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

<table>
<thead>
<tr>
<th>Property</th>
<th>Symbol</th>
<th>Unit</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Initial permeability</td>
<td>$\mu_i$</td>
<td></td>
<td>$40 \pm 10%$</td>
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<tr>
<td>Curie-Temperature</td>
<td>$T_C$</td>
<td>°C</td>
<td>$&gt; 210$</td>
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<tr>
<td>Resistivity</td>
<td>$\rho$</td>
<td>[Ω m]</td>
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<tr>
<td>Density</td>
<td>$\gamma$</td>
<td>[kg/m³]</td>
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<tr>
<td>Relative core losses</td>
<td>$P_V$</td>
<td>[kW/m³]</td>
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<tr>
<td>Specific heat</td>
<td>$c_p$</td>
<td>[J/kg K]</td>
<td>700</td>
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<tr>
<td>Thermal conductivity</td>
<td>$\lambda$</td>
<td>[W/mK]</td>
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<tr>
<td>Young's modulus</td>
<td>$E_c$</td>
<td>[MPa]</td>
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<tr>
<td>Compressive strength</td>
<td>$f_c$</td>
<td>[MPa]</td>
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<tr>
<td>Tensile strength</td>
<td>$f_t$</td>
<td>[MPa]</td>
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</table>

**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
Wireless Power Transmission (WPT) 1

Efficiency vs. magnetic permeability of the primary coil substrate for different distances to the pick-up coil
Magnetic field distribution for different coil distances and permeabilities of the primary coil substrate

Wireless Power Transmission (WPT) 2

coil distance

15 cm  \( \mu=1 \)

40 cm  \( \mu=40 \)

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 unprecedented performance/cost ratio. This is a valuable contribution to the economical viability of large scale WPT.
Thank you!

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