed

Exploiting Consumer Ignorance. All water contaminants can be categorized as physical, chemical, biological, radiological or thermal additions to water. Temperature reduction is seldom employed in drinking water treatment, but many people prefer cold water for drinking. Most physical contaminants can be easily seen in water and it is quite obvious when mechanical filtration devices fail to remove such contaminants. On the other hand, many chemical, biological and radiological agents cannot be readily seen in water and less than ten percent of U.S. citizens have the scientific literacy to understand why water that contains any measurable level of chemical, biological or radiological contamination could still be considered safe to drink.

Therefore, a favorite ploy of scam artists is to convince individuals to purchase expensive water treatment units, which they probably do not really need, to remove invisible contaminants they cannot see. The purchased equipment may improve the quality of drinking water, but still have little or no significantly increased benefit for

health or nuisance problems. Often, this is not the case. Consumers tend to have problems with some of the treatment units they purchase, either because they are improperly installed or because they are not adequately maintained. Many companies offer maintenance contracts with their equipment, for additional fees of course.

Scare Tactics. People tend to have more fear for what they cannot see nor understand. Water treatment vendors take advantage of this fear, especially of chemical agents, to sell all sorts of water treatment devices. Some devices work while some do not and others may actually increase certain potential nuisance problems or health risks. The chemical scare tactic is very effective because of the vast media attention given to the link between terrible diseases like cancer and synthetic chemicals. In reality, biological agents are a much greater short-term human health risk.

The intent of Consumer Confidence Reports, that water utilities must now make available to their customers as a mandate of the 1996 amendments to the Safe Drinking Water Act, was to improve consumer confidence in public drinking water in the United States. It's too early to tell if this is the case. In the mean time, water treatment vendors use these reports to demonstrate that there are toxic chemicals in public water supplies. These chemicals can be removed, of course, by purchasing special treatment devices offered by commercial vendors.

Consumers Sold Faulty Treatment Units/Systems

There are many schemes for marketing devices that have little or no impact on improving either nuisance or health-related water quality problems. A high percentage of the treatment scams are health quackery schemes and have been discussed previously. Other schemes deal with treating some of the most common water nuisance problems such as hard water.

Hard Water and Scale Treatment. Every household and every factory uses water and none of it is absolutely pure. One class of water impurity that is of special interest is “hardness”. This refers primarily to presence of dissolved calcium and magnesium carbonates, which are acquired as water comes in contact with rocks and sediments in the environment. Hard water causes two types of problems. It reduces the efficiency of soap and prevents complete removal of soap residue from clothes, skin and hair during cleaning. The second type of problem is associated with scale build-up that results primarily from lime scale or carbonates of calcium and magnesium precipitating from solution. Scale can also be composed of certain phosphates, sulfates and hydroxides, but carbonates usually dominate in most geographical areas.

Carbonate precipitation from water can clog faucets and showerheads; cause unsightly spots on utensils and kitchenware; plug plumbing systems and pumps; cause scale build-up in showers, swimming pools and spas; and can ruin heat exchangers, boilers and hot water heaters. In boilers and hot water heaters, the deposits act as thermal insulation that impedes the flow of heat into the water. This not only reduces heat efficiency and wastes energy; it causes overheating of heating elements with the result being catastrophic failure. Water that contains more than 180 mg/L of calcium and magnesium, usually measured as calcium carbonate equivalent, is considered to be very hard.

The economic importance of water softening has created a large and thriving industry that utilizes a number of proven methods based on well-established scientific principles. To soften hard water, the concentration of dissolved calcium and magnesium must be lowered. One of the most efficient methods for doing this is ionic exchange, where the positively charged ions of sodium and/or potassium are exchanged for calcium and magnesium ions in solution. Ultra-fine membrane

technology (ultra-filtration) is another technique that can be used to reduce the concentration of minerals in water that cause temporary hardness, permanent hardness or other problems. Reverse osmosis (RO) and both electro-dialysis (ED) and electro-dialysis reversal (EDR) techniques are the most commonly used ultra-filtration methods of water purification. The driving force for RO units is water pressure and the driving force for ED and EDR units is direct current to produce polar membranes that attract the ions in solution. An EDR unit is similar to an ED unit except that it periodically reverses polarity, which tends to have a self-cleaning effect on the membranes.

There are numerous alternative hard water treatment devices on the market that make claims to remedy the problems associated with hard water. These devices are more commonly referred to as water conditioners because they do not actually soften the water. They are supposed to change some condition of the water to prevent scale formation and, in some cases, even remove scale that has already formed.

These so-called water conditioners employ permanent magnets, electromagnets, electrolytic processes, depressurization, catalytic processes, molecular oscillations (vibrations) or light-related treatment methods to prevent scale formation.

There is no evidence in reputable scientific or engineering literature that any of these water-conditioning methods really work. However, you will see testimonials of personal experience as to how effective these devices are. Virtually all of the statements supporting alternative water treatment methods come from those who have a commercial interest in these devices. None are supported by credible and independently verifiable data or by scientifically valid explanations and should be considered pseudoscientific rubbish.

Magnetic and Electromagnetic Water Treatment. There was earlier discussion in this article on the

use of magnetism to produce specially clustered water that has health benefits. Magnetic water treatment is also the most commonly employed alternative method of hard water treatment. It does not actually reduce hardness but is supposed to reduce scale formation. It is one of the most controversial technologies on the market. Magnetic water treatment is simply the attachment of strong permanent magnets or electromagnets to the incoming water pipes of your home. Those who promote this technology cannot explain exactly what happens but their advertisements say that it reduces scale formation in plumbing and even tends to remove previous scaling. The most common theory is that the magnetic field somehow interacts with water complexes and the positive and negative ions associated with dissolved hard water minerals and other dissolved solids within the water flowing through the pipe to keep them in solution. The promoters of this technology often refer to mineral precipitation in solution instead of carbonates precipitating onto the plumbing.

No one has yet been able to prove scientifically and conclusively in a peer-reviewed journal that magnetic water treatment works. However, companies selling the technology report a high degree of success as evidenced by a high percentage of satisfied customers.

Electronic and Electrolytic Water Treatment.

Companies market what is called both electronic and electrolytic treatment devices to prevent lime scale. Some of these devices employ the same mechanism as electromagnets and claim to disturb the molecular forces in water to prevent scaling. Other vendors claim their equipment has programmed microchips that send special electrical impulse signals through the water. The carefully controlled impulses supposedly result in sub-microscopic water clusters that serve as nucleation seeds for the precipitation of calcium carbonate. The precipitation around the tiny clusters is supposed to prevent the deposit of hard lime scale on the inside of pipes.

Companies are also marketing electronic gadget boxes that are supposed to create ionic charges or change the charges of ions in water to prevent lime scale formation. Some of these devices use a water electrolysis process where the production of atomic oxygen is supposed to be the key. The working mechanism for other devices is supposed to be basic physics, the injection of electrons into the water column. THE FACTS: No one has a valid scientific explanation as to how any of this could really work. The electron injection theory is crackpot physics for sure because a multi-ton electron accelerator would be required to do this, not some small specially patented gadget wrapped around a water pipe that works on electrochemical processes. Another fact is that the ions in water are always equally balanced in electrical charge and even if you could push electrons into water, they would last less than a millisecond.

Depressurizing for Scale Control. There are a number of water treatment systems on the market that supposedly operate by subjecting hard water to rapid reductions in pressure. This is essentially a vacuum being applied to water in a plumbing system unit that would allow dissolved carbon dioxide to escape from the water, presumably rendering it more alkaline. This increased alkalinity should cause any dissolved carbonates that remain to precipitate out as finely divided particles so they can be filtered from the water instead of forming scale deposits inside pipes. Some people believe this method has potential since it is designed to work similar to the mechanism of stalactite formation in limestone caves. However, there is no obvious way this system could work in the brief time that water flowing through the system would be at a lower pressure. That's probably why there is no reputable literature to indicate that instant depressurization can be effective in removing carbonates from water. Evacuation (lowering pressure) can be used to reduce dissolved gases in water and to increase concentration of dissolved salts as some of the water is evaporated. However,

this cannot be done in a closed system where the extracted gases or water vapor have no place to escape. Depressurization and degasification can be used to remove radon gas from water.

Catalytic Water Treatment for Scale Control.

There are companies marketing what they call catalytic water conditioners. Some work in conjunction with magnetic devices and others in conjunction with depressurizing units, while still others have only a special catalytic chamber that does all the work. The process is referred to as a catalytic process because the treatment unit supposedly provides electrons to the water column through a cathode. This electron flow is supposed to enable electrochemical changes to occur in the water, which reduces scale formation, reduces corrosion, dissolves existing scale and increases the wetness (whatever that means) of the water to enhance its cleaning power. There are several web sites that specifically address what is called catalytic water treatment nonsense.

Special applications of oxidation-reduction reactions or anode-cathode processes between two metals of different reactivity can be applied to corrosion protection. When two different metals are connected directly or indirectly through an electrolytic solution, the metal of highest reactivity becomes the anode. The anode gives up electrons to the other metal, which becomes the cathode. The anode slowly corrodes away while the cathode remains relatively unaffected. This process is similar to electrolysis in that hydrogen gas can accumulate at the cathode and metals in solution would tend to plate out at the cathode in a closed system. If a chunk of magnesium is placed on an iron water pipe, this magnesium will corrode and prevent iron corrosion in the pipe where the potential difference between the magnesium and iron pipe exceeds the potential difference between the iron pipe and its other surroundings. THE FACTS: There are no reliable data to prove that a source of electrons applied to a metal pipe to prevent corrosion of the pipe

would also prevent scale deposits from forming on the inside of the pipe.

Oscillations (Vibrations) to Prevent Scaling.

There are both European and U.S. products on the market, which supposedly operate on the principle of oscillations, manipulation of oscillations, or the generation of vibrations and vortices in water to prevent hard water problems. Some of the water magnetizers mentioned previously also supposedly work on the principle of oscillations in water to change polymer structure. Other than controlling scale, some of the promotional ads claim that the techniques employed also prevent corrosion, alter the chemistry of dissolved iron and have some other unbelievable health benefits. Revitalized water that is supposedly alive versus most water, which is dead water, is due to added energy due to oscillation of the molecules. The companies promoting these products, like most scams, offer nothing but nonsense in reference to how their devices really work.

There is a lot of interest in the potential use of ultrasound and acoustic generators for water and wastewater treatment. Some are saying that various polymer forms of water can be formed with these techniques. THE FACTS: There are no data as of yet to support any practical water treatment benefits from sound generated oscillations in water molecules. However, there is some evidence that excessive noise damages hearing because of oxygen molecules being converted to free radicals by the sound waves. The military is conducting a study to see if U.S. Marine trainees, who are exposed to excessive noise, can protect their hearing by taking an antioxidant pill. If this works, fraudulent companies will soon be using this as a gimmick to promote antioxidant water.

Light-related Treatment. There are a number of scams on how light can be used to treat water. This was mentioned earlier under the alternative health and medical claims associated with structurally altered forms of water.

Far-infrared Nonsense. Most of the light-related schemes deal with the use of far-infrared (FIR) light because water has a rich absorption spectrum in the FIR region of the electromagnetic spectrum. Far-infrared absorption is generally related to motions of molecules, so FIR absorption is not unique to water molecules since individual molecules or groups of molecules within many liquids and solids also absorb strongly in this region.

There is a scam that you can treat water with far-infrared light, which will cause special vibrations and energize the water, mimicking what happens when natural springs splash over rocks and natural magnetic fields. This special form of water, sometimes referred to as “hexagonal water”, is purported to be living water that resonates with the energetic vibrations of your body to amplify your life force. This water is also supposed to absorb and retain more oxygen. Even though water molecules do absorb strongly in the far-infrared range of the electromagnetic spectrum, there is no scientific evidence that this creates hexagonally shaped water polymers that have special properties. This is nothing but junk science.

Photonic Ionization. There are Internet sites promoting the use of photonic ionization as a method that has promise in desalting water. This is a water treatment scam from the Middle East trying to entice people into investing in the development of a technology that has no promise based on known physics. The claim is that salts can be removed from water as it passes through transparent conduits where the water is exposed to specific field strengths, wavelengths, pulse widths, amplitudes and frequencies of electromagnetic energy. There is no reliable information to support any of this type of technology.

Filters That Prevent Bacterial Growth. A number of companies offer a variety of

bacteriostatic filtration units for home drinking water treatment. The devices are most frequently advertised as being EPA registered silver-impregnated carbon filter systems that inhibit bacteria growth. The company must be careful in the way they advertise these filter units. Such units must be registered with EPA under a pesticide label because they are designed to kill or prevent the growth of a living pest organism, bacteria. The EPA does not register or certify any devices for home water treatment but NSF International does.

Carbon filters can be used to remove chlorine from water, but the removal of residual chlorine from water may result in bacterial growth in a faucet or plumbing outside the filter unit. A bacteriostatic filter is designed to prevent this growth. There is no scientific evidence to confirm that these filters actually prevent bacteria growth. You can search the NSF International web site for any products certified for bacteriostatic effects at <http://www.nsf.org/Certified/DWTU/>. Since such filters are usually multi-purpose units, they are usually listed with filters to improve aesthetic effects of water.

Redox Magic. Some companies are marketing water filtration and treatment devices that use special “oxidation alloys” to supposedly produce high purity water. Promotional claims state that these devices use granulated copper and zinc-based alloys, that through special oxidation-reduction reactions, transfer electrons between molecules to create new products. These devices have similarities to catalytic water treatment that was referred to in previous paragraphs. They are promoted as being effective in removing chlorine, hydrogen sulfide, iron and some heavy metals from water. There is no reputable literature to support claims made by some of these companies.

THE FACTS: Oxidation-reduction reactions, commonly referred to as redox reactions, are some of the most common reactions involving inorganic chemicals. A number of elements most frequently

involved in redox reactions can exist in several oxidation states. Some oxidation states are more water-soluble than others, but the higher oxidation states are usually less soluble. Oxidation followed by filtration is therefore an effective means of removing many metals and a number of other chemical products from water. However, you would be smart to purchase only those filter systems certified by NSF International (<http://www.nsf.org>) as being effective at removing specific chemical contaminants from drinking water. Products with an NSF label have been tested in independent studies and certified to do what they claim to do.

Water Supply Scams. The most common water scams of the late 1800s through the 1930s were those related to quantity or supply rather than quality. These were more common in areas of the country prone to drought conditions. Tricking local residents into investing in drilling of a water-well or methods to artificially enhance rain were favorites of hucksters at one time. Although there is some scientific validity to enhancing rain today, it was once nothing but a hoax and a way to obtain money when money from any source was rare. Water dousing, which some people swear by even today, has no more scientific validity than magnetic conditioning of water to prevent scaling.

A certification program for well drillers has essentially eliminated scam artists from this market. If you have plans to drill a well, you would be advised to contract with someone on your state list of certified well drillers.

UNDERSTANDING AND RECOGNIZING SCAMS

Why Scams Work

The human brain and nervous system is designed primarily for survival, not to assure truth, logic and reason. Therefore, our brains can produce beliefs without any particular respect for what is real and what is not. The nineteenth century

prediction that good universal science education would completely defeat superstition and irrational thinking has not happened. High literacy has done little to decrease the beliefs that many people have in telepathy, astrology, UFOs and a wide array of “paranormal” and “supernatural” phenomena. If you tend to believe in the magical and mystical, such as psychic powers and horoscopes, you are more likely to believe in all sorts of “super water” that will do things that conventional medicine will not.

Many scam artists use a combination of pseudoscience and pure trickery when trying to sell you a product that may cost plenty but will provide you with no real benefit. There seems to be an increasing willingness of Americans to put faith ahead of science in deciding what is good for them.

Understanding Science

What is Pseudoscience?

The word “pseudo” means fake, so pseudoscience means fake science. A pseudoscience is some body of knowledge, which has no scientific validity or has been proven false, but still masquerades as real science, often in an attempt to claim legitimacy. It is often associated with commercial quackery that is nothing more than a professional scam to defraud people of their hard-earned money. Many references and information on pseudoscience are now available on the Internet. For example, the Stout Science Program for Educators has numerous web links on the topic of pseudoscience (http://physics.uwstout.edu/stoutsci/good_pseudoscience.htm).

Where Does Pseudoscience Come From?

Original pseudoscientific beliefs are many thousands of years old: much older than real scientific discovery. Other pseudoscientific beliefs are more recent, coming from ancient times when

human thought processes were based on superstitions, irrational thinking and mistaken ideas about people and nature rather than about objective analytical thinking. Many well-trained scientists generate pseudoscientific beliefs today when they plunge into a field of science in which they are ignorant. A physicist who claims to have found a new principle of biology for example is probably delving into pseudoscience. Good use of pseudoscience is just one of the techniques used by scam artists.

How Can You Tell Fake Science From Real Science?

If you do not have a strong background in science, it is sometimes difficult to tell the difference between pseudoscience and real science. In order to spot fake science you need to know more about the real thing. However, knowing science does not simply mean knowing scientific facts such as the boiling point of water, the distance between the earth and the sun, the distinction between a mammal and a reptile, etc. It means understanding the nature of science—the criteria of evidence, the design of meaningful experiments, the weighing of possibilities, the testing of hypotheses, the establishment of theories, and the scientific methods that make it possible to draw reliable conclusions from these theories and hypotheses.

Basic Characteristics of Scams

There are many classes of scams, which are nothing but fraud. Consumer-based fraud is one major category that can go two ways. Consumers can make false claims against reputable businesses or corrupt businesses can commit fraud against innocent consumers. The type of fraud discussed here is fraudulent activities against consumers. Such activities are commonly referred to as scams. The primary point to remember about any fraudulent person or company is that their objective is to separate you from your money, and they may lie, use trickery or even invent a problem to do so.

All consumer scams have one or more basic characteristics. Recognizing these characteristics will improve your odds against being scammed. If you are reading commercial ads or approached by sales representatives marketing a product, such as special water treatment devices, be wary of the following:

- 1) The product can remove any type of contaminant and produce water that has fantastic health benefits. If something sounds too good to be true, it probably is not true.
- 2) The working methods for the product are not based on clear proven scientific principles.
- 3) The company or sales reps have no peer-reviewed reputable support literature for their product.
- 4) The primary support for the product is a testimonial by some crackpot pseudo-scientist from a foreign country.
- 5) The primary support for the product is a long list of testimonials from satisfied customers, none of whom you know or can contact.
- 6) You are pressured to purchase or invest immediately because of some special limited time offer.

DEALING WITH SCAMS

Reporting Scams

Any Type of Scam

Local Law Enforcement. There are a number of places for reporting scams. If fraudulent salespeople are visiting homes in your neighborhood, notify the local county sheriff's office. If your city or county government has a consumer protection office, you should make them aware of local consumer scams. These offices should be listed in local telephone directories.

State Attorney General. All state Attorney General offices have a Consumer Protection Unit. Scams or other types of consumer fraud should be reported to this office. The mailing address, telephone number and Internet address for all state Attorney General offices are available from the

Federal Consumer Action website located at <http://www.consumeraction.gov/state.htm>.

False Health and Product Labeling

False claims for health products or false labeling of bottled water should be reported to local offices of the U.S. Food and Drug Administration (FDA). They are listed in the blue (government) pages of your phone directory. You can also file a complaint online at <http://www.fda.gov/medwatch>. Your name is kept confidential.

Fraudulent Mail

It is a crime to send fraudulent materials through United States mail. If you receive such materials you can file a complaint with the inspector's office of the U.S. Postal Service at <http://www.usps.com/postalinspectors/fraud/MailFraudComplaint.htm>.

Fraudulent Marketing

The Bureau of Consumer Protection of the U.S. Federal Trade Commission (FTC) does not resolve individual consumer problems related to fraud. However, consumers are encouraged to file complaints about a particular company or organization because the FTC enters fraud-related complaints into Consumer Sentinel (<http://www.consumer.gov/sentinel/index.html>), a secure, online database available to hundreds of civil and criminal law enforcement agencies worldwide. You can fill out the form to file a complaint from this site. If you wish to report electronic commerce across the border fraud, go the electronic consumer site at <http://www.econsumer.gov/>. When the site comes up, click on the language you wish to use in communicating your message.

Learning More About Scams

Local and State Sources

Any local governmental office that deals with consumer protection can usually provide information about fraud and scam trends in your area. County Cooperative Extension Offices often have information produced by professionals who deal with consumer issues such as fraud. All State Attorney General Offices have a Consumer Protection Unit that can provide specific information and answer questions about fraudulent practices.

Federal Sources

There are a number of federal sources for information on scams and fraud. The Federal Citizen Information Center (FCIC) in Pueblo, Colorado provides updated information on the latest scams, fraud and consumer abuse. The FCIC has also compiled a list of federal agencies where you can document a complaint against a company for fraudulent activity. The Internet address for FCIC is <http://www.pueblo.gsa.gov>. Another good federal site for consumer information is <http://www.consumer.gov>. Both sites have links to other federal web sites that can provide additional information to consumers.

Other Sources

Since cyberspace has become the favorite frontier for deceptive marketing, there are now a number of Internet sites that provide good consumer information on Internet scams. Some of these include Crime Watch—The Consumer Fraud Watch Network (<http://www.consumersgroup.com/crimewatch/>), Net Scams Online Protection (<http://www.netscams.com/scams.jsp>), and the National Fraud Information Center (<http://www.fraud.org/>). Internet sites can also be used to find legal information on almost any subject including scams and fraud. One such site is <http://cobrands.public.findlaw.com>. The Consumers Union has advice and information on

many consumer issues. Their web address is <http://www.consumersunion.org>.

SUMMARY

Fraudulent vendors claim all sorts of benefits from their products, which are untrue. This is especially the case for Internet sites. However, all these sales sites display the required disclaimer that the information they provide is “for educational purposes only”. That is the only way these sites can promise all sorts of vague alternative health benefits and make false claims about water treatment devices without any credible supporting evidence. To protect yourself you must learn to recognize credible supporting evidence. Testimonials on web sites and references to incredible numbers of clinical case histories purporting to support the effectiveness or alternative health benefits of specially treated water or any other homeopathic remedy is not credible supporting evidence.

Avoid free home water tests. In almost all of these cases, any water (even the purest spring water) would “fail” the company’s test. Don’t fall for prize promotional schemes. In these cases, you are required to buy a water treatment device costing hundreds or maybe thousands of dollars. You may later discover that both the prize and water treatment device are of little value. Be wary of claims of government approval of home water treatment devices. An Environmental Protection Agency registration number does not mean that EPA has tested or approved the product.

Although some contaminants have been found in public water supplies, most households using water from public sources should have few concerns. This will not keep unscrupulous salespeople from preying upon concerned consumers by using scare tactics and fraudulent practices to sell their water treatment devices. If your water source is a well, you should have it tested at least annually for bacteria, pH, dissolved solids and nitrate. It is also a good idea to have it

tested at least once for arsenic, radium and organics if there is suspicion that these contaminants could be a problem in your area. Always have your water tested by independent labs, preferably state-certified labs. A list of these labs is available from your state agency that regulates drinking water or you can get the list for your state by calling EPA’s Safe Drinking Water Hotline at 1-800-426-4791.

Remember that no water treatment device can solve every problem. Compare your test results to state and federal drinking water standards and seek the advice of professionals who understand what water test results really mean before purchasing any water treatment devices. Make sure the device you select has been tested and certified to perform according to its label (<http://www.nsf.org/Certified/DWTU/>).