

A TRUE HEAVY-DUTY HYBRID

Deutz, Heinzmann, Atlas-Weyhausen team up to develop prototype hybrid wheel loader

By Roberta Prandi



Deutz, Atlas-Weyhausen and Heinzmann have joined together to develop a prototype of a hybrid wheel loader. The Atlas AR 65-Hybrid uses a Deutz diesel engine and electric motor-generator, and controls from Heinzmann to provide machine propulsion functions with a fuel economy improvement estimated in the range of 15 to 20% over conventional machines.

Answering to the question whether future developments of diesel-electric hybrid would be limited to passenger cars, municipal vehicles and buses operating in urban areas, three German companies — Deutz, Atlas-Weyhausen and Heinzmann — have joined forces for the development of a prototype hybrid wheel loader.

Walter Burow, head of electronic control systems at Deutz AG, explained that loaders are an ideal application for hybrid drives. "The result of the combination between

diesel engine and electric engine assures a very dynamic but efficient performance," Burow said. "Hybrid drives are ideal in applications with low average power but high peak requirements for a short time, such as loaders.

"The same applies for forklifts, excavators and other special vehicles like airport tow trucks where, again, a great short-time traction effort, but low average power, is needed."

Burow added that, for the same reason, hybrid drive systems would probably not be a suitable alternative propulsion technology for machines

such as drilling vehicles, agricultural tractors or harvesters, as these operate mostly under full load.

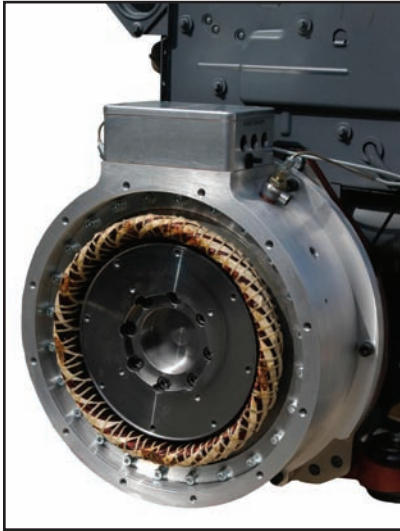
The system introduced on the Atlas AR 65-Hybrid loader by Atlas-Weyhausen is a "mild" hybrid drive, with a motor-generator installed in the powertrain between the diesel engine and hydraulic pump that is only assisting the main engine. Among the specific advantages on a wheel loader application, Burow noted that the diesel engine could be downsized in comparison with a conventional installation. When combined with the opportunity to choose the most efficient engine in relation to the operating mode, the result is reduced fuel consumption and exhaust emissions.

In automotive applications, the fuel savings of hybrids over conventional drive systems has been estimated to be as high as 30%. For the wheel loader system, Deutz calculated improvements in the range of 15 to 20%.

An electronic control unit manages the functions of the hybrid-drive system. It provides:

Automatic start and stop of the engine. As machines of this type spend about 15% of their operating time idling, the electronic control shuts down the engine when idling and restarts it quickly upon load request, also eliminating the need for a starter motor. Deutz reported that the engine is started within 0.5 seconds from when the operator touches the accelerator pedal, moves the drive joystick or turns the steering wheel. The function includes a safety interlock, leaving the engine shut down if the driver is not in the seat.

Power boost. The electric motor boosts the power and torque of the diesel engine, whenever needed.



The Heinzmann electric motor-generator replaces the flywheel in the Deutz 2011 diesel engine used in the hybrid wheel loader. There is only a negligible difference in the unit's length, meaning no redesign of the engine compartment was required.

Battery charging. When the diesel engine does not provide its peak power to the loader, the electric motor works as a generator and recharges the battery.

Energy recovery. The electric motor-generator also recovers braking energy to recharge the battery.

For this application Deutz supplied a four-cylinder naturally aspirated D 2011 L4 engine rated 36.9 kW at 2100 r/min.

Heinzmann, the manufacturer of mechanical and electronic speed controls, supplied the motor-generator, which was developed from an existing electric motor. The unit is directly mounted on the crankshaft of the diesel and it is compact (160 mm long), practically taking the place of the diesel engine flywheel. Heinzmann reported that the electric motor supplies 10 kW nominal and up to 30 kW maximum output.

The lithium-ion battery was developed and manufactured by U.K.-based company Axeon, a specialist in battery technology for automotive and consumer applications.

Looking at the technology, Burow indicated that "the disadvantage is cost.

"The price for components, especially for the battery, is still very high," he said. "But we are sure that the prices will go down in the medium term, due to the increasing volumes of the automotive industry."

As the technology is the same as that used for the automotive hybrids, the batteries would be already available and the high numbers supported by the passenger car and bus markets could result in an economy of scale very attractive for off-highway OEMs.

The hybrid wheel loader project began at the end of October 2006. "We looked for existing components and how they were working," said

Burow. "The electric motor needed to be adapted and encased in a new housing; the battery supplied by Axeon was already existing as a basic technology.

"Deutz needed to work on the electronics, the operating strategies, the safety issues, the software. The diesel motor is the same as a standard one. The difference in length with the addition of the electric unit is negligible, which resulted in no redesign of the machine. Thus, we got the hybrid loader running in a very short time."

The next step is seen as the development of a full hybrid version, where several electric motors can be used to drive all of the vehicle's functions. "Can you imagine a loader that works inside a building, or a tow tractor that takes the airplane into an hangar?" Burow said. "The vehicle can be powered electrically when inside with zero exhaust emissions, and when outside, the diesel engine recharges the battery." ♦

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