Electric trailer axles - Making the most out of wasted energy

Many manufacturers are now investing heavily in electric or hybrid trucks to reduce the emissions stemming from moving freight by road.

Broadly speaking electric vehicles fall into three main categories:

- Battery electric vehicles: Powered by electricity stored in a battery pack and recharged externally. They also recover energy when the vehicle is in use to recharge the batteries.
- Plug-in hybrids: Combine a petrol or diesel engine with an electric motor and large rechargeable battery. Some of these also have an external charging facility.
- Fuel cell vehicles: Convert the energy in oxygen and hydrogen into electrons that power an electric drive motor and charge a high voltage battery.

Advances in technology plus increasing environmental awareness means that electric trucks will become more and more popular. Many suppliers into the New Zealand market are now offering hybrids in their lighter truck range as off the shelf options.

One thing though that has not been commonly discussed is the fitting of electric axles to trailers.

At the 2018 IAA Commercial Vehicle exhibition in Hannover Bosch launched an electrified trailer axle for semi-trailers. Other major axle manufacturers have similar products available.

How do electric trailer axles work?

The principle behind these is quite simple, they capture the energy that is created when a trailer is rolling freely along the road and use this to generate electric energy to charge an onboard lithium-ion battery or high storage capacitor, typical storage voltage is 400 volts. This electrical energy can then be used to power trailer mounted electrical equipment such as fridge units and hydraulics thus reducing the carbon footprint created when this equipment is used. Energy can also be captured when braking to further enhance the storage of electrical energy. The generator that captures this energy can also be used as a motor to drive a trailer axle. Because the drive to the axle is not required all the time, generally only when starting and ascending hills, surplus energy can be generated and used for powering other trailer mounted equipment.

It is worth recalling that a generator converts mechanical energy into electrical power, it can also be the same device that converts electrical power into mechanical energy. A generator should not be confused with an alternator, although they do the same thing, convert mechanical energy into electrical energy, an alternator cannot become a motor without extensive rework.

The benefits

Tests conducted by Bosch suggest that a fridge unit operated by electricity generated by recovering wasted energy can save 9,000 litres of fuel each year, that's about 24,000 kg of C02 emissions, (burning one litre of diesel produces 2.68 kg of CO2).

A report in the February 2020 edition of Transport Engineer[1] suggests that a trailer equipped with a 22kwh lithium-ion battery charged by recovery energy from the last axle in a tri-axle set could deliver 200Nm of torque to drive the axle. It is claimed that this could result in fuel savings of between 4 and 18%.

A further benefit claimed for fitting motor driven trailer axles is that it enables the trailer to be moved around yard or storage facility without the need to couple it to a prime mover.

Design

There is no clear design direction yet. Some manufacturers prefer to have a generator/motor driving each wheel whilst others have a single motor delivering power through a centrally mounted differential as shown in this image[2]. Both designs provide for each wheel to be driven independently when required such as when going around a corner. Ultimately it may come down to cost and consumer choice.

Downside

Electric trailer axles and their associated equipment will increase the tare weight of the unit reducing pay load. Estimates suggest this additional weight could be at least a tonne.

Summary

Innovation will be the key as the industry comes under greater pressure to reduce its carbon footprint, capturing and using the wasted energy generated as a trailer moves along the road could be one of the innovations.

[1] http://www.transportengineer.org.uk/transport-engineer-features/running-gear-battery-boost/223446

[2] Image retrieved, 26 June 2020 from http://www.globaltrailermag.com/news/article/saf-holland-responds-to-electrification-trend