Taking Water From the Big Sandy River

By Marcia Sherony

Kentucky treatment plant minimizes river sand buildup with vortex separation technology

With a name like the "Big Sandy River," it is no surprise that extracting water for drinking presents challenges for treatment plant operators. Two treatment plants situated along this tributary of the Ohio River found solutions to coping with turbid flows carrying high quantities of river sand and sediment.

In many parts of the U.S., drinking water is extracted from rivers to be treated, stored and distributed. But few areas present greater challenges than southeast Kentucky. Common practice for a treatment plant, when there is room, is to use pre-sedimentation basins to allow sand and other sediment to settle out prior to the treatment process. If the pre-sedimentation area is not sufficient, the basins can bypass huge amounts of river sand during heavy rain periods. Once sand enters the process, it wears out mechanical equipment and clogs downstream processes.

Along with abrasion, accumulated sand and sediment can lead to reduced volumes in process tanks, higher volumes of sludge and high energy usage; each of these issues adds significantly to operational costs. With high sand and sediment content in river flow, pre-sedimentation basins rapidly fill up, making the sedimentation process less effective and allowing bypass; the accumulated sand and sediment have to be manually cleaned, a costly process that can take the basin out of the treatment process for significant time. The material removed then must be further dewatered and disposed.

Loaded Water

Sand, silt and coal accumulation is a common problem in Appalachian rivers, as high density of industry and mining upstream creates a high concentration of sediment. The river is very turbid—especially when it rains.

"The Big Sandy River didn't get that name accidentally," said Ralph Varney, plant operations manager for the Pikeville Water Treatment Plant. "When there's a lot of rain, the river gets atrocious. I mean, it's awful."

Described by locals as "the city that moves mountains," Pikeville received national recognition for rerouting the Big Sandy River, and the result, the Pikeville Cut-Through, enabled the construction of a new water treatment plant in 1987.

Shortly after the Pikeville plant began operating, however, the superintendent noticed that equipment was getting clogged with large amounts of river sand. As there was no pre-sedimentation tank, the flocculation tanks would accumulate as much as 6 ft of river sand every three months. The city needed a better solution than manually removing it every quarter.

River sand often clogged the plant's two flocculator basins so much that when they were turned off, they could not be turned back on. As a result, the basins needed to be checked regularly and monitored constantly. Cleaning the basins proved to be especially expensive and time-consuming.

"When we cleaned the basins ourselves, it was extremely costly," Varney said. "It usually took two or three of us about a week. We would have to spend $15,000 to $20,000 for an outside company to do the cleaning for us." The basin's mixer paddles also would become worn and twisted, requiring constant replacement.

One treatment option was an infiltration well, but there was too much clay in the ground, which would keep the water from percolating. A pre-sedimentation basin also was considered. However, at a treatment plant 20 miles upriver at Prestonburg, Verner saw vortex separation technology being used effectively. By using dynamic energy found in pumped influent to separate solid from liquid, no moving parts were required and maintenance requirements were minimized.

Successful Separation Technology

After looking at a few vortex separation models, Varney decided on the Eutek TeaCup from Hydro Intl. The technology works with a combination of free vortex separation and a boundary layer to capture, classify and remove river sand. It requires no chemicals and produces a clean, low-organic slurry. In Pikeville, this technology allowed separated sand to be directly returned to the river prior to the water treatment process.

Water flows through coarse screens in the river to an intake inside a wet well building. From the wet well, water is pumped at 4,000 gal per mintute to the separator. The unit uses centrifugal force to separate the sediment 106 μ and larger, achieving 95% removal.

The sediment settles to the bottom of the device, where it is swept to a center collection cone via the boundary layer. The pretreated water then flows to the rest of the treatment process for further treatment.

The operators were able to retrofit the 96-in. system into the plant's existing treatment process and shortly after installation, the plant started realizing its benefits. "When we first started it up, we had all the basins clean and we went a year before having to worry about them," Varney said. "Now the basins are cleaned annually and only around 4 in. of sand is removed, depending on how much rain the area received."

Larger Debris Removal

The solution that Varney saw was at a plant owned and operated by Prestonsburg City's Utilities Commission. There, a system was needed to remove sand from the pumped raw river water prior to its entering the plant for treatment to save maintenance time and money spent cleaning out the settling basins, minimize wear and tear on mechanical equipment, and reduce sediment volume.

Installing a Hydro Grit King vortex separator unit before the water treatment process improved the performance of the entire plant, significantly reduced long-term maintenance costs in downstream equipment and reduced sludge volume.

The free-standing system was designed to remove 95% of sand particles greater than 150 μ (100 mesh) with specific gravity of 2.65 at flows up to 6 million gal per day. Head loss for the installed unit is less than 12 in. at peak flow. This objective was achieved with a 108-in.-diameter unit constructed of 304 stainless steel.

In both plants, vortex separation technology is being used successfully to cope with high peak flows and low particle size in systems with low power and maintenance requirements. w&wd

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