IMPROVING THE ENERGY EFFICIENCY IN MOBILE HYDRAULICS

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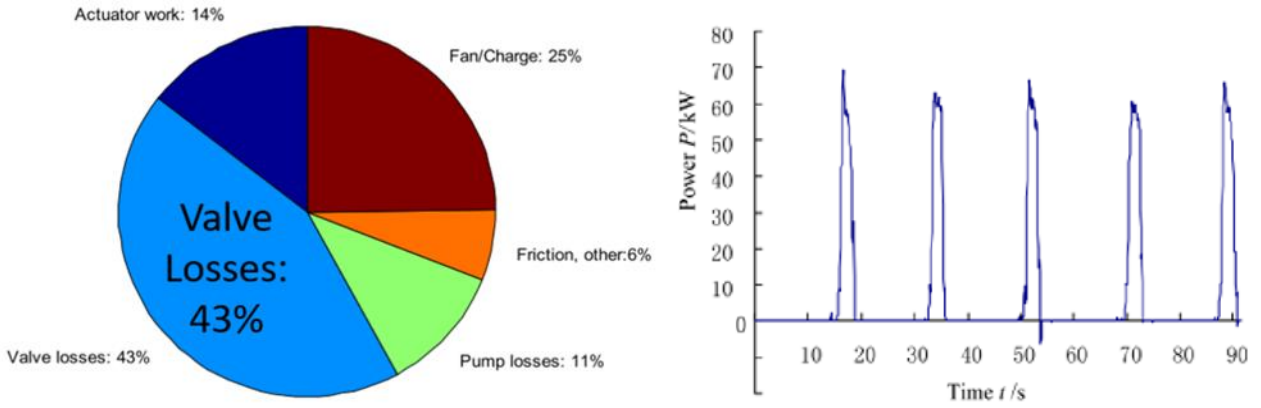
For fluid power applications, despite the robust functionality, conventional hydraulic systems still suffer from low efficiency and inevitable emissions from the traditional power source (e.g, combustion engine). According to the report from the Department of Energy (2012), USA, mobile hydraulic applications in the US market have an average efficiency of only about 21%. The main sources of these inefficiencies are the throttling losses associated with the regulation of the actuator velocity as well as the waste of potential recoverable energy, as shown in fig. 1. Figure 1, a shows the energy losses of mobile applications. Figure 1, b shows that the energy that can potentially be regenerated during one duty cycle from the boom, arm, bucket, and swing is as high as 260.4 kJ. In detail, for mobile applications such as in construction and agriculture, machines such as excavators, wheel loaders, cranes, and agricultural tractors typically use centralized hydraulic architectures.



a b

Figure 1 – Main sources of mobile hydraulic inefficiencies

A limited number of supply pumps are utilized to power multiple hydraulic actuators, with architectures based on hydraulic control valves that introduce throttling losses. Further-more, during the assistive phase of the duty cycle, a centralized system inevitably dissipates the energy entering the system from the actuator. Therefore, to improve hydraulic system efficiency, reducing throttling losses and increasing energy recuperation are the key strategies.

A dedicated electrified hydraulic drive not only allows energy recuperation, it also enables minimizing throttling losses. For mobile hydraulic applications, the potential energy is usually dissipated in a steady working phase, such as lowering the boom. During this overrunning loading phase, the energy can be easily stored in electrical equipment, such as a battery, thus making the mobile hydraulics attractive for an electrified solution. Throttling losses can be minimized by decentralizing fluid power systems. The actuation speed of a decentralized system is not traditionally regulated by throttle valves but depends on the flow source regulation.

This can be achieved in an electrified hydraulic system by using the electric motor as a prime mover.