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Feasibility analysis and development of on-road charging solutions for future electric vehicles

Magnetizable concretes as a competitive and road integrable solution to increase the efficiency and/or coil distance for DWPT

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Agenda

1. Technology
   - Material properties
     - Physical
     - Electromagnetic
   - Processing
     - Dry premixing of recycled magnetic materials
     - Wet mixing for site-casting

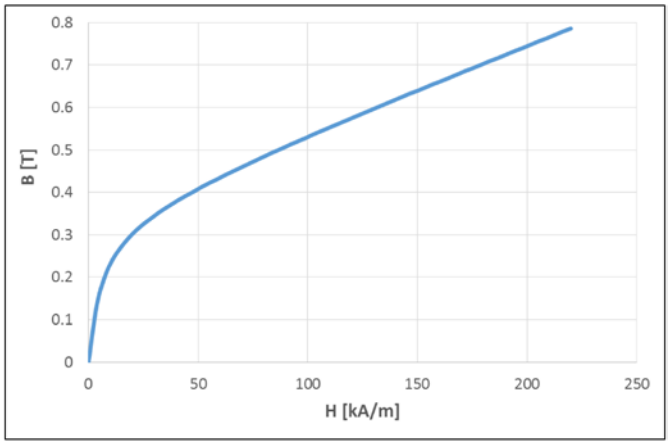
2. Applications
   - Wireless power transmission (static & dynamic)
   - Power inductors & transformers
   - EMC
   - …and many others

Magnetizable Concretes

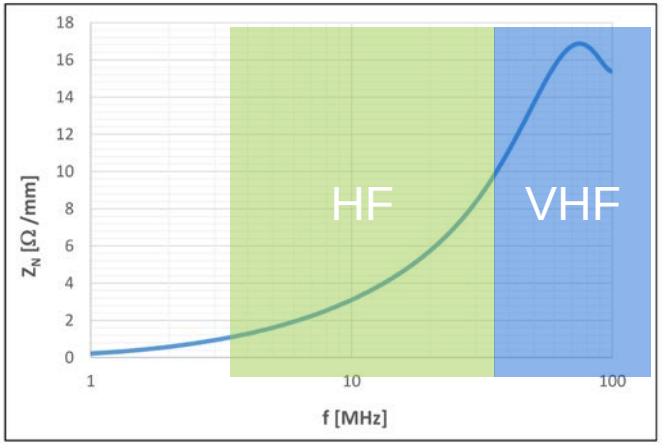
- **Composite** material based on a matrix loaded with magnetisable particles having a suitable size distribution.
- **Grades**:
  - Magnetic Cement (MC) in a special cement matrix
  - Magnetic Asphalt (MA) in a special bitumen matrix
- **Features**:
  - Very high magnetisable particle filling (up to 95 wt-%)
  - Highest magnetic permeability for a composite material
  - Very competitive magnetic material (filler obtained by recycling)
  - Robust material while fully integrable into existing structures
  - Rugged magnetic structures of unlimited size
  - Focus LF magnetic fields and absorbs HF/VHF/UHF radiation
- **IP**: covered by international patents in all target markets

Material Properties MC40

Initial permeability	@ 25°C	μ_i		40 ± 10%
Curie-Temperature		T_C	[°C]	> 210
Resistivity	DC	ρ	[Ω m]	20
Density		γ	[kg/m³]	3750
Realtive core losses	@ 50kHz 100mT	P_V	[kW/m³]	300
Specific heat		c_p	[J/kg K]	700
Thermal conductivity		λ	[W/mK]	3
Young's modulus		E_c	[MPa]	25000
Compressive strength		f_c	[MPa]	20
Tensile strength		f_t	[MPa]	2



Approach to flux density saturation over applied magnetic field



Normalized impedance vs frequency for noise radiation absorption

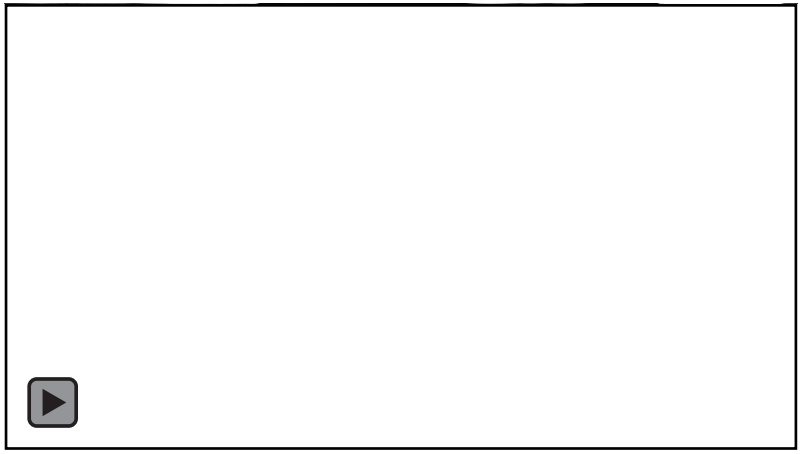
Processing 1

- Magnetisable particles are obtained through defined recycling and processing of scrap magnetic materials
- Dry premixing with special cement or bitumen for ready-to-use concrete

MAGMENT concretes require defined separation of scrap residue and electronic parts

Processing 2

- In-situ wet mixing of premixed concrete with conventional cement mixer equipment



- Automatic or manual site-casting with usual curing times for cement or asphalt concretes

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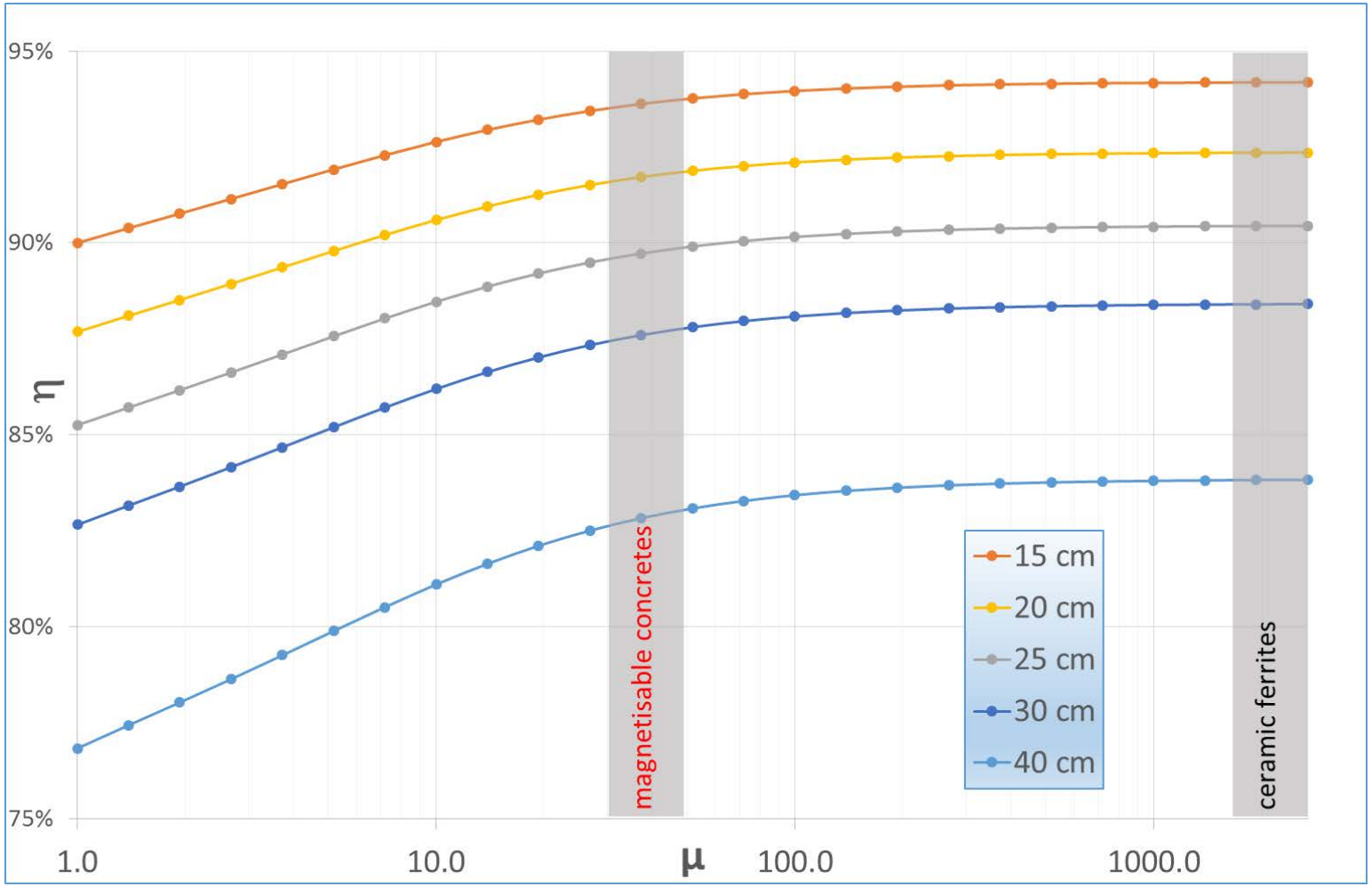
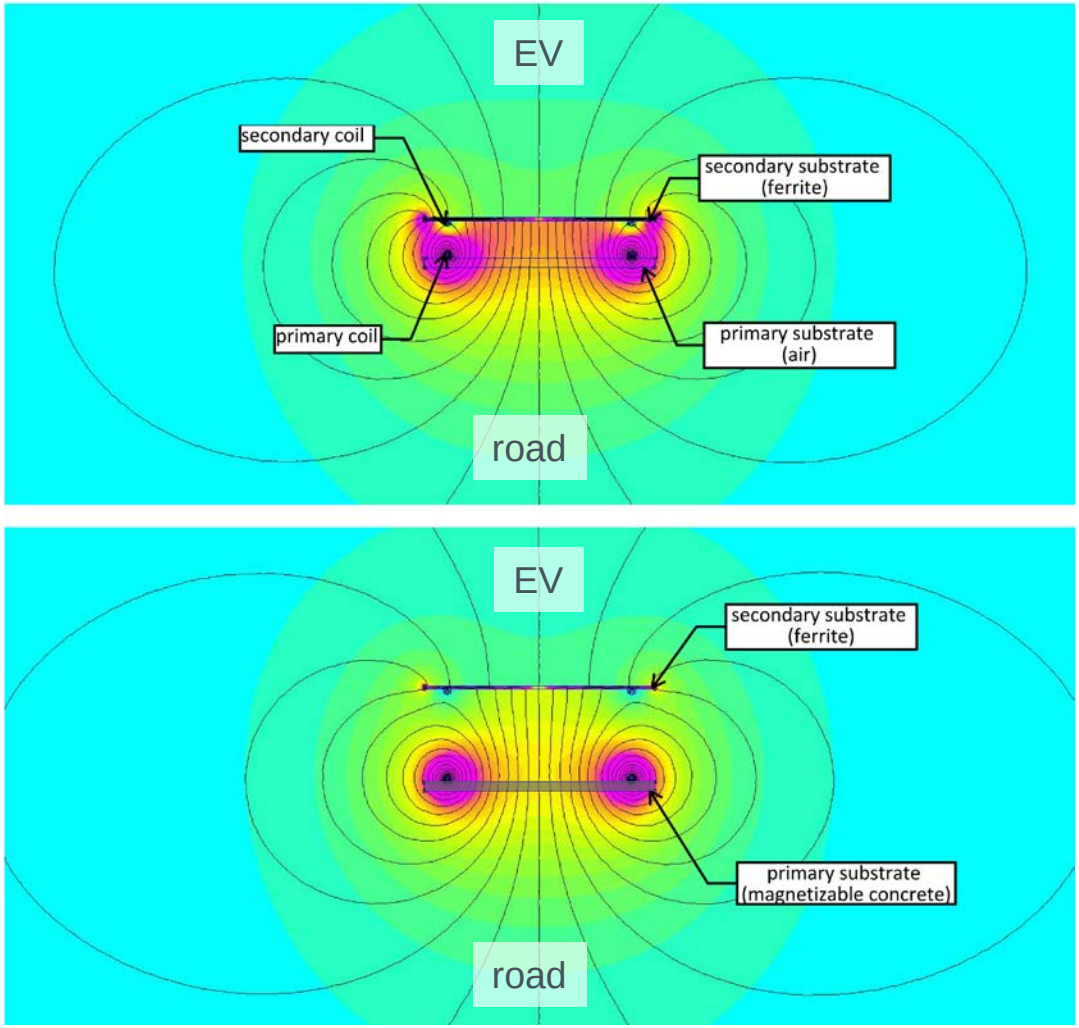
Wireless Power Transmission (WPT) 1



Efficiency vs. magnetic permeability of the primary coil substrate for different distances to the pick-up coil

Wireless Power Transmission (WPT) 2



coil distance

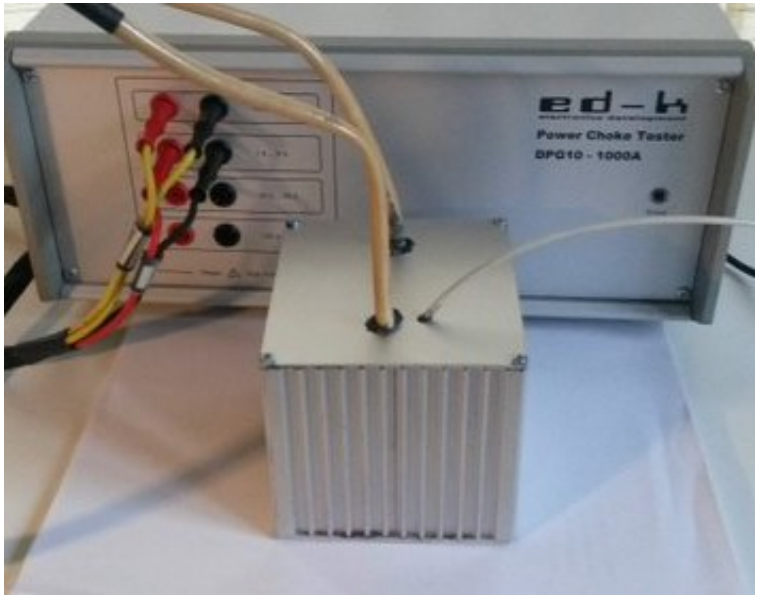
15 cm
μ=1

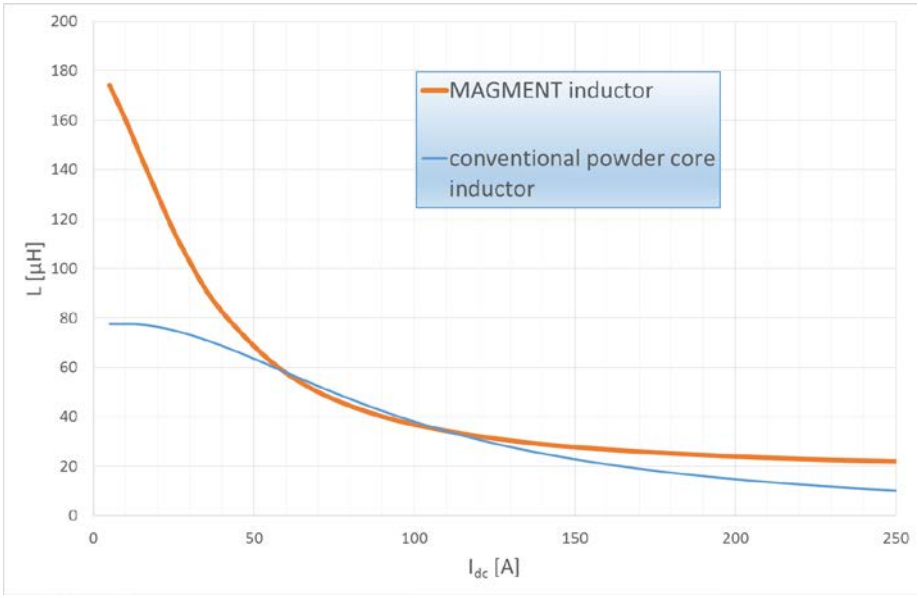
40 cm
μ=40

Magnetic field distribution for different coil distances and permeabilities of the primary coil substrate

Inductors for Power Conversion

- Power inverters used to convert energy for applications such as WPT, photovoltaic and UPS require large chokes. MAGMENT allows to make these components with unprecedent performance/cost ratio. This is a valuable contribution to the economical viability of large scale WPT.





Inductancs vs. load current for a power choke used in a 100 kW inverter

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Thank you!

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