DOWNLOAD PDF ENERGY SAVINGS WITH FLUID POWER SYSTEMS

Chapter 1 : Energies | Special Issue : Energy Efficiency and Controllability of Fluid Power Systems

Seminars teach energy saving One measure of the increased interest in saving energy is the enthusiasm for learning how to design efficient fluid power systems.

Leave a Comment Pumping systems account for about 20 percent of the energy electric motors use, and improvements such as a pump with integrated controls, as shown, represent a huge opportunity for savings. Photo courtesy of Armstrong Pumps Inc. Fluid pumping systems consume roughly 20 percent of the total electrical energy motors use in the U. S and worldwide, and 25 to 50 percent in certain industrial facilities. Clearly, pumping systems eat up a significant amount of electrical energy. One could argue that upgrading the motor or variable-speed drive VSD alone would be sufficient, because these components represent the greatest opportunity for energy savings in a pumping system. Indeed, many established incentive programs today focus on component efficiency. However, taking a component, rather than a whole-system, approach often saves far less energy than anticipated. Upgrading components individually saves up to just The average motor efficiency today is Pump efficiency improvements since have been minimal, about 4 percent. A more efficient pump system alone could save energy by improving the pump operationâ€"from the average 74 percent efficiency to 78 percent, which is a fairly aggressive efficiency gain. When VFDs are simply installed in an existing pumping system, the energy savings is 20 percent, on average. This component approach yields a total energy efficiency gain of However, the opportunity exists to achieve a lot moreâ€"82 percent energy reductionâ€"by taking a whole-system approach. Four Steps to a Whole-System Approach Figure 1 In a typical fluid pumping system, the actual delivered energy is only 18 percent because power is lost in the pump, piping, throttle, and motor. There are four areas to look for energy efficiencies in a typical secondary pumping system in a heating or cooling loop in a facility. If the pumping system was installed before perhaps 50 percent of the installed base today , it probably is of the three-way, constant-flow type. In one of these typical fluid pumping systems, 8 percent of the energy is wasted in the motor; about 29 percent is wasted in the piping that transfers the fluid to where it is needed; roughly 25 percent is wasted in throttling; and 20 percent is wasted in the pump. So the actual delivered energy is only 18 percent see Figure 1. That means that there is an 82 percent opportunity to reduce energy in the average pumping system. Energy efficiencies can be achieved in a typical closed-loop pumping system in the following areas: Most constant-speed, constant-flow systems have a throttling device that is throttling 15 percent. They have a throttle valve somewhere that just throttles the pump back. This throttling valve dissipates an estimated 15 percent of the pumping power. So the first area of opportunity is to install a VSD and open the throttling valve. Doing so improves efficiency by 15 percent see Figure 2. Many VSD systems operate today with the variable speed set at a constant reduced speed. Thirty years ago the standard pumping system for cooling was the constant-flow, constant-speed type. It was turned on and spent its entire life pumping away at the same flow and same pressure. Three-way valves basically controlled the flow. For systems with three-way valves, the second opportunity to gain efficiency is to make them variable-flow systems. The easiest way to do that is simply go into these three-way valves and close the bypass, rendering it a two-way valve. This step should net another 29 percent savings. Once a pump has been equipped with a VSD and an open-throttle valve, the next way to achieve energy savings is to control flow. Switching from constant speed to variable speed controls and maintains a constant pressure across the pump. This is considered by the heating and cooling industry to be the easiest method to control a VSD in a pumping system because the control sensors and wiring are all contained in the mechanical room. It is an easy system to install and troubleshoot. The pump delivers a constant pressure, although flow can vary. This realizes another 25 percent in energy savings. The last area is to have the system attuned to the true pumping demand of the system. This can be done by either placing the control sensor into the system itself, which can raise the cost of the control system and make troubleshooting more difficult, or by using an integrated pump control available in the marketplace just in the last decade only. This type of control senses the true system requirements through electronics present in the pump itself. Another 20 percent energy savings can be achieved here. So taking a whole-system approach can improve energy efficiency by 49 percent over a components approach. However, this does not allow for the power loss through the VSD control, although these devices are not percent efficient even at full load and are less efficient at part-load and reduced speed. The same applies to motors because motor efficiency is reduced as it runs at reduced load and reduced speed. In addition to these four areas, a number of other energy-saving opportunities are available. Changing the motor to a higher-efficiency one, right-sizing the pump, and optimizing the selection against load profile also will gain efficiencies. In a retrofit installation, a pump upgrade can increase pump efficiency by an additional 1 to 5 percent. These incentives are needed to ensure the upgrade of pumping systems. Most pumping systems today are directly rebated under the custom criteria, which is quite cumbersome. Prescriptive incentives applicable to pump systems have mostly been geared toward motors and VFDs, which encourage the component approach and save only a small percentage of the total savings available. Prescriptive incentives could be in the form of rebates based on: Pumping system upgrade type on a per installed HP basis Before and after power meter comparisons Installation of pumps with integrated controls Reduction of installed pumping horsepower Flat incentives per installed HP for impeller trimming, upgrading pump clearances, seal and bearing types Reduced discharge pressure The combination of prescriptive incentives, measures, validation programs, and tools for pumping systems has the potential to reduce the electrical energy consumption in North America by 5 percent. A Guide for Improved Energy Efficiency, Reliability, and Profitability, provides information on optimizing existing pumping systems and designing new pumping systems to run at optimum efficiency to reduce energy use. PSM also offers a day-long course, Pumping Systems Optimization, on fundamentals of doing a basic pump system assessment. For more information, visit www. Brent Ross is director of marketing for S.

Chapter 2 : Standard Energy-Saving Power Mini- Pack Systems (Inverter Motor) | ASHUN FLUID POWER

10 Tips for Saving Energy with Pneumatic Components and Systems. A renaissance in pneumatic automation technology today is creating the most productive, efficient, and flexible pneumatic motion actuation ever achieved.

Reducing the motor speed resulted in a steady proportional drop in power. The optimum speed was found to be rpm. Test results showing both direct-on-line operation and under drive control with a single actuation on the largest cylinder. The Corus Colours plant in Deeside, UK, where tests were carried out to establish whether VSDs would be a viable option for controlling energy consumption in hydraulic systems. Despite this, drives are not widely used in hydraulic installations, perhaps because the very impressive savings normally achievable in standard pump applications are not possible with the type of pump used in hydraulics. However, when Corus Colors , Deeside, UK looked closely at the issue, the company found that significant energy savings could be achieved. The aim of the study was to establish whether the drive would be a viable option for controlling energy consumption in hydraulic systems. The hydraulic system used during the trial is located on a production line used for retreating and inspecting strip material, driving actuators and web guiding systems in a hour process. The particular function used in this trial was the PID control, built into the ABB drive, which helps keep external values, like pressure, within certain limits. Pressure feedback is returned to the drive from a transducer. The drive automatically adjusts pump speed to maintain the system pressure. Saving potential Drives tend not to be used much on hydraulic systems, usually because the pressure is normally provided by a positive displacement pump, a type of pump that, theoretically, offers far less energy saving potential than the more common centrifugal pump. Unlike a centrifugal pump, which uses centrifugal force to throw fluid out through the discharge end of the pump, the positive displacement pump uses an internal mechanism that presses the fluid out. This means the output will be the same regardless of the resistance on the discharge side. The internal mechanism can be some type of gear or an arrangement with vanes. The installation at Corus Colors uses a positive displacement vane pump, driven by two 37 kW motors, one duty and one stand-by. Under pressure Positive displacement pumps are used in hydraulic systems because this type of pump can produce high pressure despite high system resistance. A centrifugal pump is far less effective working against a high system pressure. Because the pressure in a hydraulic system is very high, a centrifugal pump would not be able to pump much at all against this resistance. A positive displacement pump, in contrast, only shows a very small change of flow when the pressure goes up or down. However, the energy consumption of the positive displacement pump is not reduced when the system resistance drops. For this reason, it does not offer the same energy saving potential as centrifugal pumps at reduced speed. While the centrifugal pump offers energy savings equal to the cube of the speed reduction, a change in flow by the positive displacement pump produces a linear change in power usage. But despite using a positive displacement pump, Corus Colors achieved significant energy savings by retrofitting the existing system with a drive. The pump speed was greatly reduced both when the system was in neutral and during actuation of the cylinders. The installation was commissioned on a downshift as other maintenance was carried out on the production line. Vane pumps start losing their efficiency below rpm, as the vanes are held in position by centrifugal force, so the pump efficiency had to be monitored throughout the trial as the optimum speed was sought. This was eventually established to be rpm. Chew had concluded that leaving the drive just running in PID control would cause some unwanted side effects. The main issue was that a drop in pressure would be followed by an increase in motor speed in response to the pressure drop. The desired system pressure is 90 bar, while the maximum is 93 bar at full speed. As in many hydraulic systems, the on-load times are short. After actuation of the cylinders, the hydraulic system quickly settles back into neutral again. As the drive will have increased the motor speed rapidly to meet the drop in pressure, it is likely that it would overshoot the target of reaching a pressure of 90 bar, with the PID control having been set very high for a fast response. The system relief valve is activated at 93 bar so the system pressure will never get higher that this. As the drive only sees a small error in pressures of 3 bar, it may be slow to react. This means there will be a long transient time before the drive settles down to the required speed to maintain 90 bar in neutral and this will cause unnecessary waste of energy, sending excessive fluid back to the sump while the hydraulics are in neutral. Dual mode control The solution was to operate the drive in two modes, PID control and single-speed mode. The switching between the modes is controlled by the transistor output of the pressure transducer. When the hydraulic system is in neutral and the pressure is at the desired level, the drive runs at a single speed of rpm, the optimum speed established through the trial. When the system is operated and the pressure drops, the transducer switches the drive into PID control. The desired pressure set in the PID is 93 bar, the maximum pressure for the system, and the proportional control is set very high to ensure a rapid response from the drive. Once the pressure increases to 90 bar, the transducer will switch the drive back to single speed mode. This will prevent any overshoot in speed and reduce energy waste. Energy saving Once Chew had established the optimum speed, wired up the transducer and programmed the PID control, the installation was monitored for two days to compare the energy consumption between under drive control with direct-on-line operation. Energy consumption was measured before and after using an energy meter. When in neutral, power consumption was around 9 kW with direct-on-line operation. Reduced power An experiment was set up to test the hydraulics in direct-on-line operation and under drive control with a single actuation on the largest cylinder. This gave high sample rates over a short period of recording time. The drive was set up to run at a single speed of rpm to the mimic direct-on-line operation. The recording was then started and the cylinder actuated five times, once every five seconds. The procedure was then repeated with the drive in the dual mode setup with PID and single speed. The readings showed a similar performance between the two tests but a vast difference in energy consumption, the drive peaking at 20 kW while the system in direct-on-line mode peaked at 34 kW.

Chapter 3 : Energy savings for hydraulic systems - World Pumps

Many hydraulic systems are only required to deliver flow at pressure during certain stages in a machine cycle. This is even more prevalent in the theme park industry because we need time to reset the show or load and unload guests.

Chapter 4 : Energies | Special Issue : Energy Efficiency and Controllability of Fluid Power Systems

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Chapter 5 : Fluid pumping systems â€” low-hanging fruit for energy savings

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