GREEN MAGNETIZABLE COMPOSITE FOR WIRELESS ELECTRIC VEHICLE CHARGING

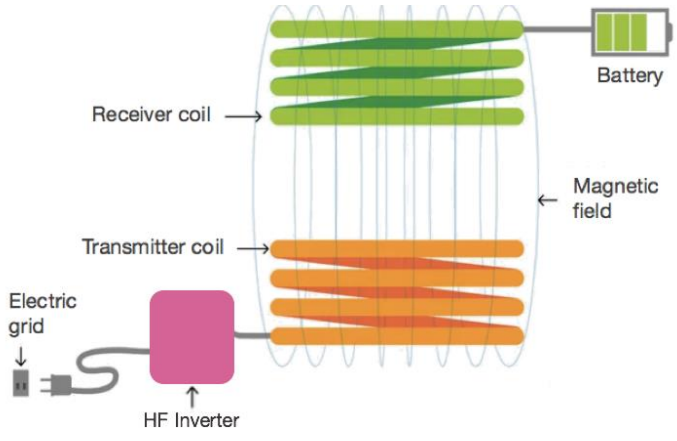
INTRODUCTION

Worldwide the adoption of electric vehicles (EVs) is gaining pace, bringing the charging infrastructure into focus. So far charge points for EVs have been plug-in devices, which work but are not very convenient. More recently fast charging plug-in devices have been introduced, which reduce the charging time, but still compare unfavourably with the refueling experience with ICE (internal combustion engine) cars. A far more convenient method is to charge the EV's batteries with Wireless (inductive) Power Transfer. Charging without a cord means that EVs can charge their batteries anywhere anytime, not only when they are stationary but also when they are in motion. In the rapidly approaching world of Autonomous (self-driving) Vehicles and Transport as a Service (TaaS) wireless battery charging will become essential.

HOW IT WORKS

Wireless charging of EVs is a rapidly evolving emerging technology. In a nutshell this is how it works:

1. An electric current from the grid is fed through the transmitter coil, which is on the ground or integrated in the pavement;
2. The current in the transmitter coil generates a magnetic field
3. The magnetic field induces a current in the receiving coil, which is tuned to the same frequency.



Schematic of wireless charging system *

* Courtesy of VOX MAGAZINE. www.vox.com

Fig. 2 EV charge in motion

A handful of companies already offer commercial solutions for stationary wireless charging, while the vehicle is parked. Although this is a recent development, charge rates and efficiencies are expected to rival plug-in fast chargers.

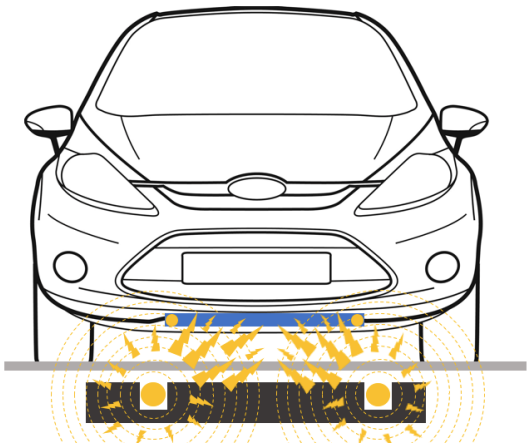


Fig. 3 Ferrimagnetic substrate focusing

However, wireless charging holds its greatest promise in dynamic charging, while the vehicle is in motion.

In order to do wireless charging of EVs at high efficiency a focused magnetic field is required between transmitter and receiver, which necessitates a high permeability of the primary coil substrate.

The conventional approach is to do this with ceramic ferrite components. Due to the size of the primary coil (up to a square meter or more) and the fact that ferrite is brittle, this is an expensive and impractical solution to put into road pavements. Because of their costs plastoferrites are not an option either. They also suffer from lower permeability and would not be dimensionally stable at high temperatures. All other soft magnetic materials (metal powder or amorphous metals) do not come into consideration due to high costs and limitations with respect to the size of the components.

MAGNETIC SUBSTRATE THAT BEHAVES LIKE THE ROAD

Fig. 4 Highest efficiency with embedded coil

A new material has been developed, which is a magnetizable composite called Magment. This patented material has the mechanical properties of concrete, thus making it durable and compatible with materials currently used in road pavements. This overcomes one of the biggest hurdles for the adoption of pavement-based charging pads and dynamic charging systems. Magment makes the charging unit as robust as the pavement whilst also protecting the road's structural performance.

Magment's magnetic properties are similar to ceramic ferrite. Although the permeabi-lity (μ) of Magment is lower than of ceramic ferrite, tests have demonstrated that virtually the same power transfer efficiency can be achieved for the same geometry. However, with Magment novel substrate shapes are feasible that boost the power transfer efficiency even further. This in combination with Magment's proprietary Metamaterial Magnetic Field Concentrator makes our wireless charging modules the most efficient in the industry. What's more, Magment's modules have the lowest level of stray emissions.

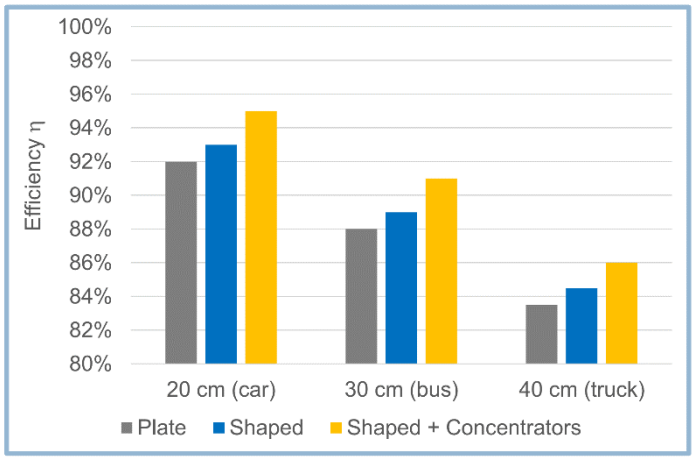


Fig. 5 Transmitter-pickup coil distance for different electrical vehicles

MAGMENT: ENVIRONMENTALLY FRIENDLY AND EASY TO USE

The magnetic properties of Magment are generated by ferrite particles used as magnetic filler in a cement matrix. These ferrite particles are obtained from recycled material from the ferrite industry and from the rapidly growing mount of electronic waste.

Just like normal concrete Magment can be supplied in pre-cast panels or cast in situ. There is no need to apply pressure or heat during the production process. This makes the application of Magment fully compatible with conventional road construction practices.

VERSATILITY

Magment is equally suitable for both stationary and dynamic wireless charging. The load bearing properties of Magment make it not only suitable for wireless charging of passenger cars, but also of busses, vans and trucks.

Due to its lower density (reduced weight) the Magment material is also attractive for use in the wireless power receiver on board of vehicles.

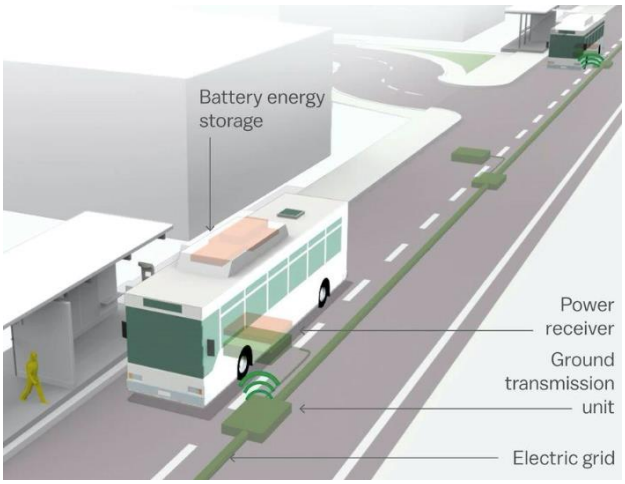


Fig. 6 Wireless charging at the bus stop**

For more information please contact us: ev@magment.de

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