Applications of Piezoelectric Technology for Renewable Energy

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Introduction

Piezoelectric energy harvesters have long been of technical interest, but their cost-performance ratio was not attractive.

Recently, newer applications, especially those using new nanometer-scale-materials have suggested that piezoelectrics can become attractive for selective renewable energy applications.

What is Piezoelectricity?

Piezoelectricity comes from the Greek word *piez* which means to squeeze, press, or apply pressure, and the later part of the word, electricity. Piezoelectricity can be defined as electricity produced by applying pressure.

More explicitly it is ability for certain crystalline materials to produce on electric potential proportional to the applied mechanical stress along the crystal.

Objectives

- Ways to implement piezoelectric devices as energy harvesters in Calvin College and in the country, Nigeria.
- Analyze the cost-performance ratio, and the payback period of applications. Low-cost, efficient materials were the focus of the study, to allow efficient cost-performance ratio and a shorter pay back period.
- A project proposal will then be established for implementing applications. If approved the projects would be carried out at specified locations.

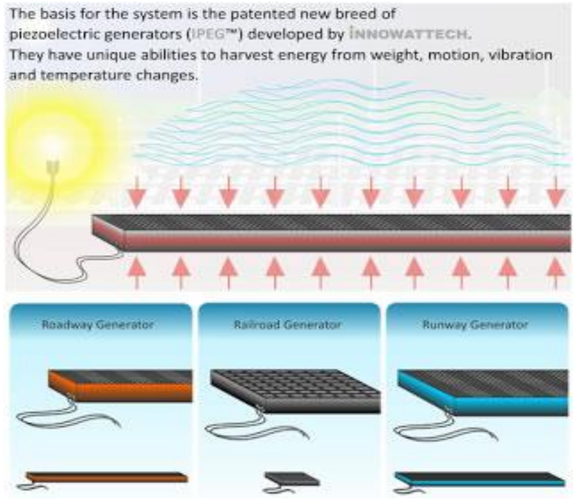
Nigeria

Method:

- The idea was to implement piezoelectric generators about five inches below the asphalt roads to generate energy from car movements.
- The generators were thought of being applied in the roads in the city of Lagos, due to the heavy amount of traffic in the city.
- The energy generated was to be used to power up street lights.

Results:

- The infrastructure for installing, maintaining and repairing piezoelectric systems does not exist yet in Nigeria.
- The proposed switch from asphalt to concrete roads would delay the project.
- Critically, while Nigeria transforms from a 30%-electrified to a 100%-electrified country, care must be taken to provide windows for renewable energies like solar, wind, and piezoelectric to enter when they are appropriate.



Transportation piezoelectric tiles designed by Innowattech

Calvin College

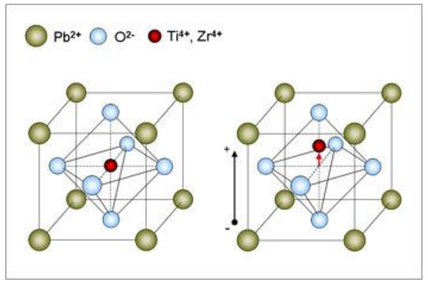
Method:

- The general idea was to install PZT (Lead Zirconate Titanate) tiles on a high-traffic stairwell in the Science Building.
- The energy generated was to be used to run sensors and/or the elevator in the Science Building.
- PZT tiles were thought to be used because they are strong, unreactive, and inexpensive to manufacture. They also have high sensitivity and higher operating temperatures than most piezoelectric materials.

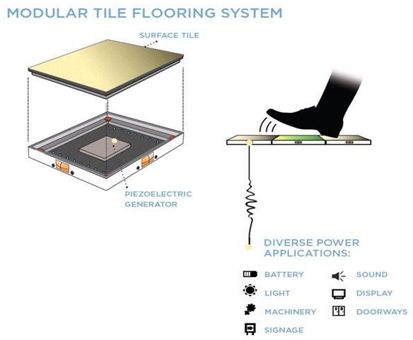
Results:

Energy produced would be below 17kWh/year leaving the pay back period to be over a thousand years.

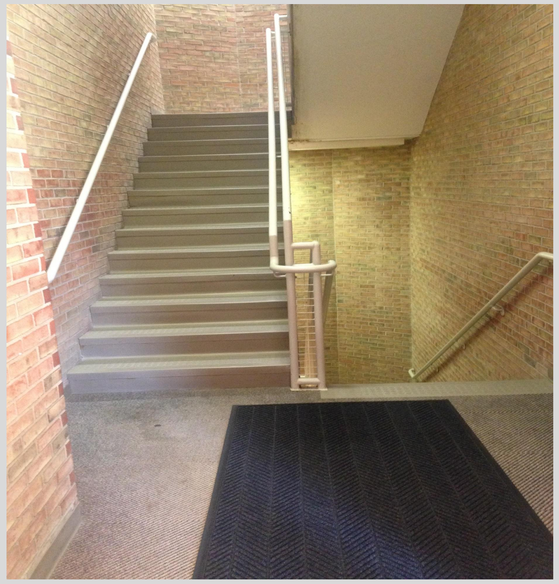
The poor economics is mainly due to the high tile expense, and the low student traffic.



Lead Free PZT piezoelectric Tile



Piezoelectric Tile



Science Building Stairwell

Conclusions

Though being advantageous in several aspects, such as manufacturing, installation, aesthetics, maintenance, availability etc, this technology can only contribute to low power applications.

The future of piezoelectric energy harvesters rely on the future of power consumption devices being created to consume less energy and themselves being sustainable.

References

Journal of Central South University, 2012, Volume 19, Number 3, Page 764 Mi-hui Yi, Wook-jung Na, Won-hwa Hong, Gyu-yeob Jeon.

PZT Tile image: http://open.jorum.ac.uk/xmlui/bitstream /handle/123456789/1022/Items/T356_1 _section17.html

Piezoelectric Tile image: http://asmarterplanet.com/files/flooring-system.jpg

Transportation piezoelectric tiles designed by Innowattech image: www.iroads.co.il