Multi-Contaminant Removal With Granular Activated Carbon (GAC) In Drinking Water Filtration

Due to increasing regulations and an ever-rising understanding of contaminants present in many drinking water sources, water treatment plants (WTPs) are more frequently tasked with addressing multiple contaminants. To many engineers and WTP managers, having to remove one or more contaminants often means adding multiple targeted removal systems. However, it is possible for a single system to be a multi-contaminant solution.

For years, the U.S. EPA has recognized granular activated carbon (GAC) as a best available technology (BAT) for a wide range of organic contaminants, many of which can be addressed within the same system (Figure 1). Calgon Carbon's FILTRASORB® GAC is proven to be a highly effective solution for removing multiple contaminants from drinking water, including total organic carbon (TOC), disinfection byproducts (DBPs), per- and polyfluoroalkyl substances (PFAS), 1,2,3-tricholoropropane (1,2,3-TCP), taste and odor (T&O), volatile organic compounds (VOCs), and algal toxins. Calgon Carbon also stands alone in the market as the only total solutions provider, offering virgin GAC, reactivated GAC, equipment, and specialized support services.

Historical Use Of GAC

Initially used to tackle taste and odor, GAC filtration has been a part of drinking water treatment since the 1930s in the United States. With the passage of the Safe Drinking Water Act (SDWA) 50 years ago, GAC treatment has evolved to encompass additional target contaminants such as VOCs, TOC, DBPs, and more. Today, water utilities are once again turning to the effective and simple solution of GAC filters for the removal of PFAS from their source waters to protect their constituents and enhance the quality of our nation's drinking water.

Why GAC Works So Well

You may be wondering why GAC filtration has been deemed a BAT for a vast variety of contaminants. Simply put, unlike other treatment technologies, GAC media is not manufactured to target one specific contaminant. Instead, GAC media removes organic contaminants in the water stream, regardless of type, through the process of *adsorption*. Adsorption is governed by the kinetics of diffusion and is powered by electrostatic forces, called Van der Waals forces, which cause the organic contaminant to stick to the surface of the GAC media, thereby removing it from the water stream. Diffusion is governed by both media properties and contaminant properties and describes the time required for the contaminant in the water to be adsorbed onto the media. Several organic contaminants share similar diffusion characteristics, thereby making it possible to remove multiple contaminants simultaneously in one GAC filter, provided there is enough contact time and media capacity. Given the importance of both contact time and media capacity, Calgon Carbon's FILTRASORB 400 paired with their AquaKnight™ Gold Certified (GC) Adsorption Systems, which utilize a cone bottom underdrain to enhance flow

Figure 1. Activated Carbon Adsorption: Simultaneous Removal of Multiple Organic Contaminants in Water: GAC is an EPA-recognized best available technology (BAT) for removing an array of drinking water contaminants including PFAS, TOC, DBPs, VOCs, and 1,2,3-TCP, among others.

distribution, can be an excellent solution for WTPs looking to tackle multiple contaminants with one treatment process. For more information on Calgon Carbon's AquaKnight GC Systems and to reach a Calgon Carbon representative directly, please go to https://www.nomorepfas.com/contact/.

Using GAC For Multiple Contaminants

As previously mentioned, the effectiveness of GAC filters at removing multiple contaminants depends on both the media selected and the equipment design, specifically the empty-bed contact time (EBCT). For instance, an EBCT of around 7 minutes may suffice for removal of most VOCs, while PFAS typically requires about 10 minutes. If a GAC system is already in place for VOC removal, engineers or operators can collaborate with the media vendor, such as Calgon Carbon, to identify and evaluate the pathways available to target additional contaminants of interest within the same filter. Some of those pathways include changing the GAC media installed, changing the flow rate through the filter, improving the performance of upstream processes, or adding GAC filters in parallel or series to the existing system. In certain situations, no changes are required at all. However, if needed, an existing GAC system can be tweaked to enable simultaneous treatment for multiple contaminants, leading to a better tasting, more stable, and higher quality drinking water.

Ultimately, it is recommended that WTPs and engineers undertake a comprehensive pilot study to determine the best approach to removing their contaminants of concern. This will not only help identify the right carbon type and vendor for the contaminants in question but also the expected media life for the system. If a pilot test is not an option, a rapid small-scale column test (RSSCT)

can be used to provide some insights, though their accuracy is not as reliable as a pilot. It is imperative in either case that the team conduct the test work with an experienced media vendor to ensure the correct assumptions are factored into the analysis. For example, Calgon Carbon is the only vendor that offers a complete pilot testing package, which includes pilot testing equipment, media, technical assistance, and modeling using the EPA's free AdDesignS software to provide clients with a holistic analysis of the results.

Alternatives To GAC

Although technologies such as IX media can sometimes be effective at removing some sulfonated PFAS compounds, they often require specific water matrices (low anion and dissolved metals content) to be more cost effective than GAC media. Moreover, IX medias, and more recently novel sorbents, provide none of the additional benefits that are typically associated with GAC, such as decreasing VOCs and TOC/DBPs, protecting the water supply against chemical spills in the watershed, and improving taste and odor.

For those operations that are already utilizing GAC filters, adjusting operational setpoints to handle new contaminants is generally the best path forward for a range of reasons. In addition to minimizing new capital expenses, it also reduces or eliminates the training associated with adding new treatment technologies. While leveraging the same media beds for additional contaminants can shorten the bed life with respect to the least adsorbable contaminant, the increase in changeouts is typically still less costly from a lifecycle perspective than adding a new removal technology. Ultimately, there are few alternative technologies to GAC that can simultaneously remove multiple contaminants, with none being as straightforward and easy to integrate from an operational standpoint and some being significantly more expensive.

GAC Treatment Is A Viable Solution

As the need for comprehensive water treatment solutions continues to grow, GAC remains one of the most dependable and scalable technologies for delivering high-quality drinking water. By integrating Calgon Carbon's FILTRASORB GAC into the drinking water treatment process, utilities can reliably achieve comprehensive contaminant removal and regulatory compliance. Calgon Carbon is the only total solutions provider and stands ready with virgin and Custom Municipal Reactivated (CMR) FILTRASORB GAC, AquaKnight™ GC equipment, and a team of dedicated field service personnel and technical experts to help utilities meet their water treatment goals. ■