Energy Dissipation in Conductive Polymeric Fiber Bundles: Simulation Effort

Dorci Lee Torres-Velázquez
Advisor: Dr. Jorge Santiago-Avilés
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University of Pennsylvania
B is the magnetic field.

I is the current through the beam.

$|F| = K IB$ is the resulting Lorentz force.
Outlines

- Electrospinning
- Polymers
- Friction
Electrospinning
Polymers

Examples of conductive polymers
Friction

Definition

a. For every stress there is a unique equilibrium value for strain, and vice versa.

b. The equilibrium response is achieved only after the passage of sufficient time.

c. The stress strain relationship is linear.

Fig. 1-8. The free decay of natural vibrations of an anelastic solid.
Mathematical Model

- **Differential Equation**
  \[ \frac{\partial^2 U}{\partial t^2} = C^2 \frac{\partial^2 U}{\partial x^2}; C = \sqrt{\frac{T}{P}} \]

- **Initial Conditions**
  \[ U(\omega,0) = f(x); \frac{\partial U}{\partial t} (x,0) = g(x) \]

- **Boundary Conditions**
  \[ U(0,t) = U(l,t) = 0 \]
Differential Equation Solution

\[ U(\omega) = \frac{F(\omega) / K_{\text{eff}}}{\sqrt{(\omega^2 - \omega_0^2)^2 - \left(\frac{\omega \ast \omega_0}{Q}\right)^2}} \]

\[ F(\omega) = A \ast \cos(\omega t) \]

- \( Q \) = Quality Factor
- \( \omega = 2\pi f \)

Constant values:
- Initial frequency = 70 Hz
- \( K_{\text{eff}} \) = Spring Constant = 1N/m
Results

Quality Factor = $10^5$
Frequency = $10^5$ Hz
Force Amplitude = 0 N to 100 N in steps of 0.2 N
Vibrational Amplitude as dependent on Quality Factor and Frequency

Force Amplitude = 0.1 N
Frequency = $10^5$ Hz
Quality Factor = 0 to 100 in steps of 10 units.

Quality Factor = $10^5$
Force Amplitude = 0.1 N
Frequency = 0 Hz to 1000 Hz in steps of 5 Hz
Vibrational Amplitude as dependent on frequency and Force Amplitude

Quality Factor = $10^5$
Force amplitude = 1 N to 100 N in steps of 1 N
Frequency = 1 Hz to 100 Hz in steps of 1 Hz
Vibrational amplitude as dependent on frequency and Quality Factor

Force Amplitude = 0.1 N
Frequency = 1 Hz to 100 Hz in steps of 0.5 Hz
Quality Factor = 1 to 100 in steps of 0.5 units
Vibrational amplitude as dependent on Quality Factor and Force Amplitude

Frequency = $10^5$ Hz
Quality Factor = 1 to 100 in steps of 1 units
Force Amplitude = 1 N to 100 N in steps of 1 N
Conclusions

Was developed a computational model that generate graphs about the functional dependence of the Vibrational Amplitude.

The model was based in a equation that represents the Vibrational Amplitude of a double clamped beam as function on Force Amplitude, Quality Factor and frequency.

For the case of Vibrational Amplitude as dependent on Force Amplitude, the model developed a graph that shows that the Vibrational Amplitude is proportional to the Force Amplitude.
Conclusions (cont.)

For the cases of Vibrational Amplitude as dependent on frequency the model developed a graph that shows that the vibrational amplitude is higher when the system is driven at low frequencies.
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