POE Systems Reduce VOC Risks

At-the-tap treatment won't do the whole job

By Michael Pedersen

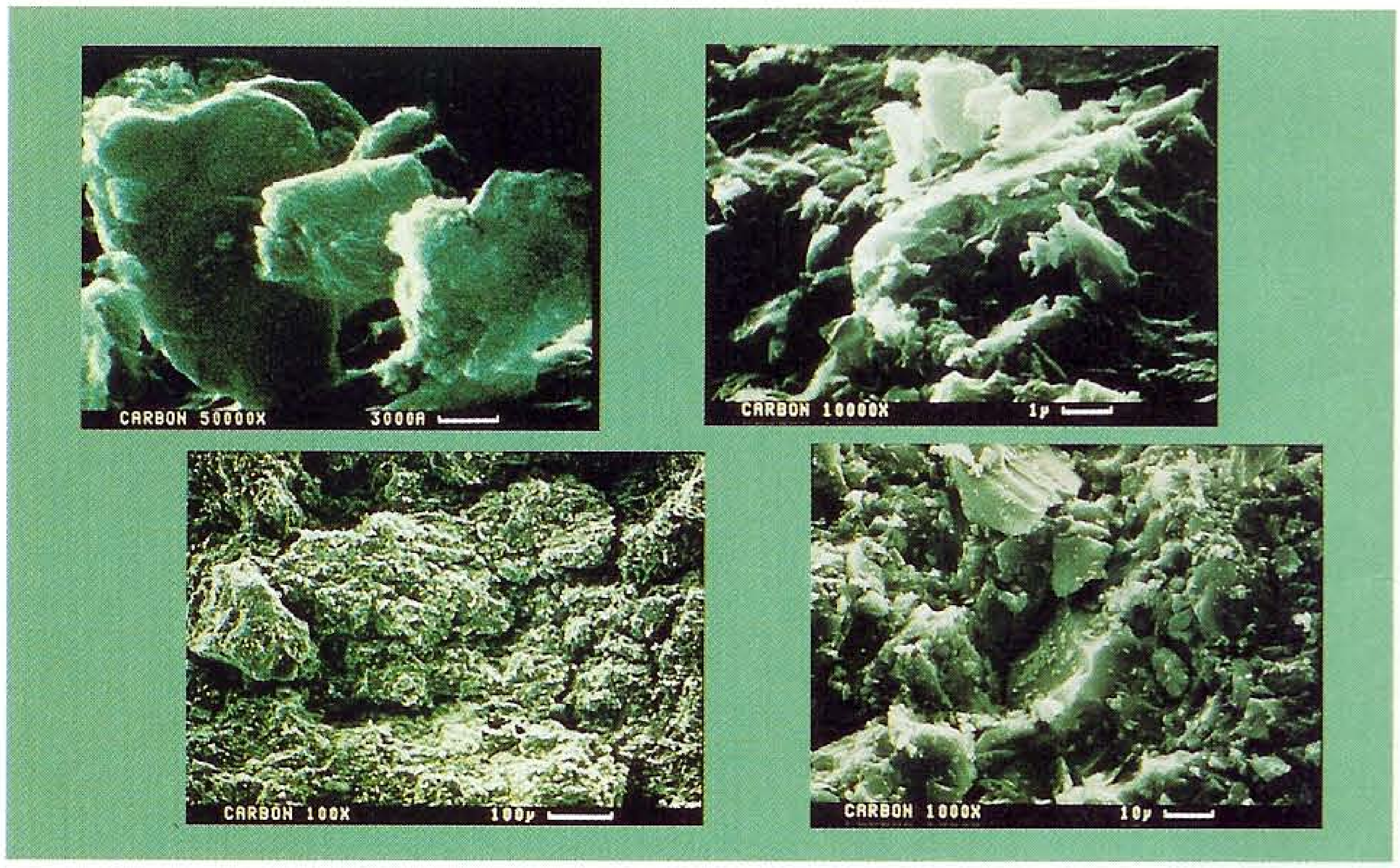
Summary: *The primary route of exposure to volatile organic compounds (VOCs) can be six times greater from inhaling than from drinking the recommended eight glasses of water per day. Here we discuss practical risks and touch on ways to remedy the problem.*

Point-of-use (POU) filter and bottled water sales are at an all time high—but treating the water your customers drink may be only a partial solution to the whole problem. Drinking the water is only part of the problem of water contamination.

The reason? Your customers may face a far more serious health threat from the air they breathe—and the primary contributor to household air pollution may be the water they use. Thus, point-of-entry (POE) water treatment may be necessary also as a preventative measure.

The risk

It is a little known fact that household water can introduce hazardous volatile organic compounds (VOCs) like chloroform into a home's atmosphere. This is understandable because, with the exception of radon, most consumer research identifies tobacco smoke, certain heating units and construction materials, carpets and wallpaper as air pollution culprits.



Source: Calgon Carbon

To complicate matters, the health risk associated with exposure to waterborne chemicals is normally based on the assumption that people drink two liters of water daily. Little consideration is given to the fact that exposure to waterborne VOCs is six times greater through inhalation and skin absorption than from direct consumption.

The threat is also widespread. For example, 75 percent of Americans are on "municipally treated" water supplies, most of which use chlorine for disinfecting water. Due to the reaction of chlorine with trace organics in the water, chlorinated water supplies will have some amount of trihalomethanes (THMs). THMs are a subset of VOCs.

History

THMs are chloroform, bromoform, dibromochloromethane and bromodichloroethane. Chloroform ($CHCl_3$) is a VOC that acts on the central nervous system. After it was determined that chloroform produces cancer in animals, its use was curtailed in many products.

In 1970, the discovery of chloroform in the blood of many New Orleans residents triggered a search for the source, soon identified as drinking water. This discovery was one of the reasons prompting passage of the Safe Drinking Water Act (SDWA) of 1974, which, among other things, limited total THMs to 100 parts per billion (ppb). This limit, which is soon to drop to 80 ppb as a result of SDWA revisions two years ago, assumes the average person ingests two liters of water daily. The limit of 100 ppb of THMs is a maximum contaminant level (MCL) and assumes an accepted risk of one death per 100,000 population per year over a lifetime at that level. The maximum safe level for any identified carcinogen, common sense tells us, is "0" in terms of an acceptable risk.

THMs

Municipalities test water for excessive levels of THMs when it leaves the treatment plant, and at downstream sites, but the conversion of organic chemicals to chloroform continues as water travels through the distribution system. This can take up to a week in a large system, so levels of THMs will often be higher when the water reaches your customer than when the municipality measured them.

How much higher depends on the quantity and type of organic chemicals present, the length of time the water remains in the distribution system and the amount of excess chlorine injected into the water to maintain an effective disinfection residual throughout the system.

It can even depend on the season, to a degree. In the summer, raw water sources are warmer and plant and animal activity is higher. The result is increased organic loading in the raw water, particularly if it's a surface water source. Municipalities must then add more chlorine; therefore water may contain higher levels of the resulting THMs.

Municipalities experiencing seasonal THM problems can continue to operate under a six-month variance, which is long enough for the problem to disappear until the next summer.

VOCs at home

Studies by the Center for Environmental Epidemiology at the University of Pittsburgh published in *Environmental Science & Technology* conclude VOCs, like chloroform, evaporate rapidly during normal household activities such as dish washing, using the garbage disposal, doing the laundry, cleaning, bathing and flushing the toilet.

The studies indicate, at normal shower temperatures, about 50 percent of chloroform in water escapes into the air—before the water even reaches the shower floor. This level of exposure exceeds that of ingestion by 600 percent, according to the studies. In effect, it doesn't matter whether your customers or prospects drink the water or not; normal household exposure is enough to be concerned about.

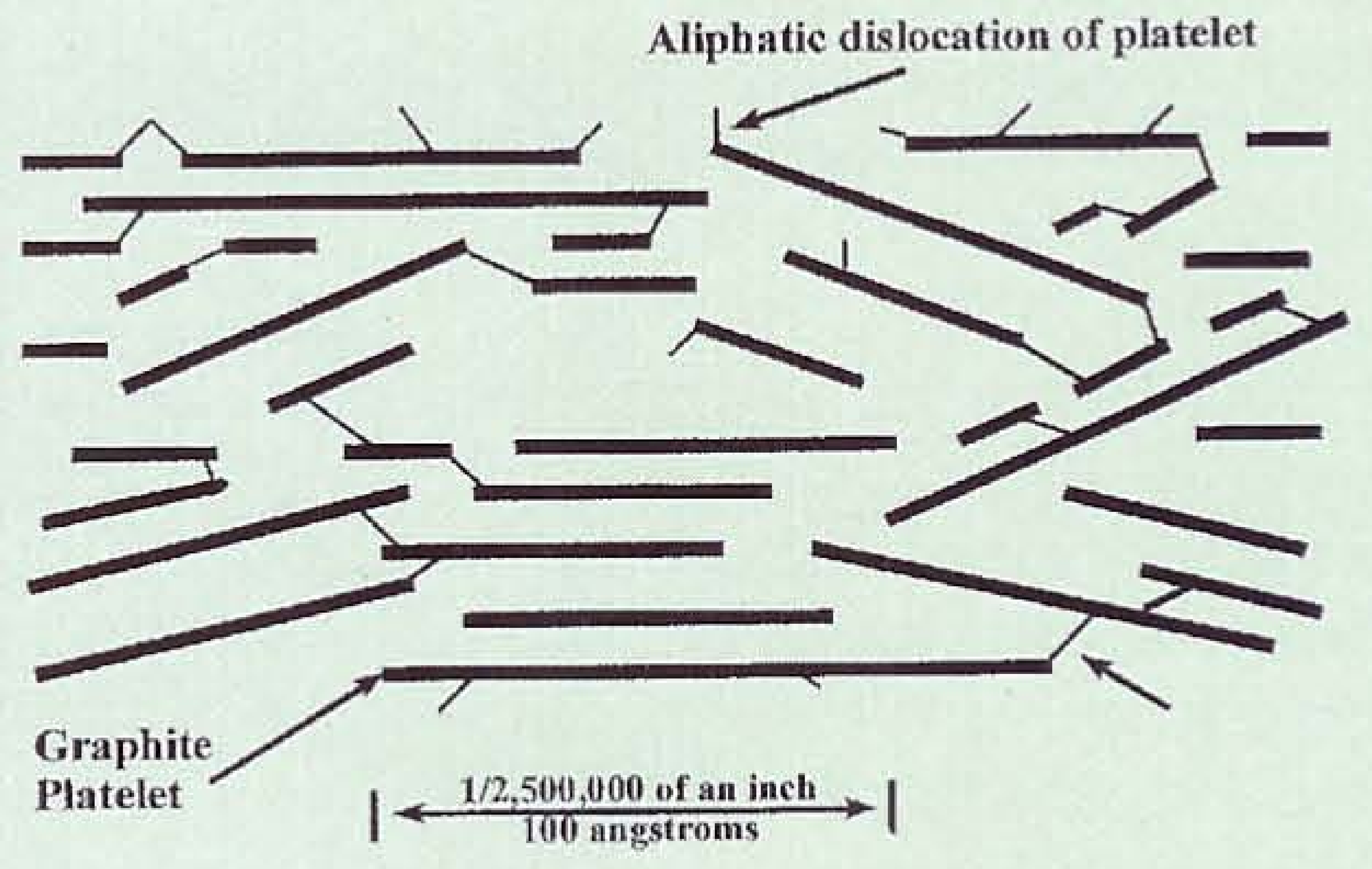
Due to the movement of underground water that may carry contaminants along with it over long distances, even well owners with private water systems in remote areas can be at risk. Trichloroethylene (TCE) from industrial site contamination and petroleum distillates from gas station leaks are major contributors to groundwater contamination. Again, VOCs, by definition, will be found in the vapor associated with showering, toilet flushing, laundry and dishwashing machines, and any aerated water source. The vaporization process is calculated in terms of volatilization rates as determined by the Law of Henry's Constant. Therefore, the risk of inhalation for each exists.[10] Radon, still an understated risk, also falls into this "volatilization profile," although it is not a VOC. For radon levels exceeding the adsorption capabilities of standard POE carbon units, POE aeration is recommended as pretreatment. In industrial applications, packed tower aeration is the preferred treatment process for radon removal. Readers should refer to articles specifically on radon removal for details of how to handle that.

VOC removal with adsorption units can be effective as long as units are maintained and sized properly for the application flow rate. Sizing for the average household demand of 5-to-6 gallons per minute (gpm) could require an empty bed contact time of up to 10 minutes for successful VOC reduction. For additional details on proper sizing of such a whole house system for VOC removal, refer to "What's New with Granular Activated Carbon," Chubb Michaud, *WC&P*, June 1996.

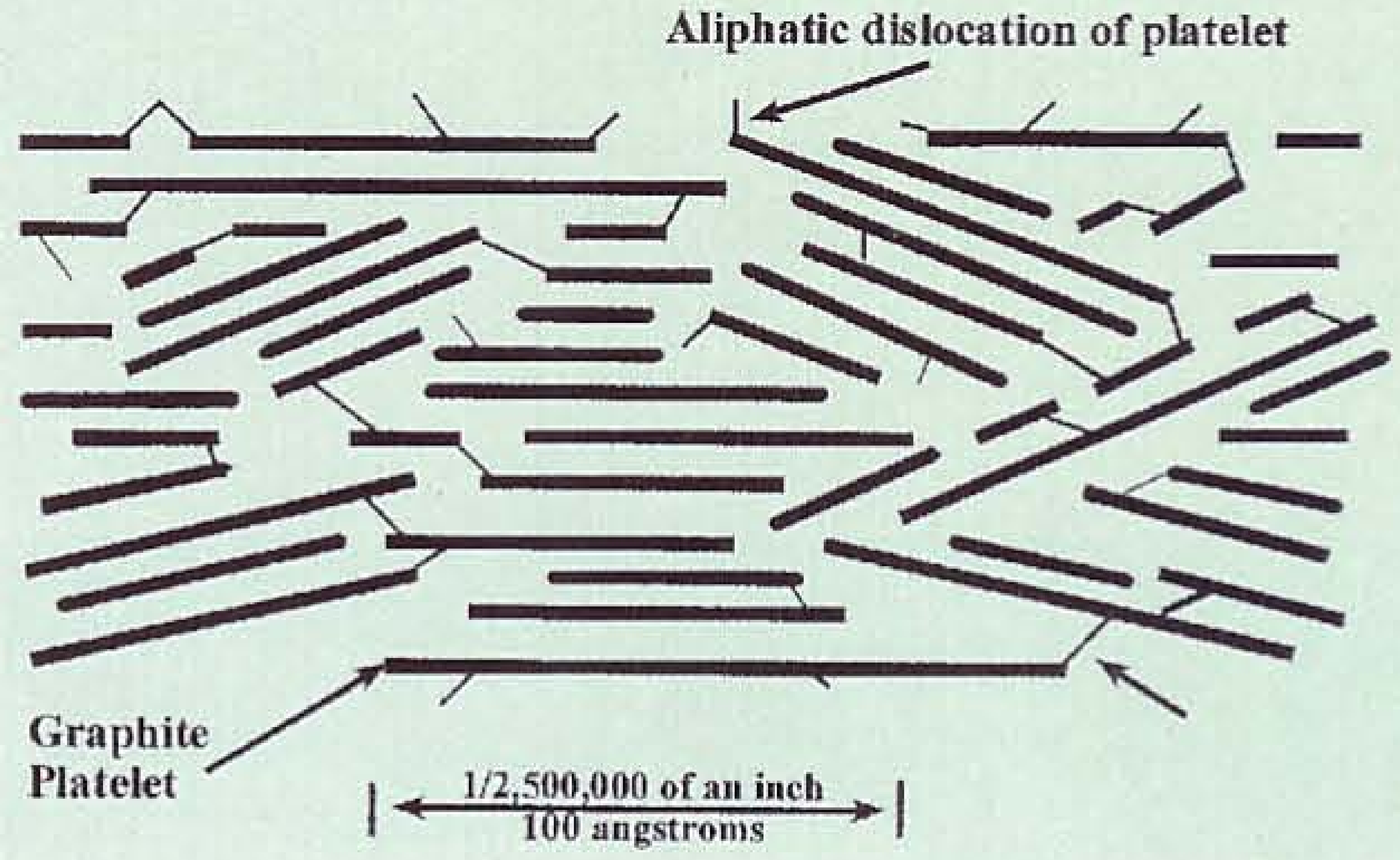
If VOCs are present in a well, caution must be taken in carbon treatment to identify possible additional contaminants that may cause a reduction in the adsorption process. Iron, for example, rapidly uses up a large portion of the carbon's surface area. It should be removed before water enters the carbon unit.

Most properly sized POE carbon units will treat the water used by an average household for 12-to-18 months,

Molecular Structure of Coal-Based Activated Carbon (10,000,000 X Magnification)



Molecular Structure of Coconut-Based Activated Carbon (10,000,000 X Magnification)



Source: Calgon Carbon

but the only way to tell if a unit is approaching exhaustion is through testing.

Carbon types

The type of carbon that is best for VOC reduction would generally be carbon that would have a high iodine number and a predominantly micropore structure, both of which are indicative of a larger surface area for better loading of contaminants. Carbon from coconut shell, with an iodine number as high as 1,100 square meters per gram (m^2/gm), is sufficient for reducing many VOCs. Generally, for petroleum-based VOC contaminants (for example, benzene), coal-based carbon with a high iodine number—1,050+ m^2/gm—is preferred.

Conclusion

Whether your customers use municipal water or well water, VOC intrusion may exist, regardless of if they live in the city or in the country. If samples tested by a certified testing laboratory indicate the presence of VOCs, your customer runs a greater risk of exposure through inhalation and skin absorption than by ingestion. The recommended treatment is POE filtration.❑

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