THE EFFECT OF SILVER NANOPARTICLE SOLUTION TOWARD THE OUTPUT VOLTAGE AND ELECTRIC CURRENT IN THE USED DRY ACCUMULATOR

Johan Haryanto, Wipsar Sunu Brams Dwandaru*

Physics Education Departement, Faculty of Mathematics and Natural Science, Yogyakarta State University, Karangmalang Complex, Yogyakarta, Indonesia
*Corresponding author: wipsarian@uny.ac.id

ABSTRACT

This study aims to i) to know the effect of H_2SO_4 electrolyte solution concentration toward the output voltage and electric current of the used dry accumulator after added 3 mM nanosilver solution ii) to find out the concentration of H_2SO_4 electrolyte solution which gives maximal influence toward the output voltage and electric current of the used dry accumulator after added 3 mM nanosilver solution, iii) to know the ratio of output voltage and electric current of the used dry accumulator which added nanosilver + H_2SO_4 electrolyte solution with variations of concentration and without nanosilver + H_2SO_4 electrolyte solution. This research begin by synthesizing silver nanoparticles concentrated 3 mM for each research performed. Next, tested the quality of the silver nanoparticle solution with the UV-Vis Spectrophotometer test. Then, make a solution of electrolyte H_2SO_4 with variation of concentration that is 50%, 40%, 30%, 20%, and 10%. Next, mix 1 mL of each H_2SO_4 concentration with 3 mL silver nanoparticle solution 3 mM and test the solution with a UV-Vis Spectrophotometer test. Then, 4 mL of the mixed solution is added to the used dry accumulator. Measurements of the output voltage and electric current of the used dry accumulator are carried out in a good quality solution until four hours with the use of LED lights. Based on the results obtained, it is known that the concentration of H_2SO_4 electrolyte solution has an effect on the output voltage and electric current of the used dry accumulator which contains H_2SO_4 solution and silver nanoparticle solution 3 mM. The concentration of H_2SO_4 electrolyte solution which gives maximal effect to the output voltage of the used dry accumulator is H_2SO_4 electrolyte solution which has 50% concentration. The concentration of H_2SO_4 electrolyte solution which gives maximal effect to the electric current of the used dry accumulator is H_2SO_4 electrolyte solution which has 50% concentration.

Keywords: nano, silver nanoparticle, used dry accumulator, sulfuric acid, voltage and current

1. Introduction

Energy is a fundamental aspect of human life. As science and human civilization grew, need for energy will increase. In this era, most energy is obtained from non-renewable energy such as coal, petroleum, natural gas and so on. In fact, the non-renewable energy of its supply increasingly shrinking day. If this can't be overcome, then the occurrence of the energy crisis can't be prevented again.

Accumulator is an important component in motor vehicle power system. There are two types of accumulator used by public for the motor vehicle that is wet accumulator and dry accumulator. The wet accumulator has an electrolyte fluid inside it. The liquid comprises a mixture of water and sulfuric acid (H_2SO_4) that the public generally recognizes as a accumulator water or *accu zuur*. The main function of this *accu zuur* is to soak the cells in the wet accumulator. If the volume of *accu zuur* is less than the minimum limit then the accumulator cells will be oxidized and corroded.

At present, one of the world's emerging sciences is nanoscience and nanotechnology. Nanoscience is a research effort to learn about the chemical properties and physical properties of a material on a scale of 1-100 nanometers (nm) called nanostructures. Such objects can be made intentionally by humans. While nanotechnology is the science and engineering in the creation of materials, functional structures, and devices in the nanometer scale. In scientific terminology, nano means 10^{-9} (0.000000001). One nanometer equals one thousandth of a micrometer, or one millionth of a millimeter, or one-billionth of a meter.

The development of the science of metal nanoparticles in recent years has attracted much attention because the physics properties and chemical properties that are unusual and different from the metallic properties in general. Metal nanoparticles exhibit unique properties such as good conductivity, chemical stability, catalytic activity, and others. It depends on particle size, size distribution, and particle shape. The synthesis of nanoparticles by controlling the size of nanoparticles has become an interesting research focus. The growth of nanocrystalline processes is controlled by the concentration of silver salts and stabilizers.

Sulfuric acid is a strong mineral acid (inorganic). Sulfuric acid is included in a strong electrolyte class that can conduct electricity. This is the reason sulfuric acid is often used as an accumulator and battery. Through this research, it is expected that silver nanoparticles can become voltage boosters and extend the active power of sulfuric acid solution commonly used as the main ingredient of accumulator and battery.

One of the interesting things to be studied and developed is the addition of silver nanoparticles into a used dry accumulator containing a sulfuric acid solution (H_2SO_4). As is known, that sulfuric acid is used as the main ingredient of the wet accumulator or dry accumulator. In this case, the concentration variation of the H_2SO_4 solution is performed to determine the effect toward the output voltage and electric current of the used dry accumulator.

2. Materials and Methods

The materials utilized for thi study are i) a gram of $Na_3C_6H_5O_7$ *(trisodium citrate*), ii) a gram oi $AgNO_3$ *(silver nitrate)*, iii) 200 mL of H_2SO_4 *(sulfate acid)* with 30% concentrated, and iv) 2 liters of distilled water, The equipment used in the study are i) a used dry accumulator GS Astra mark, ii) a heater, iii) three 500 mL measuring cups, iv) a 15 mL measuring cup, v) 6 test tubes, vi) a shelf test tube, vii) three drop pipettes, viii) a thermometer, ix) two multimeter digital, x) a digital scales, xi) 14 joined cable, xii) eight clamps, xiii) a red light LED, xiv) three white lights LED, xv) a accumulator charge, xvi) a stopwatch, and xvii) a spoon mixer.

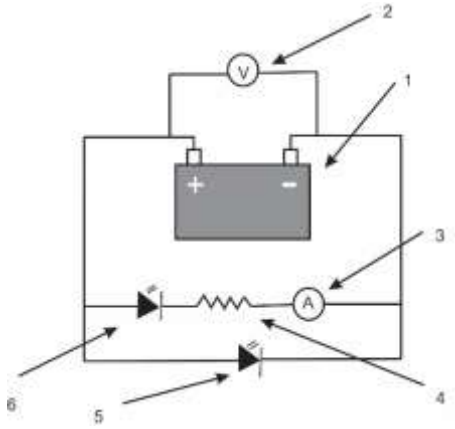

Figure 1. Schematic measurement with 4 LED lights.

In this case, number 1 is the used dry accumulator, number 2 is the voltmeter, number 3 is the amperemeter, number 4 is the resistor, number 5 is the white flame LED, number 6 is the red flame lamp.

In this research, we controlled the concentration of silver salts for the synthesis of silver nanoparticles with a concentration of 3 mM. From the synthesis of silver nanoparticles, the concentration of 3 mM was then added with variation of 10% H_2SO_4 solution concentration, 20% H_2SO_4 solution concentration, 30% H_2SO_4 solution concentration, 40% H_2SO_4 solution concentration and 50% H_2SO_4 solution concentration. So from these variations we can know the characteristic of mixed solution between silver nanoparticles with H_2SO_4 solution for each concentration.

The characteristic of mixed solution between silver nanoparticles and H_2SO_4 solution were performed using a UV-Vis spectrophotometer. The UV-Vis test results will show the absorbance wavelength and how much absorption of the mixed solution between the silver nanoparticles and the H_2SO_4 solution. From previous research it is known that the silver nanoparticles added to the Volta cells provide increased output voltage on the Volta cells. The increase in voltage is seen by comparing the Volta cells without the silver nanoparticles with the Volta cells that are added silver nanoparticles. In this research, silver nanoparticles will be added with variations of H_2SO_4 concentration and without silver nanoparticles on used dry accumulator. Dry accumulator is a refinement of Volta cells that have lower evaporation rate of hydrogen gas because hydrogen gas is conditioned again in a container in such a way that it

becomes liquid again so it does not require treatment of adding *accu zuur* during use.

Results and Discussion

In this research, we obtained the data we concluded to be analyzed using graphs and plots using Origin software. To determine the effect of the addition of silver nanoparticles with the variation of H_2SO_4 solution concentration on the used dry accumulator, we compared the output voltage of used dry accumulator with the addition of silver nanoparticles with the concentration variation of H_2SO_4 solution and without the addition of silver nanoparticles.

Measurement of the used dry accumulator voltage along 240 minutes has decreased the voltage in line with the addition of time due to the presence of resistors and LED lights. This decrease in voltage we compare to know the effect of addition of silver nanoparticles with variation concentration of H_2SO_4 solution and the effect without the addition of silver nanoparticles.

Based on the data obtained, the best fitting graph that approximates to the best result is the first order exponential with the function form:

$$y = y_o + A_1\, e^{-x/t_1}$$

With variable y is the value of voltage and electric current of used dry accumulator. A_1 denotes the value of constant, and t_1 is the time scale of the graph voltage fitting and the output electric current of the used dry accumulator. The value of yo in the 1st order exponential function equation in the graph fitting is a stable voltage value (V_0) and a stable electric current (I_0) when it reaches stability by extrapolation. The value of x is the value input for the measurement time of voltage and electric current.

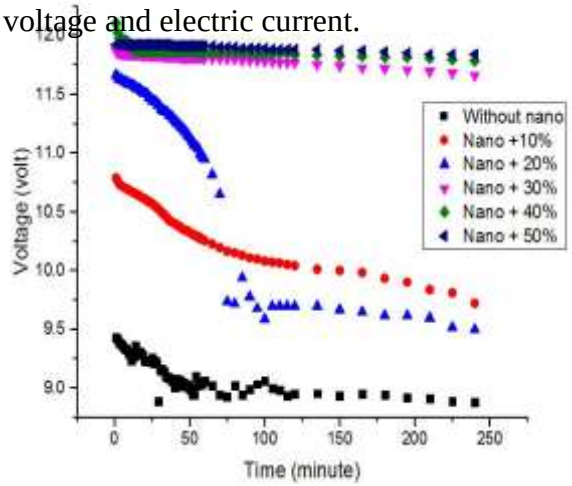

Figure 2. Graph of electric voltage output *fitting* on used dry accumulator

In the graph above, the x-axis shows time in units of minutes and on the y-axis shows the voltage in volt units. In the picture above we can observe that the concentration of H_2SO_4 solution which has the maximum stable voltage is 50% concentration. The value of V_0 (stable voltage) generated in H_2SO_4 solution for 50% concentration is 11.90958.

Table 1. Comparison of the function of the output voltage of used dry accumulator without silver nanoparticles and silver nanoparticles with variation concentration of H_2SO_4 solution using Origin fittings.

Nano Concentration (mM) dan H_2SO_4 Solution (%)	Value of V_o (voltage in stable)
without nano	9.10843
3 mM+ 10%	9.88846
3 mM+ 20%	8.72223
3 mM+ 30%	11.81214
3 mM+ 40%	11.85831
3 mM+ 50%	11.90939

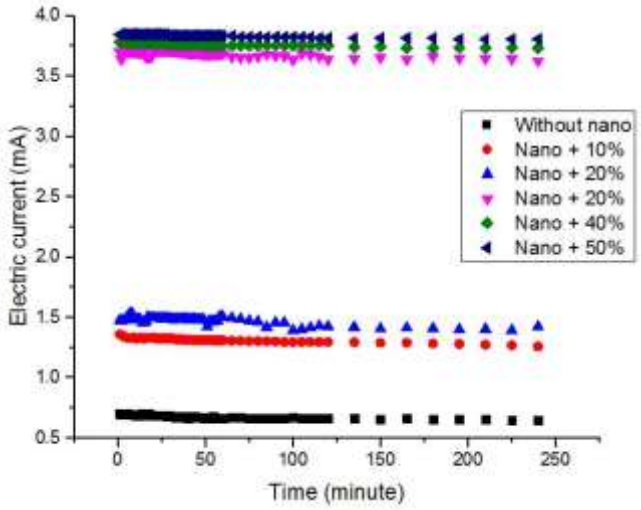

Figure 3. Graph of electric current output *fitting* on used dry accumulator.

In the graph above the x-axis represents time in units of minutes and the y-axis represents the electric current in miliampere (mA).

In the picture above we can observe that the concentration of H_2SO_4 solution which has the maximum stable electric current is 50% concentration. The value of I_0 (stable electric current) generated in H_2SO_4 solution for 50% concentration is 11.90958.

Table 2. Comparison of the function of the output electric current of used dry accumulator without silver nanoparticles and silver nanoparticles with variation concentrations of H_2SO_4 solution using Origin fittings.

Nano Concentration (mM) dan H_2SO_4 Solution (%)	Value of I_0 (Electric current in stable)
without nano	0.65488
3 mM + 10%	1.26134
3 mM + 20%	1.21471
3 mM + 30%	3.57282
3 mM + 40%	3.73099
3 mM + 50%	3.88629

3. Conclusions

Based on data analysis and discussion can be drawn conclusion as follows: H_2SO_4 electrolyte solution which added silver nanoparticle have positive effect to output voltage and electric current of used dry accumulator. That means the addition of silver nanoparticles to the electrolyte solution of H_2SO_4 increases the endurance of the used dry accumulator, the H_2SO_4 electrolyte solution which gives the maximum effect on the output voltage and electric current of the used dry accumulator after added silver nanoparticles solution is 50% concentration. This can be shown by stable voltage value

(V_0) and stable electric current value (I_0) which we obtain, we get the highest value of other H_2SO_4 solution concentrations. The output voltage and electric current of the used dry accumulator added by the silver nanoparticles + H_2SO_4 solution has a stable voltage output (V_0) and stable electric current output (I_0) which is higher than the output voltage and electric current of the used dry accumulator without silver nanoparticles + H_2SO_4 solution.

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Wipsar Sunu Brams Dwandaru , Ph.D

NIP. 19800129200501 1 003

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Dr. Supardi

NIP. 19711015199802 1 001