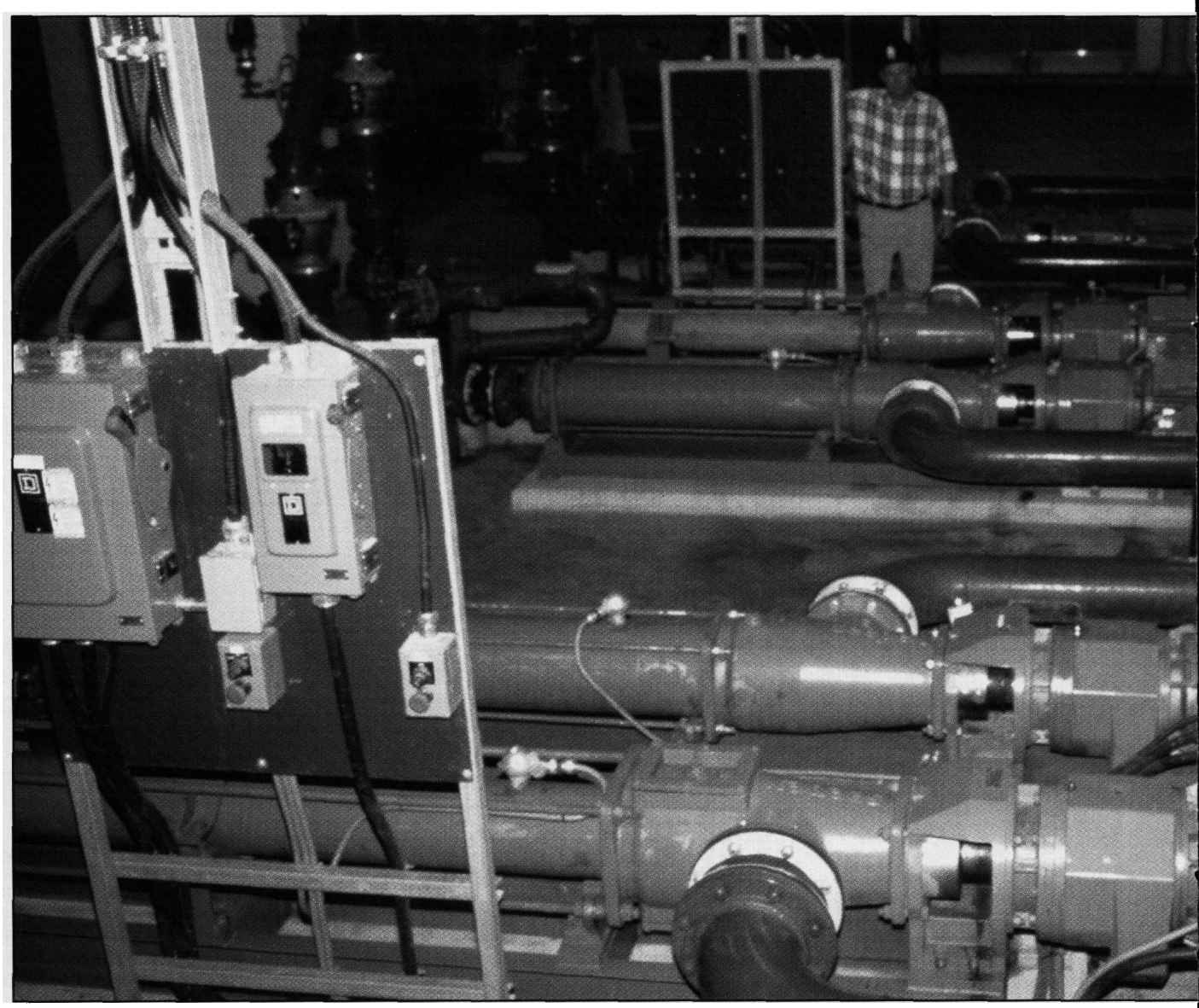
SLUDGE TRANSFER

By Ted Follest

Automating the Sludge Pumping/Polymer *Metering Systems*

The Duffin Creek Water Pollution Control Plant (WPCP), located near Toronto, Ontario, Canada, has installed a state-of-the-art, computer controlled system to regulate polymer injection rates. This installation was part of the plant's Phase II expansion project launched three years ago. The rates are regulated in relation to changing densities in the blended sludge during the sludge's transfer from holding tanks to dewatering filter presses.

The new system incorporates progressive cavity (PC) pumps for both polymer metering and sludge pumping. It proved so successful that it supplanted the WPCP's existing Phase I system that had been using piston pumps for sludge transfer and a different type of PC pump for the polymer. This switch has resulted in considerable cost savings.

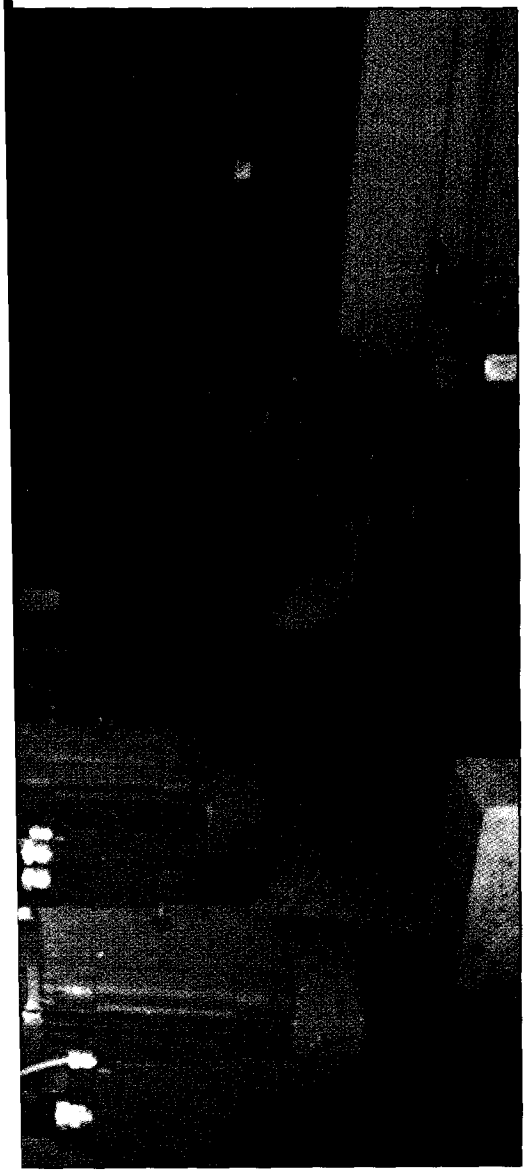


Duffin Creek WPCP

With an average capacity of 96.2 mgd and a peak capacity of 221.1 mgd, the Duffin Creek WPCP serves a population base of more than 250,000 people in the Regional Municipalities of York and Durham, bordering the eastern city limits of Toronto. The facility operates 24 hours a day, 365 days per year and is prepared to double its current capacity within a few years to meet projected population growth.

The plant uses a conventional activated-sludge process that produces a final treated effluent (not exceeding 25 mg/L of BOD5 and of suspended solids and 1.0 mg/L of total phosphorous) that is discharged into Lake Ontario. Sludge from the facility's eight primary clarifiers and four primary and four secondary anaerobic digesters (two of each now in use) is transferred to six holding tanks. There, the sludge is mechanically mixed at a ratio of about 70 percent raw water to 30 percent digested. From the holding tanks, the sludge (varying in density from 2 percent to 4 percent solids) is pumped to 11 diaphragm plate filter presses, where it is dewatered into a 30 percent-plus solids sludge cake.

Duffin Creek is currently the largest installation in Ontario using this type of press. It operates four 1,200 mm^2; four 1,500 mm^2 and three 2,000 mm^2 capacity presses, with a maximum combined output of 145 tons per day. From the presses, the sludge cake is transferred to two fluidized-bed incinerators for final reduction to inert ash that is disposed of off-site.



Sludge Pumping/Polymer Metering Problem

In the transfer of the blended sludge from the holding tanks to the filter presses the WPCP was experiencing costly pumping and chemical metering problems. For the past ten years the facility had been using hydraulic piston pumps to transfer the sludge, while the polymer was injected into the process at a predetermined, fixed rate by metering pumps. This system had two major drawbacks: the high maintenance/labor costs of the piston pumps and the over/underdosing of the polymer.

For example, the piston pumps were costing the plant between $45,000 and $50,000 per pump in parts and labor to overhaul, with about four major overhauls needed per year in its Phase I sludge treatment building.

These units were so maintenance-intensive that Duffin Creek had anticipated these problems by installing three piston pumps for every two filter presses, or twelve pumps for eight presses (four 1,200 mm^2 and four 1,500 mm^2). With this arrangement, the facility always had a backup pump ready, in case one of the piston units broke down.

Besides the overhauls, the pumps would lose their packing, causing sludge

◀ Switching to a system that uses progressive cavity pumps for both polymer metering and sludge pumping, the Duffin Creek Water Pollution Control Plant has realized considerable cost savings.

spillages requiring time-consuming clean-up and repacking operations. At any given time, the odds were that at least one piston pump was being serviced. The pumps would frequently produce pressure spikes in the sludge flow, resulting in inefficient loading and occasional damage to the presses.

In addition, since the polymer was being injected at a fixed rate, the WPCP was incurring needless expenditures for chemicals and energy due to variations in sludge density. When too much polymer was added to treat the sludge, the plant was wasting money on excess chemicals. When too little was added, the petroleum-based energy costs of incinerating the now more liquid sludge (less than 25 percent solids) would rise.

New System

When Duffin Creek's Phase II expansion was being planned, a new computer-controlled system was included to meter polymer into the blended sludge in relation to changes in its density. This was measured by the percent solids, while the sludge was being pumped to one of the facility's three new 2,000 mm^2 presses. Specifications for the system called for the use of six seepex PC pumps for sludge pumping, three for polymer injection and one for sludge sampling.

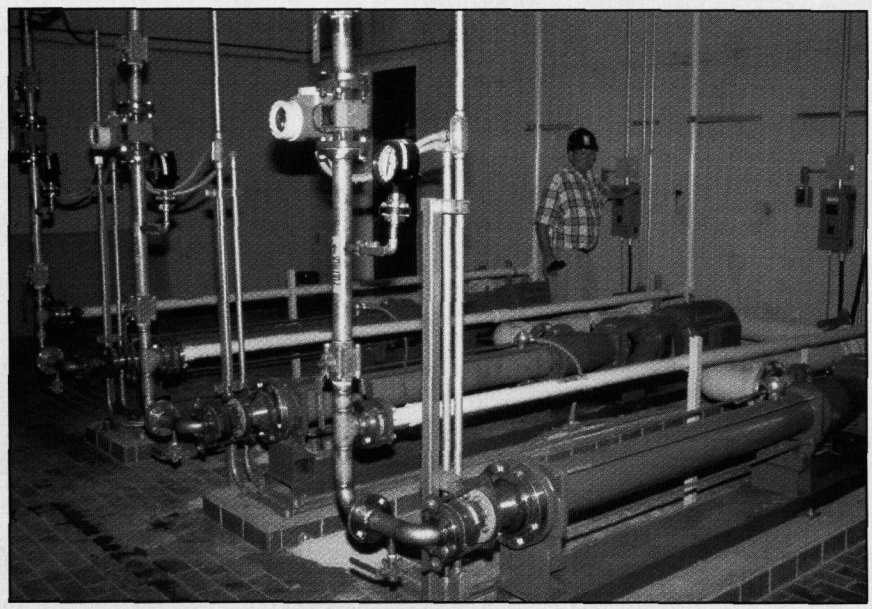
The sludge pumps are equipped with Duktil-coated hardened tool steel rotors; the polymer pumps, with stainless steel rotors. Each of the pumps is protected against dry running by a thermoelectronic sensing system.

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 length of the rotor/stator interface.

The new computer-controlled sludge-pumping/polymer-injection system at Duffin Creek now operates smoothly and efficiently. For each filter press a pair of PC pumps was installed (one with a variable speed drive (VSD); the second, or fill-in pump, with a two-speed motor). A metering pump with VSD is tied into each pair of sludge pumps and the press to inject flocculant into the blended sludge during the transfer process. The facility's laboratory periodically analyzes the sludge, determines the optimal polymer dosage rate, and enters that rate into the computer to control the metering pumps' output.

When a pumping cycle is initiated, a filter press closes up, sending a signal to start both its VSD sludge and metering pumps. After the maximum capacity of the first pump is reached, the fill-in pump is automatically activated to continue the transfer process. As the press fills up, the second pump shuts off, with the VSD unit finishing the cycle, maintaining steady pressure on the sludge to the press, even as the flow rate diminishes.

At the same time, a sample of the blended sludge from the holding tanks is transferred through a separate pipeline by



▲ Duffin Creek's Phase II blended sludge pumping operation proved so successful that the engineers decided to convert the Phase I piston-pump operation to the automated system.

the smaller PC pump to a nuclear density meter that continuously measures the percent of solids in the flow. These data are relayed to the computer. When the meter detects a higher or lower solids content than specified by the lab, the computer will compensate by increasing or decreasing the amount of polymer being injected, thus permitting the system to maintain the most cost-effective dosage rate.

Positive Results

Duffin Creek's Phase II blended sludge pumping operation proved so successful that they decided to convert its Phase I piston-pump operation to the automated system, with new units feeding its four 1,500 mm² presses, as well as for sludge sampling and, after further testing, polymer injection.

Before installing the piston pumps, the WPCP had been using a different type of PC pump to transfer the blended sludge. However, they found that the units' rotors and stators were wearing out after about three to four months. The process also had the added expense of using grinders to macerate the sludge before pumping.

During the retrofitting of its Phase I plant, Duffin Creek decided to evaluate its polymer injection system by running a side-by-side test of its existing PB metering pumps and the PC units being used in Phase II. Test findings showed that there was more slippage in the first PC pumps (also equipped with VSDs). This slippage led to fluctuating flow rates toward the end of a press's fill cycle, thereby decreasing press-loading efficiency. Therefore, these pumps were replaced.

Added Benefits

The new computerized blended-sludge/polymer-injection system has eliminated the high maintenance costs associated with the previous piston pumps. Excess dosage of chemical and increased energy usage for sludge-cake incineration have been slashed, saving the facility an estimated $1 million annually.

In addition, the new PC pumps have improved the work environment and employee morale by their almost noiseless operation, compared to the hammering sounds and vibration caused by the pulsating motion of the piston pumps.

Maintenance personnel also are pleased. The facility does not need to keep any spare PC pumps on hand, just one rotor and stator for each size pump. These parts can be changed in about four hours.

About the Author:
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