Design and simulation of Piezotires Using Comsol multiphysics 4.3b software

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Outlines:-

- Introduction.
- Working principle.
- Designing procedure.
- Results and Simulation.
- Conclusion.
Introduction

Access to electricity has become a major problem. In the process of solving this problem we should consider every small source of electrical energy.

There are different sources of renewable energy such as solar, wind, tidal… for energy generation. Apart from these piezoelectric devices are those which provide electric potential naturally on applying stress.
Piezotyres

Piezoelectric effect + Tyres
Piezoelectric effect

Natural Wonder

- Mechanical stress causes the charge separation in the individual atoms of the material.
- Any spatially separated charge will result in an electric field, and therefore an electric potential.
Natural wonder       Man Made Wonder
Shape of tyre when not installed to vehicle

Shape, when installed to vehicle

Deformation at tyre and road interface
This Idea is implemented in Comsol multiphysics software
Physical Interface :-

Solid Mechanics (solid)
And
Piezoelectric Devices (pzd)

Parameters :-

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<thead>
<tr>
<th>Name</th>
<th>Expression</th>
<th>Value</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>s0</td>
<td>6[Pa]</td>
<td>6.0000Pa</td>
<td>Stress</td>
</tr>
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</table>

Geometry Details :-

Radius :- 0.5m
Height :- 0.2m
DESIGNING PROCESS
MATERIALS

- STEEL
- NYLON
- LEAD ZIRCONATE TITANATE (PZT-5H)
Results

Deformation obtained :-

At the road tyre interface a maximum deformation of $45 \times 10^{-21} \text{ m}$
Electric potential generated.

For the resulting deformation the potential obtained is \( 8.21v \)
Simulation

In simulation thickness of piezo electric layer is changed. The thickness of the layer is 0.01m reduced to 0.005m.

Deformation after simulation at road-tyre interface $25 \times 10^{-8}$
Electric potential after simulation

A potential of 20.52v is developed after changing the thickness of piezo electric layer.
Future scope :-

✓ The energy generated from piezotyres can be stored into batteries, this increases upto 50% backup capacity of them.

✓ MEMS technology can be used in designing of piezoelectric layer in the tyre so that efficiency can be increased a lot.
Conclusion :-

Though we generate small amount of energy. This is very valuable at present Scenario
Piezoelectric effect is an excellent property, we should design devices that make use of this property to generate energy.
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We were privileged to experience a sustained enthusiastic and involved interest from his side.
Your Queries Please!!!
thank you