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Cheng Fluid Systems

The device effectively reduces vibration, pressure drop and erosion

NEW IN-PIPE FLOW CONDITIONER CUTS FLUID PROBLEMS

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Based on principles originally developed in high-energy physics, the Cheng Rotary Vane (CRV) is being used successfully to reduce vibration at pumps at the Beaumont, Tex., plant of Du Pont. Magnetic-drive pumps had been installed there with a long-radius 90-deg elbow attached at the suction end. Turbulent flow entering the pumps caused vibration damage and reduced pumping efficiency.

Calculations showed that even a straight run of pipe less than eight pipe diameters long would still produce turbulent flow to the pump impeller, which is the cause of the vibration. The CRV unit (now installed) has eliminated the vibration and the pumps now provide a higher flowrate with increased head, while consuming less electrical energy to drive the pumps.

In particular, flow on one of the pumps increased from 1,086 gal/min to 1,135 gal/min after the CRV was installed. At the same time, the horsepower rating dropped from 43 to 40 hp, and the discharge pressure increased from 81 to 88 ft of head.

But the key benefit remains the reduced vibration, which obviated a more-than-$5,000 repair of the shaft and bearings of the pump each time it was needed. A severe-failure repair job is over $14,000 per occurrence. By comparison, the one-time purchase and installation of the CRV was about $4,000.

The CRV was developed by Cheng Fluid Systems, Inc. (Sunnyvale, Calif.), and is currently designed and manufactured by the firm. Recently (*CE* Aug., p. 17), Cheng and Koch Engineering Co. (Wichita, Kans.) signed a worldwide licensing agreement that would allow Koch to manufacture and supply the device throughout the CPI.

The CRV (above) looks very similar to a ship's or airplane's propeller, but its design is subtly different. It has a stationary set of vanes installed direct-

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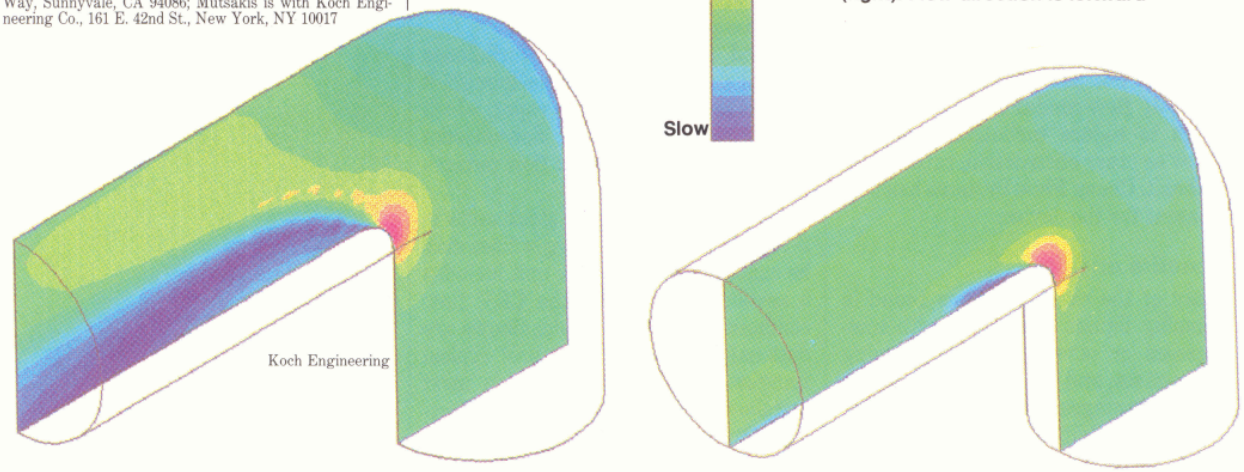

FIGURE. Flow simulations generated by a computational fluid-dynamics program show the reduction in turbulence between an elbow without the CRV (left) and with it (right). Flow direction is leftward

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Plant operators at Du Pont's Beaumont facility examine the pipe elbow (bottom of photo) where the CRV is installed, protecting a downstream mag-drive pump

ly ahead of a pipe elbow. The vanes precisely alter the characteristics of incoming flow to compensate for the turning effects of elbow geometry.

Regions of low-pressure turbulence (even reverse flow) exist at the perimeter of most elbows, due to the centrifugal effects of the bend, and the physical properties of the fluid being piped. When fluid flow is directed by the CRV so that it spirals through the bend, these turbulence zones are drastically reduced (Figure).

Looked at another way, there is a velocity profile that develops on a cross-section of the fluid going down a pipe: slower at the inside of any bend, and faster at the outside. The CRV smoothes this profile, so that more of the flow is moving at the same velocity.

This idea, while simple on the surface, has not been tried before. Most types of flow-conditioning devices attempt to reduce turbulence *after* an elbow or other obstruction, rather than before it. Cheng Fluid Systems has won a patent for the device.

Benefits multiply

Many of the same problems found in pumping liquids also occur with compressors or other machines pumping air or gases, and the CRV is believed to offer advantages in this type of service as well. In addition, the CRV can provide other benefits, or cure other pipe-flow problems:

- **Measurement accuracy.** Flow-monitoring instruments usually require low turbulence in order to make accurate measurements. With the flatter velocity profile, better measurements are possible
- **Elbow erosion.** Slurries or two-phase flows (like steam) are notorious for eroding pipe components. By smoothing flow through pipe bends, erosion can be substantially reduced
- **Water hammer.** Water hammer is a reverse-flow phenomenon — a pressure shock wave travels up a pipe in a direction opposite to the fluid flow. When a CRV is installed, its trailing edge can serve as a one-way damper that dissipates the shock wave
- **Fluid flashing.** When turbulence around a pipe bend is severe enough, it can cause fluid to flash to vapor, which can subsequently affect downstream process conditions. Better flow reduces the flashing conditions

CRVs are available as stock units in 2- to 12-in. diameters. (Larger sizes may be custom-designed.) The unit includes a section of pipe with the CRV flow conditioner mounted inside; elbows are optionally available, as are typical flanges or welding surfaces, in most metals. — *Cheng Fluid Systems, Sunnyvale, Calif.*

If you need more information or have any questions, contact Mr. Lee Kosla, our Vice President of Marketing, at (408) 720-8657, Fax: (408) 720-0166, or your local Cheng Fluid Systems Representative.