

Small Footprint. Big Capacity.

A BALLASTED FLOCCULATION SYSTEM ENABLED THE SANTAN VISTA WATER TREATMENT PLANT TO DOUBLE CAPACITY AT LOW COST

By Jim McMahon

Surface water is a primary drinking water source for the Arizona Town of Gilbert, which has two water treatment facilities.

As the population expanded rapidly in Gilbert and the adjoining city of Chandler, the town needed to double the capacity of its Santan Vista Water Treatment Plant. The key to the expansion was the RapiSand ballasted flocculation system from WesTech Engineering.

This high-rate clarification process, using rapid mixing and multistage flocculation followed by sedimentation, was a major factor in the selection of the plant expansion as 2018 Water Treatment Plant Project of the Year by the AZ Water Association.

DELIVERING WATER

The Town of Gilbert's North Water Treatment Plant can produce up to 45 mgd, serving about 125,000 residents. It receives water from the Salt River Project, which manages several dams and reservoirs on the Salt and Verde rivers and releases water into canals for distribution to municipalities.

The Santan Vista plant until 2018 had a capacity of 24 mgd, serving more than 125,000 residents in Gilbert and Chandler. This plant receives water through a canal system from the Central Arizona Project. That 336-mile system carries Colorado River water from Lake Havasu, through Phoenix, to south of Tucson, and it is integral to the water portfolios of Gilbert and Chandler. Water is brought to the plant through about 14 miles of 48-inch ductile iron pipeline.

Organic carbon and suspended solids must be removed from the Colorado River water. When it enters the Santan Vista plant, it goes through screening to remove debris, followed by ballasted flocculation and clarification, and also ozone treatment to improve filterability and remove taste and odor. Deep-bed monomedia filtration then removes viruses, bacteria and particulates as small as 1 micron. Finally, the water is chlorinated and pumped to consumers.

PLANT EXPANSION

The Santan Vista plant was commissioned in 2009, and since then, Gilbert and Chandler have seen extensive growth. That required the start of a previously planned second phase of construction, which included the building of new facilities within the operating plant.



Mike Alexander, Santan Vista plant operator, uses an Imhoff cone to determine the operating sand concentration in one of the RapiSand treatment trains (WesTech Engineering).

“Our two municipalities worked together for over a decade to plan the joint facility,” says Robert Andrews, maintenance and operations field utility supervisor at the plant. “We evaluated process technologies and delivery methods that would best serve the area and meet prevailing and anticipated drinking water regulations.”

In 2017, the Santan Vista plant selected Black & Veatch to design the expansion project and Sundt Construction and Sturgeon Electric for construction. “The expansion was designed to double capacity from 24 to 48 mgd,” Andrews says. “We opened the competition to equipment suppliers and selected the RapiSand system as the central process in the expansion.”

“The RapiSand system has fulfilled all expectations for high-rate clarification, at a fraction of the cost of the original ballasted flocculation trains.”

ROBERT ANDREWS

The expanded plant includes two RapiSand trains, each with 12 mgd capacity. Ballasted flocculation is a high-rate physical-chemical clarification process that involves the fixing of flocs or suspended solids onto microsand ballast, with the aid of a polymer. Due to its numerous particles, the microsand provides a larger contact area for binding, and the coagulated solids form a dense, ballasted floc.

FAST AND THOROUGH

The RapiSand system is a high-rate clarification process that uses rapid mixing and multistage flocculation, followed by extremely fast sedimenta-

tion. Detention time is about 20 minutes from start to finish. The process includes four steps.

In the first tank, raw water is mixed with coagulant. The coagulated water is then mixed with polymer and recycled microsand in each of two flocculation tanks. Total flocculation time is typically eight minutes, a fraction of the time required in a conventional flocculation system.

The clarification process is critical to the design and uses a high-torque segmented rake system and lamella tube settlers. The flocculated water flows into the clarification tank, where the floc settles; clarified water passes up through tube settlers. The ballasted flocs settle up to 35 times faster than in conventional clarification.

Clarified water exits by way of finger launders above the tube settlers. After clarification, settled floc and sand are collected and pumped to a hydrocyclone, where the sand is separated from the solids. The waste solids are sent to a thickener for settling, and the underflow is recycled to the ballasted flocculation clarifier. The separated sand is returned to the first flocculation tank. Each treatment train contains 10 tons of silica microsand.

“What the RapiSand process does is accelerate the settling rate of the particles,” says Shawn Sturgeon, applications engineer with WesTech. “One of its upsides comes when there is a need for more flow capacity with limited real estate. Rapid flocculation and settling combine to reduce the space requirement by up to 90%, when compared to conventional clarification.”

In terms of both turbidity and TSS, the system’s high rate of sedimentation provides excellent performance characteristics, leaving behind a highly clarified effluent. Typical outlet turbidity is less than 2 NTU. Due to its stability, the process can handle large spikes in raw water turbidity.

CONTROLS UPGRADE

As the plant doubled in size, the controls had to be expanded and modernized. The first step of that project included a complete evaluation and



The high-rate sedimentation process tank allows ballasted flocs to settle up to 35 times faster than in conventional clarification processes.



A double-train ballasted flocculation system doubled treatment capacity for a low cost.

upgrade of the existing control panels, including programming, all performed by WesTech.

“The controls were upgraded to include redundant programmable controllers, Ethernet communication between all components in the system, remote operation and new programming to handle the additional equipment,” Sturgeon says. “This required two phases to create as little process interruption as possible while allowing a smooth transition into the expansion.”

Phase one included preinstallation testing of the upgraded controls, communications and additional inputs/outputs at the WesTech assembly and testing facility in Salt Lake City. The company’s controls experts then visited the Santan Vista plant to install the upgrades during a scheduled shutdown. The intent was for the existing system to operate exactly as before, eliminating confusion for the operators. When the plant came back online, the upgraded controls worked flawlessly and the original equipment functioned as usual.

Phase two involved upgrading the operations interface and the programming of the RapiSand trains with the upgraded controls while maintaining a similar feel for the plant. The electrical equipment installation met the construction schedule through the combined efforts of the Santan Vista plant staff, Black & Veatch, Sundt Construction, Sturgeon Electric and WesTech.

“WesTech’s controls and programming group made all the physical hardware, made sure the controls and connectivity systems could do what they needed to do, and programmed it so the operators would not see a difference between what they had been doing and what they were going to do in the future,” Sturgeon says.

SUCCESSFUL OPERATION

Startup work began in February 2018, and final commissioning was completed in May 2018. “The RapiSand system has fulfilled all expectations for high-rate clarification, at a fraction of the cost of the original ballasted flocculation trains,” Andrews says. “Within hours of startup, the outlet water quality matched the quality of the two existing ballasted flocculation trains.

“This is a very robust system. Over the first month of treatment and data collection, the system successfully reduced turbidity in all conditions and yielded a low, more consistent turbidity range in the effluent water quality, between 0.3 and 1.4 NTU.”

The expansion received the Water Treatment Plant Project of the Year award for its efficiency in doubling the plant’s capacity and for on-time completion 20% below the original cost estimate. The award also cited the project team’s collaborative working relationship and the careful planning that minimized shutdown time. **tpo**



Scott Johnston, lead operator, monitors the equipment and process parameters of the RapiSand treatment trains from his computer.