VERSA-MATIC®
800 North Main Street
Mansfield, Ohio 44902
419-524-8388
www.versamatic.com

AODD Pump Efficiency
AirVantage™

By: Mark McCourt
Director of Innovation
Versa-Matic®

Contents

Introduction

This document addresses several energy saving solutions for AODD pumps and the methodologies in which they are applied.

Problem Statement

Air operated double diaphragm (AODD) pumps are known for their positive attributes of handling fluids that are heavily laden with solids, abrasive, shear sensitive (paints and coatings), and the ability to pump soft solids without damaging the solids. They are also used for their lightweight portability and ease of use due to pneumatic power. With the increasing awareness of energy costs and government and corporate goals to conserve energy, the pumping efficiency of AODD pumps has become a topic of discussion and a challenge for AODD pump customers. The IDEX Corporation's AODD Group has been engaged in the research and development of several methods of increasing the pumping efficiency of AODD pumps and reducing energy costs for customers by up to 50% which equates to millions of dollars in annual savings.

The current standard configurations for AODD pumps utilize compressed air or gas to drive the diaphragms to end of stroke. Compressed air management is performed by a mechanical system typically consisting of a pilot valve mechanism which provides a small flow of compressed air to actuate a larger valve that changes to flow path of the supply pressure which in turn changes the direction of the diaphragm movement. This reciprocation of motion creates the pumping action of the AODD pump. By design, standard AODD pumps change direction at the end of stroke. The compressed air is supplied to the inner chamber until the pilot valve is actuated at the end of stroke and then the main valve shifts and the

compressed air is exhausted from one inner chamber while the opposite inner chamber is being pressurized. This end of stroke exhaust sequence creates the scenario where excess compressed air energy is being exhausted without doing work before exhausted to atmosphere if the pump discharge pressure is relatively lower than the air pressure being supplied to actuate the pump. This is typically the case in most AODD pump applications. In the following information we will introduce a new technology.

AODD Pump Up-Sizing

One method to reduce energy consumed by AODD pumps is to increase the size of the pump for the same desired flow. This increases the pump efficiency of volume of liquid pumped per amount of compressed air consumed. Versa-Matic® has proven that the total cost of ownership of an AODD pump will be reduced by "up-sizing" the pump for the application.

AODD Pump Quick Exhaust Valves

Another way to reduce energy consumed by AODD pumps is with quick exhaust valves. By adding quick exhaust valves to AODD pump inner chambers, the actuation of the next pump stroke is made more efficient. This is accomplished by a change in the diaphragm deformation and in the amount of force required to begin the pump stroke.

AODD Pump Air Supply Restriction

Restricting the air supply to an AODD pump can also improve pumping efficiencies in certain applications. Versa-Matic® brand pumps have contained adjustable restrictors in the past, but that practice has been discontinued in recent years. Some Versa-Matic® pumps still contain fixed restrictors to increase efficiency. Adjustable air supply restriction can be applied if the air supply pressure, the flow and discharge pressure requirements remain relatively constant in the application and the restrictor can be adjusted to optimize the pump performance. Adjustable air supply restrictors will not work for pump application where any of the application parameters are subject to change. When the application changes, then the restrictor must be adjusted again in order to optimize the performance. Most pump applications have changing performance requirements throughout the pumping cycle and/or changing air supply pressure throughout the life of the pump.

Versa-Matic® AirVantage Technology

Versa-Matic®, Inc. has developed a new, patent pending technology that optimizes pump efficiency and utilizes adaptive optimization as pump application parameters change. This method maintains all of the positive attributes of AODD pumps while employing the latest control technology. The devices are electromechanically controlled utilizing a micro-processor and linear feedback system to monitor pump actuation and adjust the air supply according to the required performance, thus optimizing energy efficiency. The technology still allows for simple installation by integrating electrical power generation into the system, thus eliminating the need to provide electrical power to the AODD pump. The positive attribute of ease of installation for the customer

is therefore maintained. An optional power supply is available if preferred by the customer. The new technology is also fail-safe in the event of any failure within the device; the pump will operate as a standard AODD pump and will maintain the customer's processing objectives without interruption. By maintaining the robust characteristics of standard AODD pumps, this technology eliminates the risk of any increase in process down time for the customer due to the integration of this high tech solution.

The new energy reduction technology manipulates the air supply to obtain the same geometrical characteristics of pump operation and efficiency gains with respect to diaphragm deformation and force reduction at the beginning of the pump stroke as mentioned in the earlier methods. One of the key differences is that this new technology automatically adjusts to maintain optimum efficiency for different and changing pump application parameters. This is made possible through the application of a patented feedback technology that monitors the full range of motion of the diaphragm movement including position, velocity and acceleration. This information is read by the micro-processor and then associated algorithms are applied to control a valve system that manipulates the flow of air supplied to the pump. The air flow is manipulated in a fashion that allows for full air supply flow at the beginning of the pump stroke and then reduces the air supply flow at various points in the stroke that are dependent on the specific application parameters. This flexible supply flow reduction enables increased pump efficiency regardless of differing pump applications. As the pump discharge pressure, the air supply pressure and fluid viscosity changes, the system automatically adapts and optimizes the pump efficiency.

There is also no need for the customer to supply the operating parameters to the processor. The system contains a learning algorithm that learns the pump operation without air manipulation, as standard pump operation, and then starts the optimization process. The feedback and control system continually servos about the diaphragm velocity and enables continuous optimization for maximum energy savings across real world pump applications. The system will relearn as the application parameters change or the pump is placed into a new application, providing utmost ease of use for the customer.

The combination of adaptive optimization, self learning capability and integrated power generation advantages found in the new Versa-Matic® AirVantage enables customers to enjoy all of the positive attributes of traditional AODD pumps while still reducing energy costs. More information about AirVantage can be obtained by calling the Versa-Matic® Application Engineering Department at (419) 526-7296 or (419) 524-8388 at the www.airvantagepump.com.