Effects of fillers on the properties of liquid silicone rubbers (LSRs)

Yu, Liyun; Vudayagiri, Sindhu; Zakaria, Shamsul Bin; Skov, Anne Ladegaard

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Effects of Fillers Depend On

Particle Size
- >10μm: Degradants
- 1-10μm: Diluents
- 0.1-1μm: Semi-reinforcing
- 0.01-0.1μm: Reinforcing

Particle Surface Area
- Smaller is Better

Particle Shape
- Broader (and Longer) is Better
- Platy
- Fiber
- Acicular
- Cluster

Particle Surface Activity
- (Compatibility With/Adhesion To Matrix)
- More is Better
- Poor contact
- Good contact
- Bonded
- Matrix wetting
- Matrix adhesion

Particle Size
- Smaller is Better

Particle Surface Area
- Bigger is Better
SiO\textsubscript{2} reinforces the networks with no increase in permittivity (\(\varepsilon_{r,\text{SiO}_2} \sim 3.9\)).

The inhomogeneous compatibility of the unmodified multiwalled carbon nanotubes (MWCNTs) causes the risk of conductivity.

Micron-sized CaCu\textsubscript{3}Ti\textsubscript{4}O\textsubscript{12} CCTO (\(\varepsilon_{r,\text{CCTO}} \sim 10000\)) decreases the mechanical properties of the composites.
1.2.3 Effects of fillers on the properties of liquid silicone rubbers (LSRs)

L.Y. Yu, S. Vudayagiri, S. Zakaria, A.L. Skov*
Technical University of Denmark
al@kt.dtu.dk

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Nano-sized: 25-250nm
Spherical particle

Rutile \( \varepsilon_r : 114-180 \)

Hydrophobic: modified polysiloxane

<table>
<thead>
<tr>
<th></th>
<th>Tear strength (N/mm)</th>
<th>Relative permittivity ( \varepsilon_r @ 0.1\text{Hz} )</th>
<th>Young’s modulus ( Y ) (MPa)</th>
<th>Breakdown strength (V/( \mu \text{m} ))</th>
</tr>
</thead>
<tbody>
<tr>
<td>LSR</td>
<td>6.6</td>
<td>2.8</td>
<td>0.8</td>
<td>130</td>
</tr>
<tr>
<td>LSR/TiO(_2)</td>
<td>20</td>
<td>5.5</td>
<td>1.0</td>
<td>150</td>
</tr>
</tbody>
</table>