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Vortex Diode Pumps:
No Moving Part Pumping Systems

INTRODUCTION

NuVision Engineering, Inc. Power Fluidics™ Technology has been in use in the UK nuclear industry for more than 30 years and in the US nuclear industry for more than a decade. Power Fluidic™ devices are pumps, mixers, valves and samplers which have no moving parts in contact with the material they are processing.

BENEFITS OF POWER FLUIDICS

These systems are maintenance free and have number of cost and safety benefits when compared traditional mechanical systems including:
· Robust and reliable
· Can handle liquids, slurries and suspended solids (including debris)
· Modular and compact equipment
· Safe and efficient to meet ALARA
· Proven technology
· Cost-effective

Power Fluidics™ technology can be used to pump and control toxic, radioactive and other hazardous liquids and slurries.

· Standard industrial tooling interface
· Uses a variety of tools (saws, drills, grinder, etc.)

TECHNOLOGY- VORTEX DIODE

One example of Power Fluidics™ technology is the Vortex Diode, a highly reliable check-valve that can be employed when complete and immediate flow shut off is not required. The major advantages of the Vortex Diode over conventional alternatives are:
· No moving parts
· No maintenance requirement
· Ideal for aseptic and hazardous environments
· Improved reliability
· Blockage and erosion resistant

Operation of conventional check-valves relies up physical closure and the use of moving parts results reduced reliability. In contrast, the Vortex Diode utiliz the properties of the fluid itself to generate a grea resistance to flow in one direction and uses no movi parts, thereby improving reliability.

The Vortex Diode consists of:
· A vortex chamber
· An axial "forward flow" port
· A tangential "reverse flow" port

When compressed air is supplied to the upper Charge Vessel connection, its contents are driven towards the two Vortex Diodes.

The Drive diode is in the forward, LOW resistance mode, allowing slurry to enter the delivery pipe. Conversely, the Refill diode is in the HIGH resistance mode limiting flow back to the surrounding fluid. The effect is a net transfer of fluid into the delivery line.

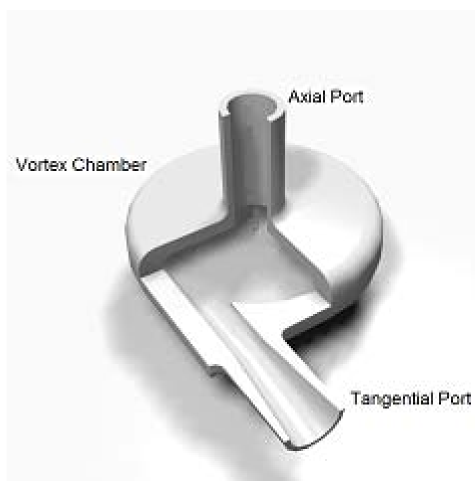

Figure 1—Vortex Diode

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The reverse is true when the supply of compressed air is removed or suction is applied. Process fluid now enters the Charge Vessel via the Refill diode. When the Charge Vessel is again full, the sequence can be repeated to continue the pumping process.

As with conventional check valve pumps, the flow from this Vortex Diode pump is pulsatile in nature, however, a grouped arrangement of four Vortex Diodes can be utilized to provide a continuous positive flow. The sequence of operation of a Vortex Diode is illustrated in Figure 2 and 3.

In the forward flow direction, the fluid enters via the axial port and encounters a relatively LOW resistance to flow that is approximately equivalent to two 90° bends.

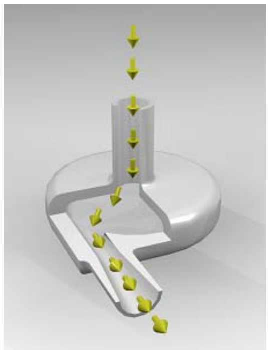

Figure 2—Forward Flow (Low Resistance)

In the reverse flow direction, the fluid enters via the tangential port producing a vortex in the central chamber. The high pressure drop associated with this vortex results in a HIGH resistance to flow.

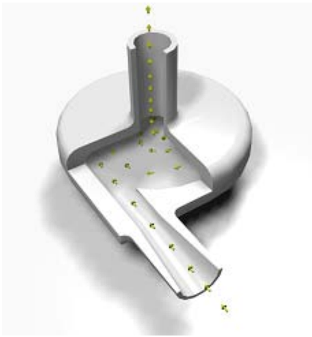

Figure 3—Reverse Flow (High Resistance)

The ratio of pressure drops in the reverse and forward flow directions can be in the order of 150:1. A typical Vortex Diode is shown below in Figure 4.

Figure 4—A Welded Vortex Diode

VORTEX DIODE PUMPING SYSTEMS

Vortex Diodes can be utilized in pumping systems that are similar in operation to conventional air driven check-valve pumps.

The simplest form of a Vortex Diode Pump consists of a Charge Vessel (CV) with upper and lower connections. Cyclic air pressure is applied at the upper connection resulting in fluid either entering or leaving, via the Vortex Diodes. See Figure 5.

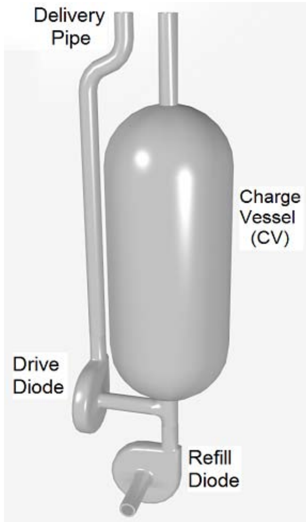

Figure 5—Vortex Diode Pump