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Design And Test Equipment Model Rain Water Based Energy Effect of Size of Printed Material of Piezoelectric In Indonesia

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***Abstract*:** Piezoelectric is a material that, when pressurized will generate electric current. A piezoelectric voltage generated volt DC voltage. Previous research piezoelectric developed in some applications, for example an earthquake early warning system, and some objects such as placed in footwear, balls, mats doormat and the bumps. However, in this study, piezoelectric pressure applied by utilizing rainwater, it aims to reduce the use of electricity from the government for small-scale (household).The literature used in the study consisted of a literature review, the basic theory and hypotheses. The basic ingredients used in making the piezoelectric are baking soda, distilled water and cream of tartar. While the tools are the tools used to make piezoelectric materials and tools to test the results piezoelectric. This research was conducted to determine the size of the piezoelectric print CAD (Computer Aided Design) Code best use analysis, namely 1x1x0.5 cm^3. Furthermore, the manufacture of materials by reacting a few ingredients, and the results are tested with a digital multimeter and oscilloscope. Results voltage on oscilloscope sequence of low pressure, normal and high is 0.104 Volt DC, 0.496 DC Volt and 0.720 Volt DC. Having obtained the results of further tension, be making a series of electrical circuits and generates a voltage of 2.0 Volt DC, 2.10 Volt DC and 2.34 Volt DC. Then made a series of electrical and piezoelectric simulations in order to show a piezoelectric voltage can be used for everyday purposes, namely to turn on the lights.

Keywords: *piezoelectric, energy, design, electric, testing*

I. INTRODUCTION

Piezoelectric is a material that, when pressurized will generate electric current According to previous research on the development of piezoelectric already applied in some areas, for example in Yogyakarta, the form of a piezoelectric as an earthquake early warning system, and as a producer of electricity generated by applying pressure to the piezoelectric [1]. Development of piezoelectric as a producer of electricity is applied to some application, for example placed in footwear, balls, mats doormat and the bumps. The number of piezoelectric manufacture some application encourages researchers to fabricate piezoelectric by utilizing natural energy, it aims to reduce the use of electricity from the government [2].

Indonesia is a tropical country, thus making Indonesia has two seasons: the rainy season and dry season. Utilization of natural as electrical energy in the dry season exploited by utilizing the heat of the sun as an energy stored during the day and used or used as electricity at night. However, during the rainy season there is no utilization of energy that can be exploited or used as electrical energy. Thus, in this case the researchers intend to use the energy generated from the pressure of rain water that fell from the sky as a tap on piezoelectric energy. With the help of rain water pressure on piezoelectric, piezoelectric then produces electricity that can be used for everyday purposes, such as lighting. [3]

Pemolingan process and characterization of electrical properties of the environment-friendly piezoelectric materials BNT-BT-BKT [4]. In this study, the synthesis of the material carried by solid state reaction method. Results of the analysis showed that the material BNT-BT-BKT has a rhombohedra perovskite crystal structure that is hard ceramic. 0.90BNT-0.05BT piezoelectric material has a dielectric constant-0.05BKT 1.29x102 and Curie temperature of 428^{o}C. The piezoelectric material 0.93 BNT-0.05BT-0.02BKT have the dielectric constant of 1.87 x 102 and Curie temperature of 428^{o}C. From the results of a poll-0.05BT 0.90BNT-0.05BKT obtained frequency values themselves and look voltage is generated when the pressure test performed on the material.

For the synthesis of BNT-BT piezoelectric material with the addition of Ta2O5 using solid state reaction method [5]. In this method the milling for 4 hours, compacting pressure of 5000 psi, calcination for 1 hour at a temperature of 300^{o}C and sintering at 1000^{o}C temperature for 4 hours. In this study, the addition of BaTiO3 performed variations of 3%, 5%, 7% and 9%. Samples were characterized using XRD and SEM. Based on the XRD result that material BNT-BT-Ta has a tetragonal structure for generating lattice parameters a and b of 3.87; 3.88; 3.89; C value of 3.90 and 3.88; 3.89; 3.90; 3.91 at an angle α, β and γ is 90^o. The morphology of

the material BNT-BT-Ta-shaped needle, but at the time of the addition of 9% BT, shape micrograph of the material is not clearly visible because the grains of crystal joined and irregular.

Study on the characteristics of the energy generated by the mechanism of vibration energy harvesting piezoelectric method for frontal and lateral loading [6]. This study contains the energy cannot be destroyed, but can change the shape of the energy into other energy. This causes the man trying to find new energy by converting unutilized energy into useful energy for life. Vibration on an object store potential energy that can be generated and can be used as an alternative energy.

Piezoelectric material is a material which, when subjected to mechanical stress will deform so that it can generate electric energy. Based on the nature of the piezoelectric material of this study will be subjected to compressive force derived from the spring and round spinning disk eccentric [7]. The parameters varied are the compressive force frontal and lateral direction, the frequency of compressive force derived from the motor rotation at 100 rpm, 150 rpm, 200 rpm, 250 rpm, 300 rpm, 350 rpm and 400 rpm. From these tests will then look for the resurrection of voltage and current is generated. From this study it was found that the higher the speed of the motor voltage and current generated generation will be even greater. Besides, from calculations and experiments showed that the lateral direction of loading seizure produce voltages higher than the frontal direction of loading, the current generated tetra frontal direction of loading is higher than the lateral direction of loading [8]. In this study conducted a few tests on a piezoelectric, as did some tests on presence or absence of voltage on piezoelectric, piezoelectric circuit testing and testing to simulate piezoelectric order to produce an electric current and turn on the lights.

II. RESEARCH METHOD

The research method can be seen in Figure 1 below:

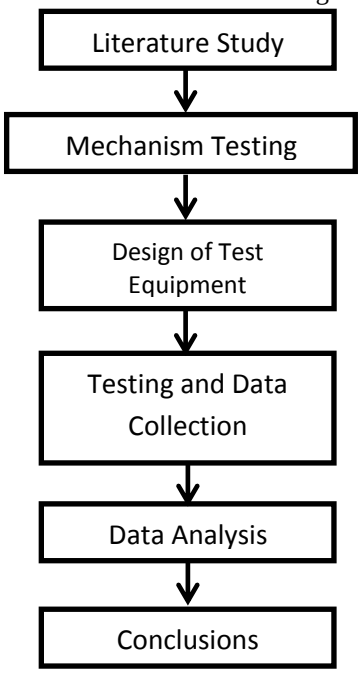

Figure 1. Flowchart of this research

Design and engineering test equipment models with piezoelectric energy rainwater done in stages as follow:

1. Literature
   The literature study consisted of a literature review is a reference source obtained from previous studies. Basic theory is the source of reference derived from the source book and website.
2. Mechanism testing
   The mechanism of the testing is to determine the testing to be performed. Next determine the piezoelectric material and tool manufacture.
3. Design of Test Equipment
   Design of test equipment is done to realize a design concept that already exists to facilitate testing.
4. Testing and Data Collection
   Testing is done by applying pressure on the piezoelectric ready, then performed from data using oscilloscope.
5. Data Analysis

Data analysis was performed by observing the results of the data have been obtained from the tests using the oscilloscope to be further analyzed and conclusions drawn.

III. RESULTS AND DISCUSSION

Preliminary research done is creating piezoelectric prints using the optimum size of the pressure and thermal simulations using CAD (Computer Aided Design) Code. The best size is generated which is a measure 1x1x0.5 [cm^3]. The process of making molds that create the pattern mold, mold design and mold making with a copper plate, as shown in Figure 2-4.

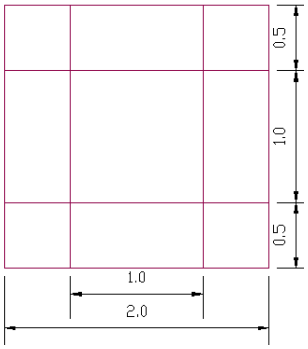

Figure 2. Pattern Print

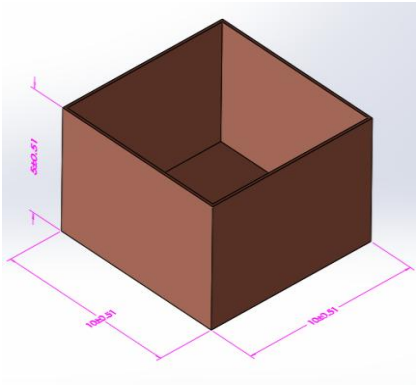

Figure 3. Design of Print

Figure 4. Piezoelectric of Print

IV. PIEZOELECTRIC MATERIAL MANUFACTURE

Making the piezoelectric material begins by determining in advance the materials, the materials of manufacture include: baking soda, cream of tartar and distilled water. Piezoelectric making procedure is as follows: First, in

this reaction will occur conversion of sodium bicarbonate into sodium carbonate, with heating resulting in a decomposition of these materials, as shown in Figure 5.

Figure 5. Baking soda

Second, the core reaction of cream of tartar with baking soda are reacted to produce a piezoelectric material, can be seen in Figure 6-8.

Figure 6. Leaching Process Materials

Figure 7. Crystallization process

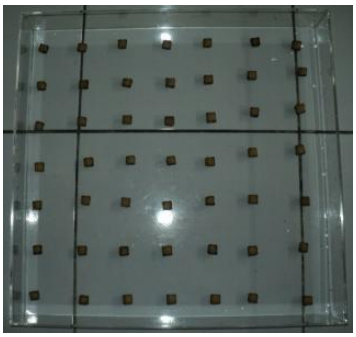

Figure 8. Efflorescence in the Matter

V. ELECTRICAL TESTING PIEZOELECTRIC MATERIAL

The process of piezoelectric material electrical testing done in 2 ways: by using a digital multimeter and digital oscilloscope tool. The process of the first piezoelectric material electrical testing done by using a digital multimeter. Tools digital multimeter is used to detect the presence or absence of electricity in the

piezoelectric material. At the time of the testing process using a multimeter positive terminal is pressed on a piezoelectric material and a negative terminal pressed on copper, as shown in Figure 9.

Figure 9. Testing With Digital Multimeter

The results of electrical testing using a digital multimeter can be seen in Table 1 below:

Table 1. Electrical Testing Results Using Digital Multimeter

No.	Pressure treatment	Multimeter Digital DC [Volt]
1	Low	0.034
2	Normal	0.092
3	High	0.152

Based on the test data in Table 1 above can be made a graph of each treatment pressure on the amount of testing [Volt], as shown in Figure 10.

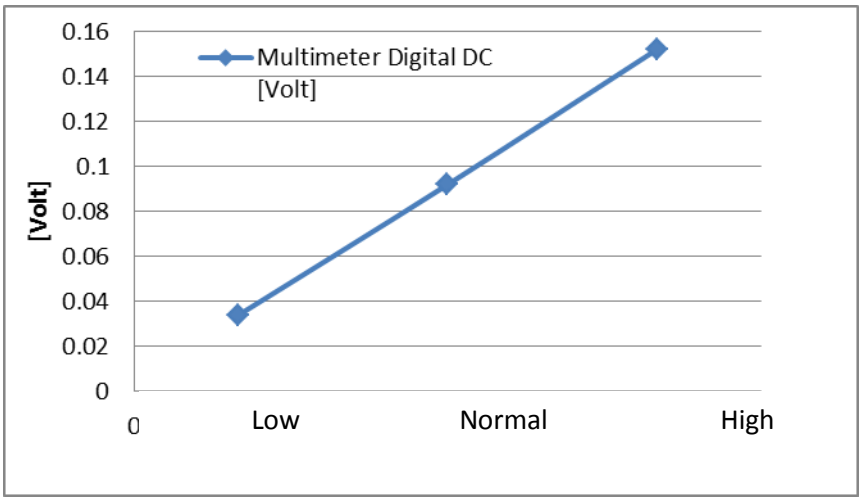

Figure 10. Electrical Testing Results Using Digital Multimeter

Electrical testing process piezoelectric material that is both carried out by using digital oscilloscope. Digital oscilloscope tool used to detect the presence or absence of electricity in the piezoelectric material and the tool also has the advantage of being able to see the oscillatory motion of electricity. At the time of the testing process using oscilloscope pressed at the input terminals and output terminals of piezoelectric material is pressed on copper, as shown in Figure 11.

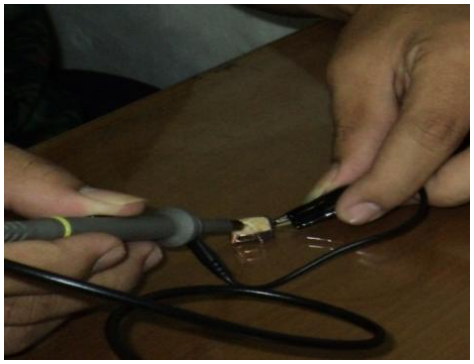

Figure 11. Testing With Digital Oscilloscope

The results of electrical testing using a digital oscilloscope can be seen in Table 2 below:

Table 2. Electrical Testing Results Using Digital Oscilloscope

No.	Pressure treatment	Oscilloscope Digital DC [Volt]
1	Low	0.104
2	Normal	0.496
3	High	0.720

Based on the test data in Table 2 above could create a graph of each treatment pressure on the amount of testing [Volt], as shown in Figure 12.

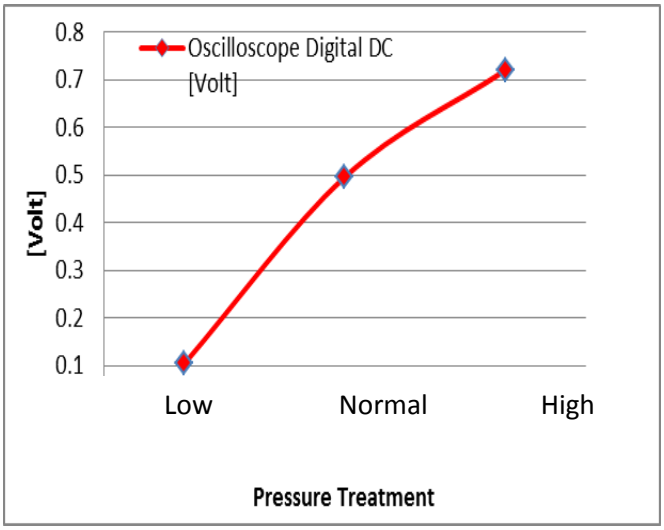

Figure 12. Electrical Testing Results Using Digital Oscilloscope

Comparison of the results of electrical testing piezoelectric material by using a digital Multimeter and digital oscilloscope are as follows:

Table 3. Comparison of results for Electrical Testing with Digital Multimeter and Digital Oscilloscope

No.	Pressure Treatment	Multimeter Digital DC [Volt]	Oscilloscope Digital DC [Volt]
1	Low	0.034	0.104
2	Normal	0.092	0.496
3	High	0.152	0.720

Based on the test data in Table 3 above can be made a graph of each treatment pressure on the amount of testing [Volt], as shown in Figure 13.

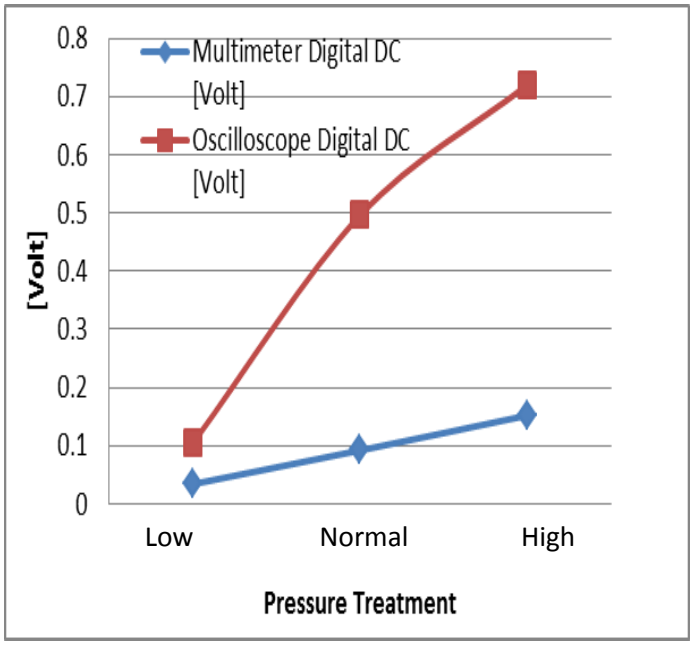

Figure 13. Comparison of results for Electrical Testing with Digital Multimeter and Digital Oscilloscope

After analyzing the test results comparing electricity piezoelectric material using a digital multimeter and digital oscilloscope, then in this test electrical voltage data used is data from piezoelectric material electrical testing using digital oscilloscope. As for the value of voltage used is at 0496 DC (Volt) or using digital oscilloscope value of the test results with normal pressure. It is assumed that the rainfall is normal that the pressure being obtained from rain or drizzle.

VI. CONCLUSION

Based on the results of research and testing, then the conclusion is as follows: The size of the container (mold) which is optimum for the piezoelectric is the length x width x height that is 1 x 1 x 0.5 cm^3. The electrical circuit of the best in the manufacture of piezoelectric is the series circuit, the results of calculations can produce a series circuit piezoelectric voltage amounted to 24 304 Volt DC ≈ 590 684 Watt..

VII. ACKNOWLEDGEMENTS

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