



SIDOARJO MUDFLOW ELECTRIC (SMF-E): OPTIMALIZATION OF SIDOARJO MUDFLOW AS AN ELECTRIC SUPPLIER BASED ON ELECTROCHEMICAL

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Abstract . Sidoarjo mudflow or known as Lusi (*Lumpur Sidoarjo*) is an ecological disaster that has caused the community fret. Most of them have not known that the mud contains elements that can produce electricity. This research aims to find the basic value that can be obtained from ecological disaster. The research design uses electrochemical method development with magnesium and copper electrodes. The result of The mud can be used as a source of eco-friendly electricity with magnesium electrodes as anode and copper electrodes as catode that produce a potential power of 8.8 volts and electrical power of 7,07135 watts/hour. The use of Lusi is very effective because it contains high metal and high salt content. The abundant amount of Lusi can be utilized effectively throughout this way.

Keywords- Sidoarjo mudflow; Electrochemical; Electrical Energy; Electrodes

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INTRODUCTION

Sidoarjo mudflow or known as Lusi (*Lumpur Sidoarjo*) is an ecological phenomenon of mud volcano eruption in Lapindo Brantas Inc., Balongnongo, Renokenongo, Porong, Sidoarjo, East Java. It has been erupted since November 2006 and has also covered approximately 250 hectares of land including 7 villages, paddy fields, sugarcane plantations, irrigation channels, and transportation pathways. The average volume of mud that burst is around 50.000 m³ – 120.000 m³/ day. The water that is separated from the muddy sediment is around 35.000 m³-84.000 m³/ day [1]

Sidoarjo mudflow has made a tremendous impact on people's lives both around the centre of the Sidoarjo mudflow and the economic activities in East Java. These impacts include the disruption of transportation means. It cut off the main traffic road of Surabaya-Malang and Surabaya-Banyuwangi. In addition to the above two impacts, there is an impact that also has been troubling the surrounding community, which is the disruption of educational aspects. Some formal or non-formal schools are flooded with the mud and automatically it impacts the schools' learning activities [2]

Besides, the hot mud contains of some metal substances that can produce electrical energy by applying the science of voltaic cells. The volta cell or the galvanic cell itself has the meaning of electrochemical cells that can produce electrical energy caused by spontaneous oxidation-reducing reactions [3] [4] . The current can

occur if there are certain electrodes. The electrodes used are magnesium (Mg) and copper (Cu).

Most of people around the mudflow have not understood the existence of substances contained in the mud. The list of the substances is displayed as follows.

[Table 1 about here.]

In addition to the content described above, the mud is composed of 70% water and 30% solids [5] . The salt content (salinity) of mud is very high. The heavy metals that are contained in the mud are Hg, Pb, Cr, Cu [6] [7] [8] . Electrical energy is one of the essential fundamental needs in human life today. Almost all human activities are associated with electrical energy. As the economic growth and population in Indonesia are increasing, the demand for the electrical energy also increases. Therefore, the efforts made by the government to meet the needs of the electricity needs of society. In the period of 2013-2023 or in the upcoming 10 years, the electricity system of Java-Bali is expected to increase from 144 terra watt/hour (TWh) in 2013 and it will be 375 TWh in 2022. It grows 7.6% / year [9]

The use of voltaic cells with magnesium (Mg) as an anode (place of oxidation reaction) and copper (Cu) as the cathode (place of reduction reaction) along with the electrolyte solution in the form of the mud. The use of Magnesium and Copper electrodes has also been carried out in electrical experiments on waste water from oranges and tomatoes [9] [10] [11]

The installation of copper and magnesium in series include eight magnesium rods and eight copper rods. The

Table 1. ContentTest Result: Sidoarjo Mudflow 1

Parameter	Quality Standards	Test Result	Unit
TDS	4000	91.350	mg/lt
TSS	200	226.100	mg/lt
BOD	150	259	mg/lt
COD	300	600	mg/lt
Phenol	2	5,9	mg/lt
Zn	15	0,45	mg/lt
Ni	0,5	0,22	mg/lt
	1	0,23	mg/lt
Li	0,6	60	mg/lt

use of magnesium and copper electrodes is the oxidation of magnesium into dissolved ions and the reduction in copper into deposits.

METHOD

Materials and Tools

Experiment Materials

1. Sidoarjo Mud Fluid

Experiment Tool

1. Container (plastic jar)
2. Crocodile Clamp
3. Cables
4. Electrodes (Mg and Cu)
5. Digital Multitester
6. Lights

Research procedure

This research was conducted in the following stages:

1. Stages of making a voltaic cell electric generator from Sidoarjo mud dough.
2. Stages of testing the voltaic cell electricity generator from the Sidoarjo mud dough

Tool Making Procedure

The way of making electricity generating devices is as follows:

1. Prepare a container (plastic jar)
2. Filling the container with Sidoarjo mud mixture
3. Installing the cable on the electrodes (Mg and Cu)
4. Inserting electrodes (Mg and Cu) connected series into the Sidoarjo mud mixture

Tool Testing Procedure

Testing the tool with two stages, namely measuring the voltage with a digital multitester, and also testing the tool using a lamp. The test method is:

1. Attach the cable that has both ends of the alligator clamp attached to the digital multitester, paying attention to the positive and negative poles

2. Set the multitester to the DCV position with a potential difference of 10 V
3. Clamp a magnesium (Mg) rod on the negative polar alligator clip and a copper (Cu) rod on the positive polar alligator clip
4. Partially dip both stems in the solution
5. Record the results using a digital multitester
6. Remove the cable from the multitester
7. Connect the cable with the lamp
8. Record the test results, whether the lamp is on or not

RESULT AND DISCUSSION

This study resulted in a spontaneous (perfect) reduced-oxidation reaction by generating an electrical potential of 1.1 V/circuit, while this study uses eight circuits which resulted a potential electrical power of 8.8 V.

By comparing the result data with 16V decree data that has 12,857 watts/hour the acquired energy will be:

$$\begin{aligned} Watt/hour &= (8,8 \text{ v} \times 12,857 \text{ watts/hour}) / 16 \text{ v} \\ &= 7,07135 \text{ watts/hour} \end{aligned}$$

The data comparison aims to determine the calculation of electrical power based on measured data analysis

The Dubai provision plant has 8 plants as support for the area to produce electricity [12] [13]. In this case, East Java area with 1 plant can be calculated as follows:

$$\begin{aligned} 8 \text{ plants Dubai} &= 7,361 \text{ MW} \\ 1 \text{ plant} &= 0,920125 \text{ MW} \end{aligned}$$

Effectiveness of Sidoarjo Mudflow As A Power Generator.

Paiton is a PLTU that supplies electricity production in the Java-Bali area [14]. The area of Java-Bali is 134,077 km². Paiton PLTU supplies electricity needs in Java-Bali as much as 28,000 MW. The previous data stated that one plant produces 0.920125 MW. The area that will get electricity through the supply of this plant is:



Figure 1. Construction Prototype SMF-E side view

$$\begin{aligned} \text{Area} &= ((0,920125 \times 134,077)/28.000) \\ &= 4,405986 \text{ km}^2 \end{aligned}$$

Based on the calculation, the area that will get the electric current is 4,4 km². The number can be projected as a residential area. The benefits are quite large considering that the materials used are waste and abundant.

Effectiveness of The Use of Sidoarjo Mudflow

The Sidoarjo mudflow has a high metal content can deliver the electric current and environmentally friendly. By using a series of circuits, copper, and magnesium connected to the digital multimeter can produce a large electric current. The utilization of the mud into alternative and efficient energy is a form of environmental rescue especially in the area around the overflow and Porong river. It is also can be considered as a form of assistance to the government in addressing the electrical energy problems in Indonesia because the abundant amount of mud.

CONCLUSION

The mud can be used as a source of eco-friendly electricity with magnesium electrodes as anode and copper electrodes as cathode that produce a potential power of 8.8 volts and electrical power of 7,07135 watts/hour

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Figure 2. Construction Prototype SMF-E above

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The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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