
DESIGN AND DEVELOPMENT OF SUN ENERGY WITH SOLAR CELL AND DISTILLATION SYSTEMS TO CONVERT SEA WATER TO BE SALT AND FRESH WATER

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ABSTRACT

Solar cell is a renewable energy that utilizes solar energy sources. Energy is widely developed for various activities, especially for lighting. Researchers are interested in applying in other fields. That is utilizing solar cell energy to make salt and fresh water from sea water.

The principle of this system is the solar cell change sunlight becomes energy, then stored in the battery and in the converter into an AC voltage source to be connected to a heater. This heater serves as a heating for seawater which has been designed in such a way that there is a distillation pipe (distillation) to drain cooled water vapor to produce fresh water.

The results of this study are expected to be a solution or alternative from renewable energy to produce multi-use products, it's salt and fresh water.

Keywords: *Solar cell, Heater, Accu, Converter, Distillation, Renewable energy*

1. INTRODUCTION

Our country is an equatorial country that gets sunlight all the time. Only in the rainy season does the intensity of sunlight decrease. Therefore it is necessary to utilize this solar energy. Usually, the sun is used for activities such as drying clothes, drying food, crops and others. According to statistical data that the total intensity of irradiation averages 4.5 kWh per square meter per day, Indonesia is classified as a large source of solar energy. The sun shines in Indonesia per year ranging from 2,000 hours. Then, according to data from the Directorate General of Electricity and Energy Development, the installed capacity of solar electricity in Indonesia has only reached 0.88 MW of the available potential of 1.2 x 109 MW.

So, the use of solar energy can be utilized in several sectors, one of which is the salt-making sector, which is with seawater distillation technology with solar cells panels as an energy source. With the distillation system there are two results obtained, namely in the form of salt and fresh water or clean water to overcome the problem of the clean water crisis in the coastal area.

2. LITERATURE REVIEW

Solar Cell Panel

Solar panels are the main component of solar power generation system. Solar panels (a collection of solar cells) function to convert solar energy into electrical energy. The output current is DC direct current. So, the energy can be stored into the battery.

Solar panels consist of small parts called cells. These small cells are arranged to get greater power. The series of cells is called solar cell panels. Power that can be made on the panel is 10 watts, 20 watts, 50 watts and so on.

To increase power (scalable) is combining several solar panels that are low power to get greater power. Combined solar panels can amount to tens / even hundreds depending on how much power will be substituted with solar cell energy.

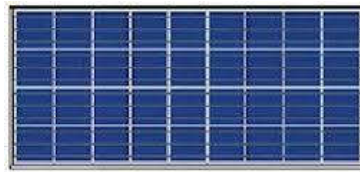


Figure 1 Solar Panels

Distillation

Simple Distillation

Simple distillation or ordinary distillation is a chemical separation technique to separate two or more components that have distant boiling points. A mixture can be separated by ordinary distillation to obtain pure compounds. The compounds contained in the mixture will evaporate when they reach each boiling point. Simple distillation is shown as below.

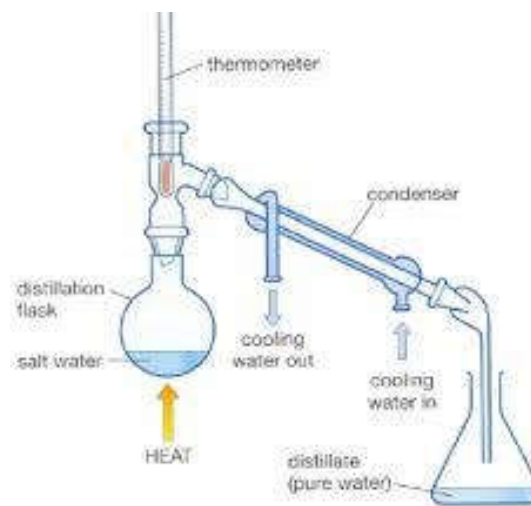


Figure 2 Simple Distillation

Multilevel Fractionation of Distillation

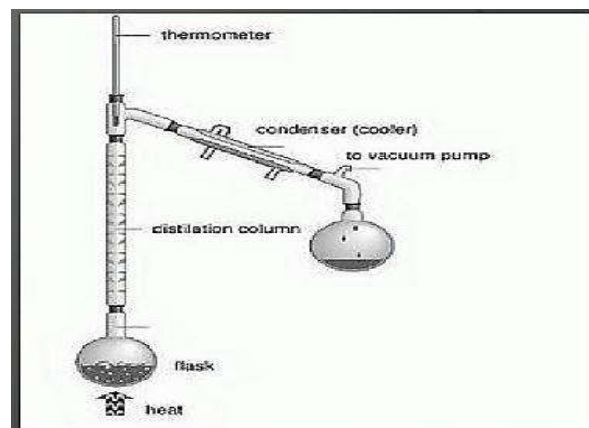


Figure 3 Multilevel Fractionation of Distillation

The principle is the same as simple distillation, only this multilevel distillation has a better set of condenser devices, so it can separate two components that have adjacent boiling point differences. To separate the two types of liquid that are easily volatile can be done by multilevel distillation. Multilevel distillation is a repeated distillation process. This repetitive process occurs in the fractional column. The fractional column consists of several plates where condensation occurs. Steam that higher plate contains more volatile (volatile) fluids while less volatile liquid has more condensate.

Azeotrop Distillation

Separating the azeotropic mixture (a mixture of two or more components that are difficult to separate), usually in the process other compounds are used which can break the azeotropic bond or by using high pressure. Azeotrop distillation can be seen in the picture below.

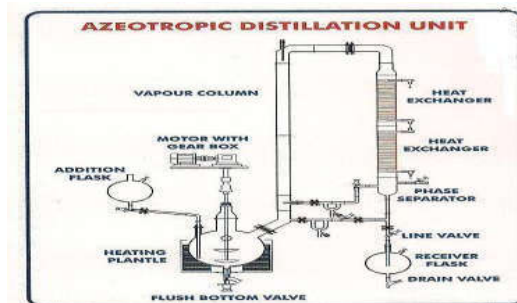


Figure 5 Azeotrop Distillation

Steam Distillation

To purify liquid substances / compounds that are not soluble in water, and the boiling point is high enough, whereas before the liquid reaches its boiling point, the liquid has decomposed, oxidized or undergoes a reaction, then the liquid cannot be purified by distillation simple or multilevel distillation, but must be distilled by steam distillation. Steam distillation is a term commonly used for distillation of water mixtures with compounds that are not soluble in water, by flowing water vapor into the mixture so that the evaporating part changes to vapor at a lower temperature than direct heating. For steam distillation, the pumpkin containing the compound to be purified is associated with a steam generator pumpkin (see picture of a steam distillation device). Water vapor which is flowed into the flask containing the compound to be purified is intended to reduce the boiling point of the compound, because the boiling point of a mixture is lower than the boiling point of the components. Steam distillation can be seen in the following figure.

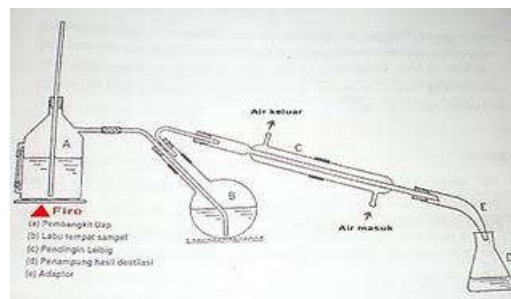


Figure 6 Steam Distillation

Vacuum Distillation

Separating two components with a very high boiling point, the method used is to reduce the surface pressure lower than 1 atm, so that the boiling point is also low, in the process the temperature used to distill it does not need to be too high. Vacuum distillation can be seen in the picture below.



Figure 7 Vacuum Distillation

3. METHODOLOGY

Flow Chart of the research can be seen in below.

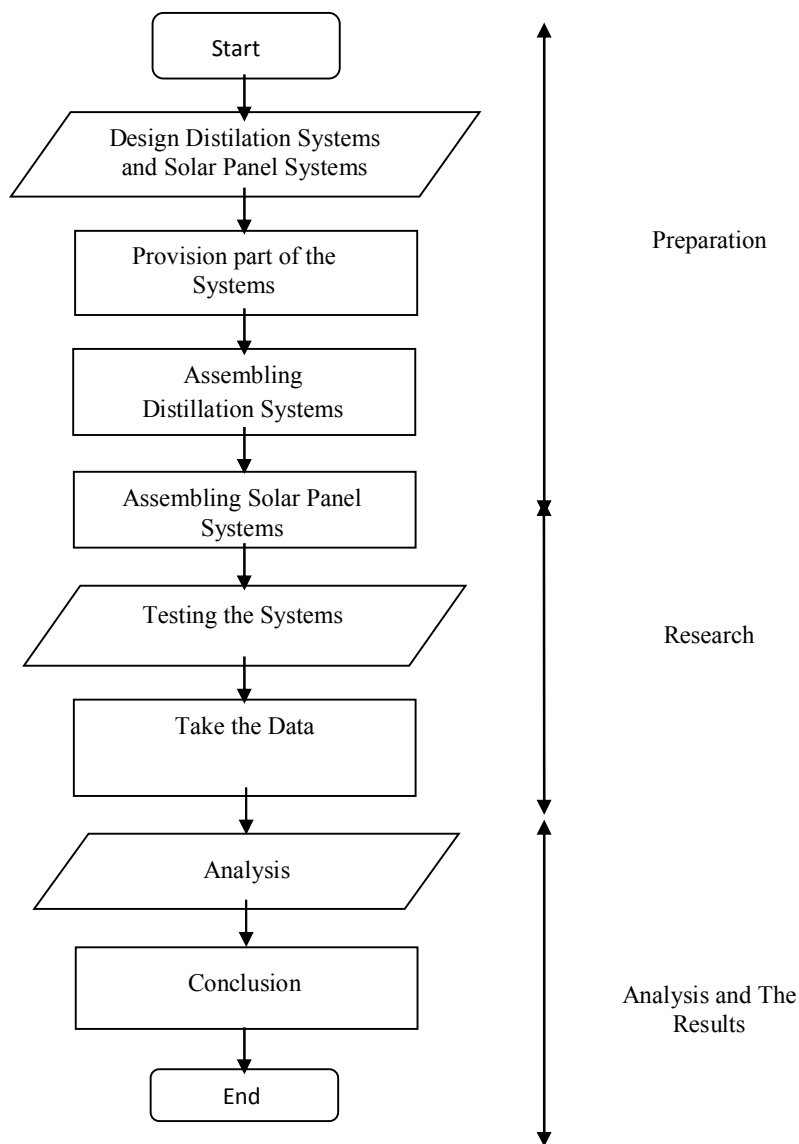


Figure 8 Flow Chart of the Research

The method used in this study is experimental methods. So that in this study do the design of the systems and the making of the equipment are in accordance with the results to be achieved. That is to produce a basic idea of the use of solar cell energy that is applied to produce or convert sea water into salt and fresh water by a distillation process. By knowing the results obtained (salt and fresh water), it is expected to be able to calculate the use of solar energy through solar cells to be applied on a larger scale.

Step of Research

Preparation

This step starts with designing of the system. Design of distillation systems used to sea water processing, and design of solar cell systems as energy resources. After the design is done, it is continued with the provision of tools. Provision of tools is done by buying the equipment needed for this research. Tools are available at local stores and some are ordered from outside the city because they are only available in certain stores. Likewise with supporting tools such as grinding, welding, scissors, cutter, construction equipment, screwdriver, avometer, soldering iron, tin and so on.

Research

At this step the installation of the tools is done to be made according to the initial design. The distillation device is assembled with a heater which serves to heat the furnace. Solar cells are arranged and supported by aesthetics. Accu, inverter and converter are made into one panel and assembled under the solar cell panel. Next is the connection (connected) between the solar cell, converter, battery, inverter and heater. Observations are ready for evaluation and research results.

Analysis

In the step of data analysis, an analysis of the results of the research design that has been assembled will be analyzed. Each point (test points) is measured and recorded. Then the results of the test were carried out, in which this study tested or sampled 1.5 liters of sea water. Run to produce salt and fresh water.

Testing

In this step, a system test is made so that problems can be found and corrections are made. Tests are carried out on hardware and system integration. The goal is to know the performance of the system that has been made and provide analysis of the results of testing. This effort is also carried out to determine the ability of the test equipment that has been made, whether it has fulfilled the desire or not. This test is done several times to get good results.

Conclusion

After get the data then an analysis of the results, and it will get a conclusion that can be taken based on existing data.

Design of the System

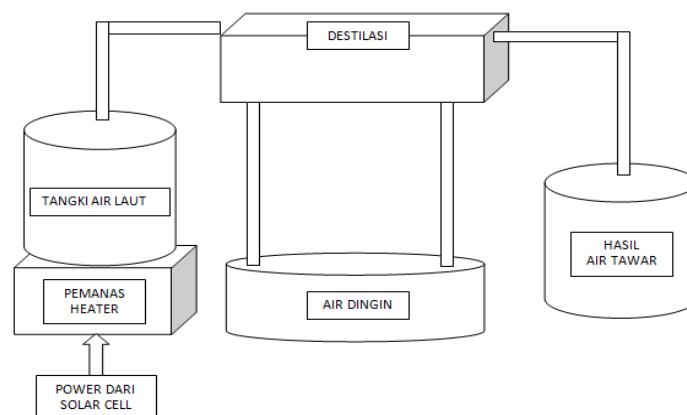


Figure 9 Design of Distilation System

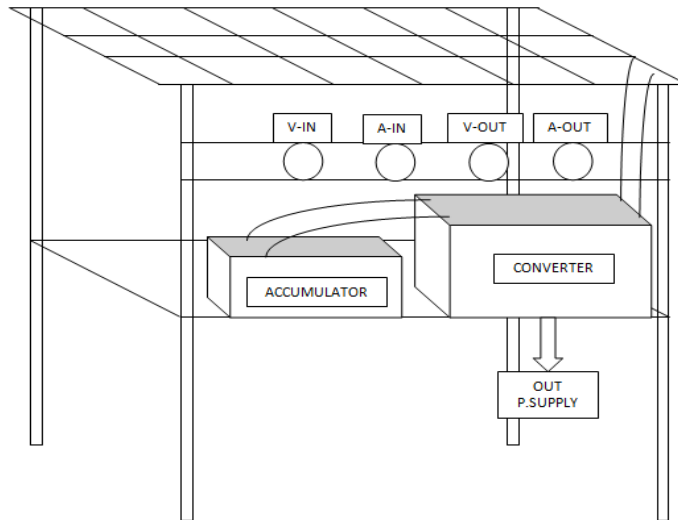


Figure 10 Design of Solar Panel Unit

4. RESULT AND DISCUSSION

Table 1 Solar Panel Measurement Results

No	Waktu	Pengukuran				Keterangan
		Tegangan(v)	Ralat(17 v)	Arus(I)	Ralat(11.38A)	
1	9:00	13	23.5%	5.25	53%	
2	9:15	13	23.5%	5.25	53%	
3	9:30	13	23.5%	5.25	53%	
4	9:45	13	23.5%	5	56%	
5	10:00	12	29%	5	56%	
6	10:15	12.3	27,6%	6	47%	
7	10:30	12.3	27,6%	6	47%	
8	10:45	12.45	26.7%	7.25	34%	
9	11:00	12.6	25.8%	9	20%	
10	11:15	12.6	25.8%	9	20%	
11	11:30	12.7	25%	9.5	16.5%	
12	11:45	12.7	25%	9.5	16.5%	
13	12:00	12.75	25%	9.8	13.8%	
14	12:15	12.75	25%	9.8	13.8%	
15	12:30	12.6	25.8%	9	20%	
16	12:45	12.6	25.8%	9	20%	
17	13:00	12.65	25.8%	9	20%	
18	13:15	12.5	26.4%	8.5	25%	
19	13:30	12.5	26.4%	8	29.7%	
20	13:45	12.5	26.4%	7.5	34%	

21	14:00	12.5	26.4%	7.5	34%	
22	14:15	12.45	26.7%	6.5	42%	
23	14:30	12.4	27%	6	47%	
24	14:45	12.4	27%	5.25	53%	
25	15:00	12.3	27%	5	56%	

Testing of Solar Panel Units did to determine the standard electrical measuring values so that the equipment works in accordance with the design.

Table 2 Testing of Distillation Systems

No	Volume(ml)	Waktu (menit)	Hasil	
			Garam(gram)	Air(ml)
1	250	120	8	200
2	250	125	9	210
3	250	115	8	200
4	250	120	8	200
5	250	120	8	200
6	250	115	8	200
7	250	120	9	200
8	250	125	9	200
9	250	120	10	200
10	250	120	10	200

In testing the integrated system aims to know the results by the system, it's salt and fresh water.

5. CONCLUSION

From the results of the analysis and processing of this research data conclusions are obtained as follows:

1. The design of a solar cell utilization tool to convert sea water into salt and fresh water can be realized by converting solar energy into electrical energy stored in the accumulator which is then converted into AC voltage through an inverter as a power supply of heaters to evaporate seawater which distilled into fresh water and salt.
2. The results of testing systems, sea water can be converted into salt and fresh water. 250 ml of sea water produces 10 grams of salt and 200 ml of fresh water.

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