PC Pump Facilitates Operation of Water Clarification System

By Bob Gralton, President, Clearwater Industries, Inc. and Pumps & Systems Staff

A rogressive cavity (PC) pump installed as part of a turnkey water clarification system has helped solve a costly problem plaguing the aggregate industry for years—the method of transfer and recycling of dirty washwater generated during the manufacturing process. The aggregate industry, referred to as non-metal mining, consists primarily of sand and gravel (S&G) producers, and quarry operators, who often incur high labor and maintenance costs in disposing of the waste. The PC unit has proved both cost-effective to the OEM and enabled its complete system to yield a payback for the end-user in less than three years.

The difference between the two aggregate operations is that a quarry works with large rocks and must blast them into stones, while the S&G form takes stone directly out of the earth with loaders. In processing the pieces of rock, both types of companies run the product through crushers and a series of screens, usually three (triple-deck) that have progressively smaller openings, for example, 1.5", 3/4", 3/8". A triple-deck screen will separate the stones into four specific sizes. As the crushed material is being screened, spray bars, on top of each screen, shower copious amounts of water on the aggregate, which is then taken by conveyors and deposited in discrete piles, for sale mainly to concrete and asphalt manufacturers.

The wet screen process is necessary to remove all silt and clay from the rocks, because the contaminants can cause the customer's concrete to crumble and fall apart. Aggregate producers typically use between 1,000 and 3,000 gpm of water to wash the stone. To process 300 tons per hour of sand and gravel, a company will use 1,00 to 2,000 gallons of water. In the past, the dirty washwater was transferred into a system of three to four ponds, where the silt and mud would settle out over time, with some clean water eventually being reused in the screening process.

A case in point is Johnson Sand & Gravel Company, New Berlin, Wisconsin. The plant, which yields about 1,730 gpm of unclean washwater, mostly silt and mud, was previously emptying it into a series of three dirty ponds, positioned in a row. After the process had been running for about three days, the ponds would have to be dredged, forcing stone production to be shut down. Operators, using expensive earthmoving equipment, would then have to take the useless byproduct to remote sites for disposal. The mud had to be dispersed over a wide surface area so that the equipment would not be trapped or damaged in transit by the still-soft mud. At Johnson, about 30 tons of this waste mud is generated per hour, with manual labor costs in the past averaging $22.50 per hour. The plant operates ten hours a day, five days a week, nine months a year.

After several unsuccessful attempts to improve its washwater operation, Johnson found a solution in a Clearwater Industries clarifier system that used two 1,000 gpm, 11' diameter circular clarifier tanks with a central flocculation chamber. A polymer system injects a low dosage of the chemical into the flocculation vessel before the dirty washwater reaches the clarifier, optimizing floc size, while minimizing polymer usage. Clean water now overflows the top of the clarifiers on a continuous basis, as the undesirable clay and silt fall to the bottom. Here a slow-moving hydraulic rake removes the thick mud, which, in turn, is pumped through a 6" pipeline, 500 feet horizontally up to a 40' incline to a single discharge area. There is no need to move the pipeline for the duration of Johnson's operating year.

Proper pump selection for mud transfer was crucial to the overall successful performance of the Clearwater system and, in the end, a 225 gpm seepex Type 200-6LNS PC unit

The author inspects a progressive cavity pump used in Clearwater Industries' water clarification system in service at John Sand & Gravel Co., in New Berlin, Wisconsin.

was chosen. The pump was supplied by R.W. Baron & Associates, Inc., a New Berlin fluids handling firm. The pump consists of a gray cast iron housing, Duktil-coated hardened tool steel rotor, a molded-to-size Buna stator and a patented device to adjust tension on the stator so that its useful lifetime is extended about three tomes longer before a replacement is required.

In operation, the positive displacement pump's single external helix rotor turns within a molded double internal helix stator to form progressively moving cavities, creating the pumping action. The pump's output is directly proportional to its speed, and its customized stator ensures an identical compression ratio along the entire rotor/stator interface.

For Clearwater, the PC pump has the advantage of providing a non-pulsating flow, taking a pre-determined quantity of mud out of the bottom of the clarifier, prior to discharge, thereby preventing "rat holing," that is, a spiraling-down action of a column of water from the top of the clarifier through the mud to the bottom of the vessel, which would occur if a centrifugal pump were used. The water would penetrate the mud and exit the bottom of the clarifier with the solids waste, an expensive proposition for the aggregate producer, who wants to pump as thick and dry a quantity of material as feasible—to one remote site—and recover as much water as possible. The seepex unit enables this.

In the aggregate industry, most clarifier systems on the market are supplied without a mud pump. Thus, some producers will simply drag the waste manually with loaders from the vessel to the discharge area. Other producers have tried various pumps, besides the centrifugals. Positive displacement units used in the industry include maintenance-prone air operated diaphragm (AOD) pumps, which have a limited pumping range, and peristaltic units, which are significantly more costly to operate and maintain, requiring frequent hose replacements. They also are unable to transfer the mud over long distances.

Since 1995, at Johnson Sand & Gravel, the seepex unit has been pumping a 51-54% solids waste mud byproduct over hundreds of feet to one site, without manual handling, as in the past. Once moved, the mud continually dries, with clean water weeping into a pond. The dried mud is covered with topsoil and reclaimed for other uses. In addition, the pump has performed reliably, with low maintenance costs under harsh conditions. It has had only three stator replacements since its installation. Moreover, by integrating the durable, versatile PC unit into its clarifier system at the Johnson facility, Clearwater Industries can point out that its product has easily paid for itself in its first 1.5-2.5 years of operation. ■

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