Making Hydraulic Machines More Efficient

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Hydraulic equipment such as diggers, (US: backhoes), cranes, telehandlers, trenchers and pile-drivers currently depend on having a constant supply of hydraulic fluid at high pressure, typically 2000 to 3500 Bar (30,000 to 50,000 psi). This is maintained by using a diesel engine to pump the fluid into a hydraulic accumulator. Once the fluid in the accumulator is up to pressure, a pressure relief valve spills back excess fluid into the supply reservoir. The engine speed automatically adjusts to maintain the pressure when working, but during idle periods, the speed reduces to its minimum, but still some fluid is pumped up to pressure and returns to the reservoir via the spillback valve. This costs energy (diesel fuel) for no useful purpose. This wastes diesel fuel, and during most operations, the hydraulic system spends perhaps 20% of the time idling, and less than 10% requiring the full output of the pump. All the time, the engine continually speeds up and slows down, which also consumes energy and contributes to engine wear.

It is possible to design a hydraulic system that does not depend on a hydraulic accumulator. The diesel engine runs at constant speed, the speed at which it is most efficient, driving an electric alternator; a control system automatically adjusts the fuel supply to maintain this constant speed. The controls for the hydraulic functions are electrical and adjust the speeds and directions of electrically driven hydraulic gear pumps that deliver fluid to the various actuators. When the pressure in a particular hydraulic cylinder needs to reduce, the gear pump reverses direction and the pressure generates electrical power that can be stored in a vehicle propulsion battery; the power can thus be recycled and used again for other actuations. The battery has a charge control system that maintains the average charge level at around two-thirds; this means that there is always capacity for both delivering power and absorbing excess.

A hydraulic machine that uses this system will perform the same largely manually controlled operation with about 40% of the fuel consumption, (i.e. a 60% reduction), when compared with current machines. Operators will find that the action of the machine is much less jerky and significantly more precise, which is far less stressful for the operator. Because of this, less rework is required and so most operations are significantly quicker. Lesser savings in the region of 15% are expected with highly automated operations such as trenching and pipe laying. Most types of hydraulic machine will be far quieter leading to better acceptance in populated areas.

Initial estimates suggest that such a machine will be slightly less costly to manufacture, and long term servicing and life-cycle costs will reduce significantly.

