Water System Uses Anion Resin

Meets increasing demand while maintaining environmental compliance.

The plant superintendent for the Dare County/Cape Hatteras Water Treatment Plant, Frisco, NC, reports successful application of an especially long-lasting, strong base anion exchange resin to allow use of high total organic carbon (TOC) shallow fresh well water that would otherwise have caused trihalomethane (THM) and haloacetic acid (HAA5) formation in excess of maximum contaminant levels (MCL).

With no surface water available to meet increasing demand for high-quality drinking water from the coastal community, the Dare County Water System developed a combination source of anion-treated shallow fresh water wells and reverse osmosis (RO) treated, deeper brackish water wells as the most cost-effective solution.

"Without the anion resin, we couldn't use as much of the shallow well water because of its TOC problem," said Terry Goldman, the plant superintendent. "The anion system has been virtually trouble-free, with only a broken lateral that occurred during construction.

"We are still using some of the original resin, greatly exceeding the five-year life span that was promised, and only replaced the rest after seven years of use. And the anion resin has never required off-line cleaning.

"The TOC of the fresh water coming into the anion averages about 12-13 mg/L, for an average of 50 to 60 color units, and coming out, it drops to an average 1 to 1.5 mg/L, which is essentially colorless, and an average 80 to 90 percent TOC reduction," he noted. "When we blend that with the output from the RO-treated water, in a ratio of about 4:1, the TOC drops down to about 0.85 to 0.81 mg/L.

"The anion exchange system works very well—it has a low energy requirement, is simple to operate and virtually maintenance-free, and gives us a very high-quality blended output for our customers."

"That keeps our THM's in the range of nine to 30 ppb, and an average of 12 ppb, versus the MCL of 80 ppb, and our HAA5's at two to five ppb, versus the MCL of 60 ppb. It also maintains our average finished water total hardness at 65 to 70 ppm, so we don't get corrosion problems from using only RO water."

The two-mgd, combination RO/anion exchange plant is expandable to three mgd. Its output is a blend of RO water that derives from four 260-ft to 308-ft brackish wells, at an average RO exit flow of 800 gpm, with anion water that derives from nineteen 70-ft to 90-ft freshwater wells, at an average anion exit flow of 200 gpm.

Chlorine is added to the anion output as an oxidizer for iron and manganese, which is followed by sand filtration before it reaches the ground storage

Anion-treated fresh water increases hardness of RO-treated brackish water to both reduce corrosion and help reach the required flow of two mgd. Available fresh water was otherwise not usable for that purpose due to high TOC content.

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tank. Water from regeneration is pumped to settling basins before discharge. The RO water is treated with chlorine, fluoride, and corrosion inhibitors, and is adjusted for pH, before ground storage.

The combination-source plant was developed during 1999 to 2000 to replace the area's original, 1.4-mgd average, conventional flocculation, sedimentation, filtration, and softening water treatment plant.

"As we increased demand on the old plant, we had gotten to the point where we were too often exceeding the 80 percent capacity factor that the state prefers you stay within," recalled Goldman, "and I remember one July 4 when we were really right on the edge of capacity. Since the county did not have additional property suitable for shallow wells, and didn't have any fresh surface water sources, we drilled deep wells into a brackish aquifer for a reverse osmosis water source."

"To do that, we needed to increase the hardness of the RO finished water so it wouldn't corrode our distribution system. But we couldn't do that by adding raw brackish water because its salinity was too high, which would have caused us to exceed our 250 ppm chloride MCL.

"And we didn't want to do it by adding more chemicals. So that led us to anion exchange to take care of the TOC, and allow us to use the available fresh water for blending.

"The anion exchange system works very well—it has a low energy requirement, is simple to operate and virtually maintenance-free, and gives us a very high-quality blended output for our customers, making up for the moderate recovery rate the RO system provides due to the high salinity of its source water."

Clarified and filtered fresh shallow well water enters the anion exchange system at a flow rate of about 700 gpm, or one mgd. Two 275-cu ft columns of resin handle a service flow rate of two- to three-gpm/cu ft. Throughput is 14,500 gal/cu ft.

Regeneration dosage is eight lb salt/cu ft. Estimated salt cost is $0.022/1,000 gal, and estimated resin cost is $0.03/1,000 gal.

The PUROLITE® A860 Anion Exchange Resin (The Purolite Company, www.purolite.com) is a macroporous, Type 1 strong-base resin with an acrylic matrix. The acrylic matrix is said to assure high levels of removal of organic matter from a water supply in conjunction with its reversible removal upon regeneration, with non-hazardous sodium chloride.

The resin is regenerated efficiently, with lower levels of sodium chloride than those required for a polystyrene-based Type 1 resin, but with a comparable ability to remove weak organic acids, lignins, and tannins. The resin is also noted as particularly resistant to organic fouling, even when loadings are relatively high. GE

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