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Category : PHYSICAL SCIENCE

Level : Middle Level

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Title :

Generation of Electrical Energy from Road Using Piezoelectric Effect

Abstract

- What piezoelectricity is.
- The idea of generating electricity from road traffic pressure.
- Brief methodology (piezo discs under a panel, rectifier, capacitor, load).
- Key findings (tiny but measurable energy).
- Applications (streetlights, sensors, energy harvesting).

Introduction & Principle

- Define **piezoelectric effect** (mechanical stress → electric charge).
- Piezoelectric effect is a fascinating phenomenon where certain material generate an electric charge response to mechanical stress ,such as pressure or vibration . This effect is reversible, meaning that when an electric field is applied to these materials, they can change shape or produce mechanical stress.
- Real-world uses (sensors, lighters, ultrasound, etc.).
- Motivation: rising energy demand, renewable energy.
- Concept: embedding piezoelectric materials in roads to harvest energy from vehicles.

Aim & Hypothesis

Aim: To study how piezoelectric discs can generate electricity from road/foot pressure.

Hypothesis: If a road surface with piezoelectric discs is pressed by wheels/footsteps, then measurable electrical energy can be harvested and stored.

Materials & Methods

- **Materials**: Piezo discs, wooden/plywood base, rubber sheet, diodes (rectifier), capacitor, multimeter, wires, load (LED).
- **Setup**: Piezo discs arranged under a small panel → rectifier → capacitor → LED.
- **Method**: Apply pressure (steps/weights), measure voltage, record capacitor charging, calculate energy.
- **Diagram**: (Insert the **model diagram** we prepared).

6. Data analysis : Example table: expected data :

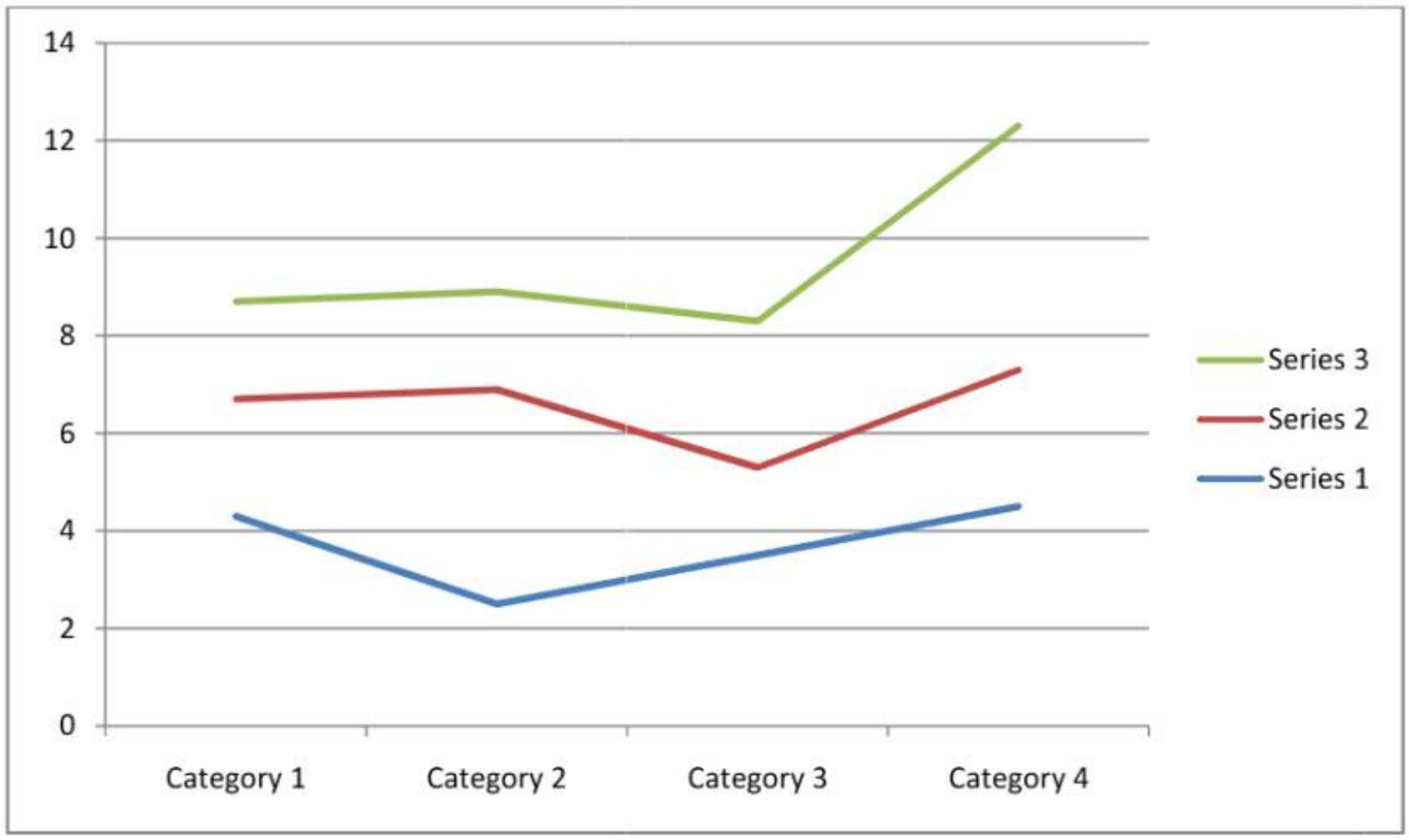
Constant : NH HIGHWAY

Variable : VEHICLES

Non variable : ENERGY GENERATION

	Capacitance (µF)	Voltage (V)	Energy (µJ)
10	10	0.6	0.5
50	10	1.2	7.2
100	10	2.0	20.0

Graph: **Voltage vs Presses, Energy vs Presses.**



Calculations :

Formula:

$$E = \frac{1}{2} \times C \times V^2$$

Worked example: If $C = 10\mu F$ and $V = 2.0V$:

$$E = 0.5 \times 10 \times 10^{-6} \times (2.0)^2 = 20\mu J$$

Observations & Limitations

- Small-scale demo produces **tiny energy** (enough to light LED briefly).
- More discs in series/parallel → higher output.
- Road traffic can provide repeated stress, but durability and cost are challenges.
- Large-scale real application still experimental.

Conclusion

- Piezoelectric effect can convert mechanical road vibrations into electricity.
- Useful for **low-power devices** (sensors, LEDs, wireless transmitters).
- Potential applications:
    - Smart roads with sensors.
    - Self-powered streetlights.
    - Traffic monitoring.

Further research in process ..