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Back Pressure Valve Solves Pump Problems

Effluent Pumps

The effluent from the Washington Wastewater Treatment Facility in Washington, N.C., is pumped to the Pamlico River. The river is near the coast and the level changes with the tides. Also, the river is subject to flooding on a frequent basis.

Engineers who designed the effluent system decided that the effluent should be pumped to the river since reliable gravity flow was not possible and because the effluent structure had to be elevated to prevent flooding of the plant. However, this design condition created problems.

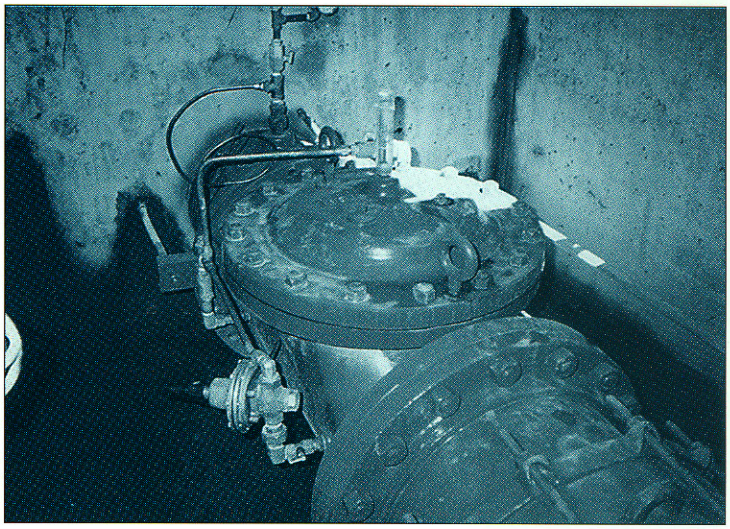
The effluent pumps ended up pumping the water downhill to an effluent diffuser several thousand feet away in the river. Widely varying head conditions created very difficult pumping conditions. Engineers were faced with the following problem: If the pumps are to deliver the needed capacity when the discharge head is the highest (when the river is high), what can be done to keep the pumps from cavitating when the river is low and the head is not high enough to maintain the pumps on their design curves?

There are a number of ways to solve this problem, including variable speed drives on the pumps, but the engineers decided to use a back pressure sustaining valve due to its simplicity, ease of maintenance and low cost.

Unfortunately, the valve selected for this application was a motor operated butterfly valve modulated by a pressure controller. Maintenance personnel soon found this arrangement to have several flaws. The motor operator was prone to electrical problems, the vault in which the valve was located was often under water which caused the valve to stop functioning, and the pressure control loop was not reliable. A more workable solution was needed.

It was decided that a totally hydraulic back pressure sustaining valve was a better solution. It would require no electrical service, would operate when the vault was flooded, would be easy to maintain and simple to adjust. It would automatically adjust for varying pressure conditions and maintain a constant back pressure on the effluent pumps.

This appeared to be the best overall solution, but there was still one pitfall that could have made this solution a failure.



A hydraulically operated, diaphragm type back pressure sustaining valve installed at the Washington (N.C.) Wastewater Treatment Facility. OCV model 108-2XS

The key was to select the correct type of hydraulic control valve. Basically, these valves fall into two major categories; the differential piston type and the diaphragm type. For this project it was critical that the diaphragm type be selected, because of the design of the differential piston type valves.

The differential type designs have a piston which has an area on the top of the piston which is approximately twice the area of the seat side. This provides a closing force which is almost double the opening force. At Washington, there was a back pressure in the effluent piping at high flows which is sufficient to cause a differential type valve to be forced shut by the pressure exerted on the top of the piston.

With a diaphragm type hydraulic valve, the area is the same on the top and the bottom of the diaphragm so the valve will fully open under all conditions where it is needed. Unfortunately, the differential piston type valve would close when it was most needed to be open.

In some cases, this can be resolved by opening the control pilot piping to atmosphere. This relieves the back pressure on the top of the piston and will allow the valve to function. However, this was not possible at Washington due to the flooding conditions and the fact that there was no place to dispose of the water which would have been discharged by the pilot piping. The city was in no position to handle the exhaust water and a differential piston type valve would have been the wrong choice.

The city decided to purchase a diaphragm type hydraulically operated valve from OCV Control Valves. The valve was installed by city maintenance personnel and was started up with the assistance of authorized OCV service staff. Once the valve was adjusted to the desired pressure conditions, it operated flawlessly.

The city has experienced no service problems since installation and the valve is in continuous operation. When the system back pressure is above the valve setting, the valve is fully open. Conversely, when the system sees low back pressures, the valve closes to generate just enough back pressure to hold the pump on the pump curve without cavitation.

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