

TECHNICAL PAPER10-004-TP
Oct 2007**Activated Carbon and Filter Membranes
Working Together in Harmony:
The Duck River Utilities Success Story**

Every time there is a purification process required, and a new opportunity for suppliers of the various materials used for the purpose of purification identified, an end user has felt that they are faced with a decision of choosing between a filter membrane approach or using activated carbon to achieve required finished water quality. However, as some customers are learning, there can actually be a synergy found in using both of these technologies together to achieve the most cost- and quality-effective means of reaching their purification goals. Such is the case at Duck River Utilities in Tullahoma, TN, where a filter membrane system is actually being used up stream from a Norit HYDRODARCO 3000 granular activated carbon bed, which is used to polish the filtered water to remove taste and odor compounds. Word of success from this configuration is spreading rapidly in the southeast region of the US, and there certainly will be more opportunities for this approach at other municipalities.



With each passing year, U.S. Federal regulations place ever more stringent purity demands on municipal water treatment plants (WTP) to meet the needs of an ever-increasing population. The laws are intended to reduce the presence of compounds that, with prolonged exposure, are detrimental to human health. Although a number of organic compounds are specifically named and regulated, collectively they are often referred to as total organic carbon (TOC).

The health hazard of these compounds is amplified by the widespread presence of chlorine in finished water, used as a disinfectant in the distribution system. Chlorine in the presence of TOC creates a group of compounds known as disinfection by-products (DBP) several of which are known carcinogens. To reduce the formation potential of these compounds, TOC reduction requirements of up to 50% have been established for all WTP in the U.S. For the Duck River Utilities Commission (DRUC) facility in Tullahoma, Tennessee, the target is a 35 – 45%.

Membranes

Ultrafiltration is the most common technology considered for municipal water purification because of its proven capabilities for particulate removal. In addition, ultrafiltration operates at lower pressures than other filtration processes, such as nanofiltration and reverse osmosis (RO), while still meeting Federally mandated purity guidelines.



Improved Water Quality

With fresh lignite-based GAC installed, DRUC was able to produce water essentially free of TOC and a resulting THM level of finished water in the distribution system of 3 – 4 micrograms/L. In addition to purity requirements, the water must be aesthetically pleasing to the customer (no taste and odor, T&O). The compounds responsible for T&O (2-Methylisoborneol and Geosmin) are not removed by membranes but are well adsorbed by GAC.

After 3 years in service the combination of membranes and Norit's lignite-based GAC are still routinely providing a 60 – 80% reduction in TOC and there have been no complaints of T&O.

Longer Filter Runtimes

Whereas most WTPs backwash media beds as often as daily the GAC at Duck River requires this procedure only once every 3 months. In addition, the backwashing process is of shorter duration than prior to the incorporation of membranes. Less frequent and shorter backwashing means a significant cost savings due to reduced finished water usage.

Reduced Water Usage

Duck River uses seven (7) foot deep beds of lignite coal-based HYDRODARCO 3000 GAC. Typically deep GAC beds require substantially more water to achieve complete bed expansion but according to Randal Braker, General Manager of DRUC, "The significantly lower backwash flow rate and frequency allowed the DRUC to switch from bituminous to lignite carbon, improving taste and odor removal while lowering capital cost of the GAC."

Backwashing for filtered solids occurs primarily in the membrane system. Although the water usage is typically more water than used by a conventional filter system the overall consumption is offset by the significantly lower backwash requirements of the GAC filters.

Summary

Duck River Utility Commission is a success story on the synergy of using activated carbon and membranes as complementary technologies. Randal Braker stated that, "The use of membranes in front of the carbon has extended the service life of the carbon for taste and odor removal by approximately 60 percent. This represents a significant savings in carbon replacement cost." As news of this successful integration of treatment techniques continues to spread, it will lead the water treatment industry – both practical application and research - in an entirely new direction. Norit's Activated Carbon and X-Flow groups are working together to develop this new joint opportunity in North America, and to create new success stories of Norit products integration.