Industrial Hydraulics

Methods and Tools to Identify, Compare, and Reduce Energy Losses in Industrial Hydraulics Systems

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Energy continues to be an area of major focus globally as populations increase, standards of living rise in high population areas and the reality that much of the needed energy today comes from non-renewable or problematic sources. Yet demand for the variety of human comforts such as transportation, HVAC and the myriad of products and services available are likely to also increase. This situation is a recipe for broad changes and it is not surprising that it is influencing industrial hydraulic systems.

A review of the electrical power consumption in the USA points out the significant position of electric motor power draw. With this awareness comes attention and potential government legislation to affect changes in the future. Hydraulic systems are prevalent in industry and are most commonly powered by electric motors so these changes would impact them, likely directing them to more efficient solutions.

Energy inefficiencies or losses in hydraulic systems are understood and quantifiable. They include losses in the prime mover or electric motor/drive, losses in the pump mechanism itself, line losses or pressure drops, valve throttling losses, actuator losses and cooling system energy usage. The valve throttling losses in particular are very dependent on the hydraulic system approach selected. These losses can be estimated quite well by considering the difference between the pump operating P-Q condition versus the actual useful work being done at the actuators.

There are a number of possible system approaches that are being used in industrial hydraulic systems today. These include fixed pump and variable pump systems, pressure compensated pumps, load sensing pumps, displacement control pumps, fixed speed and variable speed motor drives, multiple pump systems and combinations of the above. Each of these approaches has its own characteristics that can be summarized quite well by the resulting P-Q operating condition on the pumps. Armed with this information one can estimate each of the contributing areas of energy loss in the various system approaches and use this information to do a comparative study.

One other important element here is machine duty cycle. Industrial equipment is designed and built to do a specific job and do it precisely and consistently. This duty cycle is a signature of that process, machine and part. This cycle impacts the operational points of the equipment and can greatly influence the power draw requirement and associated losses. By combining knowledge on the areas and size of losses, the impact on various hydraulic system approaches and the specific machine duty cycle, one can create very useful tools for comparative analysis and decision making. Program choices exist today which can be used to create a tool which can complete these studies – Excel, Automation Studios and Matlab-Simulink are just a few. An Excel-based tool will be considered to highlight this overall process.