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OFF-ROAD DIESEL ENGINES
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HYBRID EQUIPMENT
Hybrid is a term we hear in our everyday lives to describe everything from automobiles to vegetables. In the construction industry, hybrid is used to reference any equipment type that has two power sources, or equipment that can collect, store and reuse energy. No matter how the term hybrid is defined, the technology allows manufacturers to use smaller, more efficient engines to achieve fuel savings.

Hydraulic and electrical regenerative energy systems are used in hybrid construction equipment. These energy systems can be used separately or together to reduce the load on hydraulic pumps and to generate electricity to run pumps, motors and other electrical systems. The energy produced by the hybrid systems can help reduce the load on the diesel engines. Diesel engines are able to operate at lower revolutions per minute (RPMs), which translates into lower fuel consumption and fuel costs. Fuel savings vary depending on the equipment type and the job it performs. Komatsu and Caterpillar, manufacturers of hybrid equipment, cite considerable fuel savings for their hybrid models when compared to diesel systems performing similar tasks.

According to Komatsu, “the HB215LC-1 hybrid model saves an average of 25 percent in fuel consumption and a like amount in emissions.” Caterpillar states that its D7E Crawler Dozer averages “10 to 30 percent less fuel burned per hour.”

Hydraulic Hybrids, like the Caterpillar 336E H Excavator, use hydraulic regenerative braking. Hydraulic regenerative braking is a technology that converts kinetic energy into hydraulic energy and stores the pressure to be used during an energy-saving mode, which reduces energy and fuel costs.

Electric Hybrids use an electric motor or generator to move the excavator arm. The motor acts as a generator when the swing arm is slowed or stopped. During the braking process, the motor is reversed, which allows the motor to generate electricity. This electrical energy is then stored in a battery or capacitor and later released to help the swing arm’s acceleration. The Komatsu HB215LC-1 Hybrid Excavator is an example of construction equipment that utilizes this technology.

Diesel-Electric technology has been around since the beginning of the 20th century and was historically used in large mining equipment, cranes, locomotives and marine vessels. This technology has been adapted and is now emerging in smaller construction equipment. Diesel-electric hybrid technology is being used in crawler dozers, wheel loaders and asphalt pavers.
Diesel-electric equipment converts mechanical energy into electrical energy. The diesel-electric equipment eliminates the need for traditional torque converters, transmissions and drive trains for generators and drive motors. The diesel engine powers a generator, which in turn produces electrical energy to power the drive motors, hydraulic pumps and other electrical operating systems. These diesel-electric systems can reduce fuel consumption and emissions. According to Caterpillar, "fuel savings for its D7E Crawler Dozer are estimated to be between 10 percent and 30 percent, depending on the application." Equipment World highlights that fuel savings for Komatsu’s HB215LC-1 and Deere’s 644K Electric Hybrid Wheel Loader average 40 percent and 25 percent better fuel economy, respectively. Additionally, the diesel-electric system uses fewer moving parts, which will result in fewer repairs and service for the equipment.

**Electric-Heated Screeds** are being used with hot-mix asphalt to comply with the 2014 EPA regulations. Screeds are metal plates used to flatten and smooth recently laid asphalt mix. The paver's screed is heated in order to keep the hot-mix material pliable and deliver a better and smoother finish. Historically, depending on the size of the paver, screens have been heated with both propane and fuel oil, but the new screens are equipped with a diesel-powered generator. The electricity produced by the diesel-powered generator is used to heat the electric elements attached to the screed. These systems provide more control to the operator, increased fuel savings, reduced emissions and can minimize warping to the screed plates. The emissions reduction has been noted positively by government entities, especially with pavers used in populated areas.

**PRICE VS. FUEL SAVINGS**

Fuel-savings estimates vary among manufacturers, as does the premium one can expect to pay for hybrid equipment manufactured with the advanced technology. Equipment World reports that the Komatsu hybrid excavator is getting 40 percent better fuel economy than similar conventional excavators, and Deere's Hybrid Wheel Loader is averaging 25 percent fuel savings. Engineering News-Record highlights that for hybrid excavators, “the premium on the machine can rise well above 20 percent.”

Before purchasing one of these units, careful consideration must be made when determining the upfront costs and long-term benefits. Buyers must consider fuel savings compared to the additional cost associated with the technology, maintenance, service intervals, reliability, application, manufacturers warranty, resale value and anticipated useful life.

**CONCLUSION**

It is expected that the National Highway Traffic Safety Administration (NHTSA) and EPA government agencies will announce additional regulations for the transportation industry in March 2015. Historically, proposed off-road engine regulations—which are seen in the construction and agriculture industries—as well as regulations on generators, pumps and compressors, are released shortly after transportation regulations. Since manufacturers will be forced to comply with government standards, industry experts believe that the stricter regulations will result in more advanced hybrid technology and more fuel-efficient engines with cleaner run-off-road engines. It is also expected that end users will look to purchase hybrid equipment, in order to cut fuel costs and meet clean air standards.

End users have access to both hybrid and non-hybrid equipment that meet current federal standards. Demand by end users is currently mixed, as they must consider the reliability of the new technology, equipment costs and fuel savings. Currently, demand is difficult to predict; however, it is expected that demand will become more predictable once end users have had the chance to use and evaluate the equipment. Time will allow end users to determine how the hybrid equipment compares to previous models.

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