

A Review on Piezoelectricity

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Abstract -A future of electricity generation cannot be fully depends on the fossil fuel and conventional energy sources. As this sources are depleting day by day to solution for this problem is using non-conventional energy sources. In India there is 80% fuel is imported from foreign gulf countries. Which is spending 150 billion US dollar yearly [6] and also recently India promises to increase the share of non-conventional energy source up to 40% by2030 [6]. To achieve this India have to move from conventional to non-conventional energy sources. There is a hidden non-conventional energy source so far that is piezoelectricity. This can be develop a new area in electricity generation .this can be achieve by piezoelectric materials. This material converts a mechanical energy to electrical energy proportionally and efficiently. This paper includes some methods and modes of piezoelectricity.

KEYWORDS: Piezoelectric, Piezoelectricity, Energy.

I.INTRODUCTION

As electricity becomes a vital part of human society. Day by day as increase in population of world the demand of electricity is also going to increase proportionally.

To meet this increasing demand we have to find a alternative solution for the electricity generation. There is one way of electricity generation which is by using piezoelectric material.

Until now piezoelectric material are used only as a sensor or transducer in various measurement because its lower output. But now it can be used as energy source for domestic as well as industrial application.

Piezoelectric Material and Its Origin:-

The word piezoelectric taken from the Greek word ‘piezo’ which means to press. Piezoelectric materials are the material which has natural ability to generate an electrical energy in response to applied mechanical stress. This effect can done vice versa means mechanical vibration can be made up from applying electrical potential across it. This phenomenon is known as piezoelectricity or piezoelectric effect.[1]

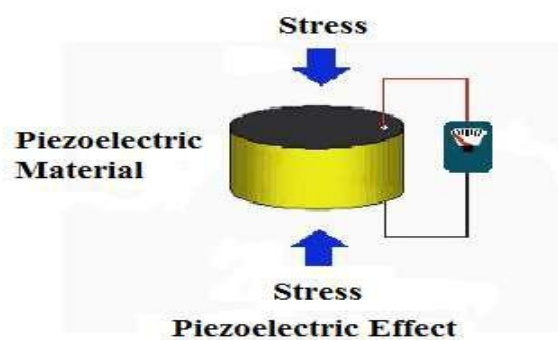


Fig.1 Piezoelectric Effect [1]

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Inside the piezoelectric material:-

piezoelectric material consist of both positive and negative charge parrides arranged in a such a way that all positive and negative charged particles are grouped about the same central point. two opposite forces of crystal is placed under pressure, the crystal can be attend and destroyed and charged particle moving up the crystals are pushed together and spread out sideways. The change is such that average positions of negative charge particles shift slightly with respect to the same of positive charge particles this mean there is separation of positive and negative charges which caused a potential difference between two faces crystal. The output voltage and power directly proportional to the pressure applied. The output voltage is in mill volts and the output power is in microwatts for signal crystal. So to achieve higher voltage and power cascade connection is required [1].

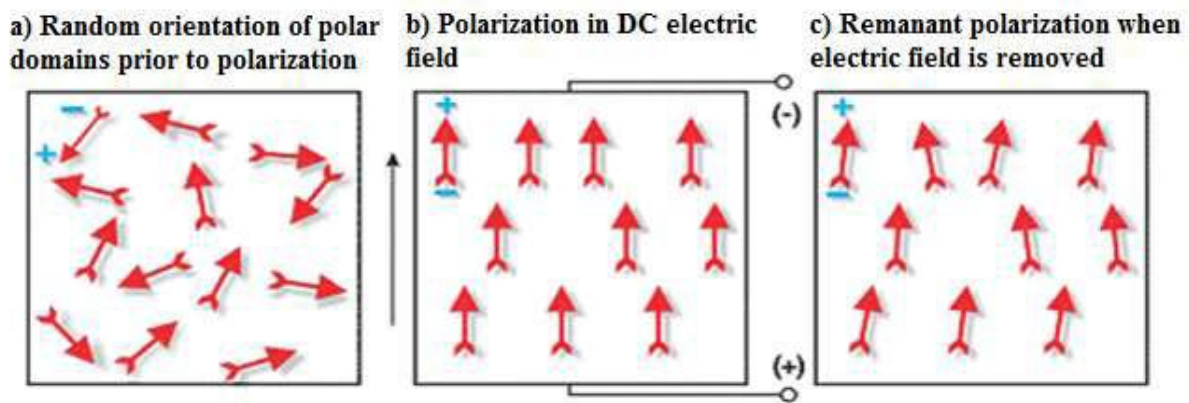


Fig.2 Different Cases of Polarization [1]

II.METHODOLOGY

Methodology used in energy harvesting device

There are two effect of polarization which is as follows, the detailed diagram of generation and motor action is as follow.

Generation action:-

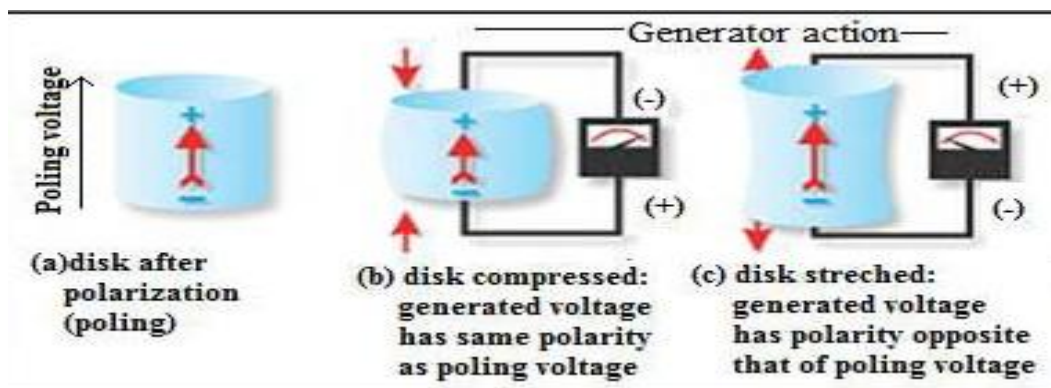


Fig.3Effect of Polarization And Generating Action [1]

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Motor action:-

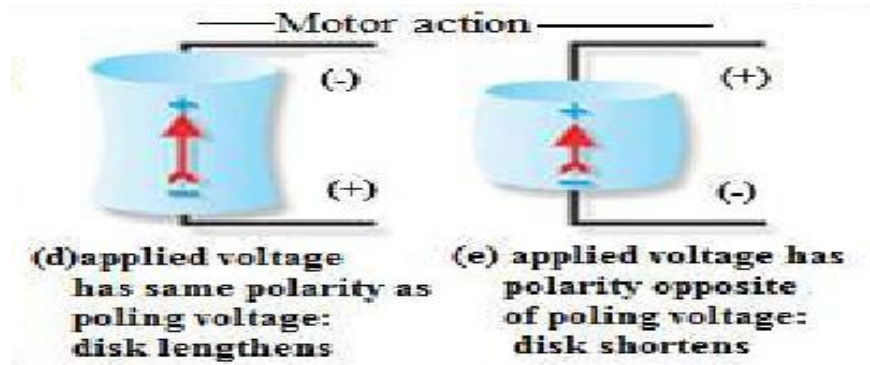


Fig 4.Motoring Action [1]

The generating action mainly carried out in three steps.

These three main important steps are as follows.

- After the polarization the disc is in normal form is that polling.
- Then the disc compressed and voltage is generated. This generated voltage has the same polarity or that the polling voltage which is shown in fig 4.
- After that in the generating action disc stretched at that time the generated voltage has polarity opposite that of polling voltage. The motor action is mainly carried out in two steps
- When disc is lengths then applied voltage base polarity as polling voltage .
- When disc is shorted when applied voltage has polarity opposite of poling voltage that generation and motor action shown in fig 3,4, simultaneously.

There are main two effect of piezoelectricity.

- Direct effect
- Converse effect [4]

Direct effect is generation or charged when mechanical strain applied. The piezoelectric material converts mechanical energy into electrical energy with the help of energy harvesting device

III. DESIGN CONCEPT

The basic electrical model for the piezoelectric sensor is shown in following diagram.

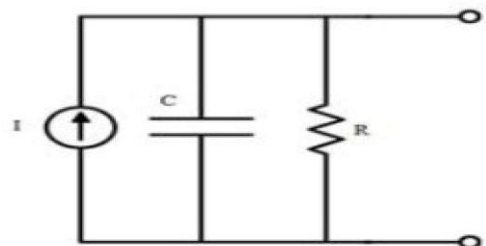


Fig-electrical model of piezoelectric sensor [5]

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The material is used in the sensor is the piezoelectric material lead zirconate titanate (PZT). The piezoelectric sensor is in connected in parallel that the work in instrument where the large scale of mechanical energy wasted like vibration in machine.

The basic block diagram for the piezoelectric energy harvesting process is given below.

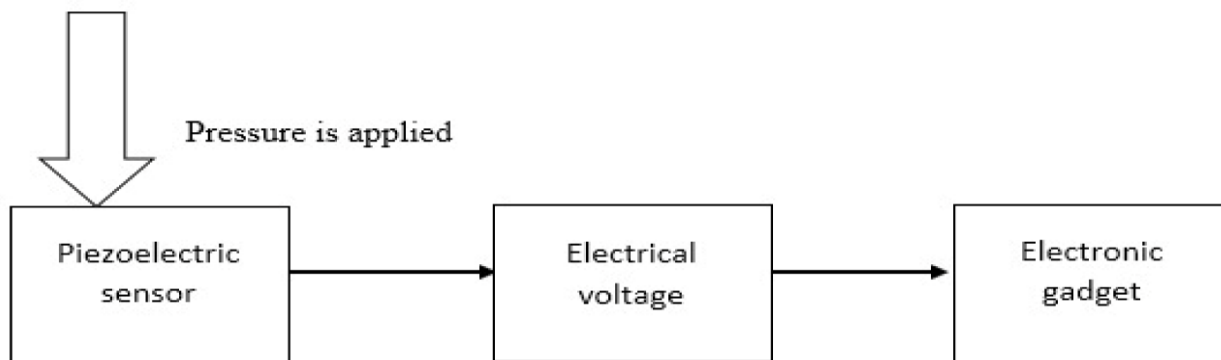


Fig- piezoelectric energy harvesting process [5].

The applied pressure or vibration energy is that mechanical input is converted to electrical voltage which is given to the electronic gadgets. A human while walking exerts about 30 W of power on ground and theoretically out of which 100mW the electrical power is possible to obtain without disturbing the convert of the person walk.

The following fig shows that energy harvesting circuits.

It consists of switching device in parallel with the piezoelectric element. The input is given to the system is mechanical input. The crystal system can convert into the electrical form and battery get charged with the help of ac to dc converter and there chemical energy is further converted into the mechanical or another form this energy is replace with help of piezoelectric harvesting device.

The piezoelectric materials which can produce the amount of energy are given following table.

Sr.no	Type	Voltage
1	Single crystal	0.67
2	Parallel combination (4-5 piezoelectric crystal connected parallel)	2.28
3	Series combination (4-5 piezoelectric crystal are connected in series.)	2.62

Table 1: Energy Produced By Piezoelectric Material [3].

The material which are used in piezoelectric harvesting device

Component	Material used
Pizo igniter	PZT or quartz crystal
Wind mill	i. Quartz ii. Rochelle's iii. Salt Topaz
Footsteps	lead zirconate titanate(PZT)
Lition battery charging	Artificial PZT Natural quartz

Table 2: Materials Used



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IV.APPLICATION

- 1) Convention machine.
- 2) Where the active and passive vibration are carried out
- 3) Footpaths
- 4) Wind Power Plants [2]
- 5) Railway Platforms
- 6) Subways

V.FUTURE STUDY

Our future plan is to build a practically working model using this concept. We have planned about making a piezoelectric crystal. Later, we will carry out a study of a variety of piezoelectric crystals, and make a comparison between them, so that we get the best performing crystal. Using this crystal, we will design a circuit or a project, which will harness the output of this crystal.

VI.CONCLUSION

On the Basis of researched papers we can conclude that the piezoelectric material can be used as electrical energy generator as well as mechanical vibration generator. Piezoelectric material can take participation in renewable energy sources. It is possible to generate the electricity from mechanical energy whichever mode we use like walking, highways etc. The advantage of these materials are their versatility in various fields such as in electrical, mechanical, marine, automobile engineering development and research organizations.

REFERENCES

- [1]. Ashutosh Pandey, Shivam Shukla, Vishakha Shukla “Innovation and application of Piezoelectric materials: a theoretical Approach *International Journal of Advanced Technology in Engineering and Science* www.ijates.com Volume No 03, Special Issue No. 01, March 2015
- [2]. Tanvi Dikshit, Dhawal Shrivastava, Abhijeet Gorey, Ashish Gupta, Parag Parandkar, Sumant Katiyal “Energy Harvesting via Piezoelectricity” *Proceedings of the 4th National Conference; INDIACOM-2010*
- [3]. Arjun A.M., Ajay Sampath, Sandhya Thiyagarajan, and Arvind V “A Novel Approach to Recycle Energy Using Piezoelectric Crystals” *International Journal of Environmental Science and Development*, Vol. 2, No. 6, December 2011.
- [4]. G.jithendra naidu, K.pranay kumar reddy & S.siva Prasad “piezo based electric power generation using 3-dimensional mechanical vibrations produced in vehicles” *International Journal of Electrical and Electronics Engineering (IJEEE) ISSN (PRINT): 2231 – 5284, Vol-2, Iss-1, 2012*
- [5] J. John Livingston* and M. Hemalatha. “Charging an Electronic Gadget using Piezoelectricity” *Indian Journal of Science and Technology*, Vol 7(7), 945–948, July 2014
- [6] <http://economictimes.indiatimes.com/news/economy/indicators/150-billion-crude-oil-bill-and-60-billion-spending-on-import-of-gold-silver-upset-trade-balance/articleshow/12657813.cms>