Utilization of sensor TGS 821 as hydrogen detection of result water electrolysis process in real time with DAQ on PC

Bambang Suryanto[1,3,*],Tulus Ikhsan Nasution[1,2,3], Kerista Sebayang[1], Siti Khanifah[1,3],

[1]Department of Physics, Faculty of Mathematics and Natural Sciences, Universitas Sumatera Utara, Medan 20155, Sumatera Utara, Indonesia

[2]Centre of Excellence for Sensor Systems and Technology,Universitas Sumatera Utara, Medan 20155, Sumatera Utara, Indonesia

[3]Integrated Laboratory, Universitas Sumatera Utara, Medan 20155, Sumatera Utara, Indonesia

* bambangsuryanto1978@gmail.com

Abstract. The world's energy needs from year to year, as well as giving a bad impact on the increase in the concentration of greenhouse gases and other pollutants. So, that it becomes a major problem of the world today. Therefore, need to do research to find other renewable energy sources, including the utilization of hydrogen gas. Hydrogen gas can be produced from water electrolysis process. To detect hydrogen gas resulting from the electrolysis process can use sensor TGS 821 is done in real time by using the DAQ is connected to PC. Retrieval data on electrolysis process is performed by variation voltage; apply 9 V, 11 V, 13 V, 14 V, 15 V for the electrolysis using filters. With the hydrogen-based zeolite filter was the ability to increase the power of hydrogen adsorption on the filter through the electrolysis process. The maximum concentration of hydrogen generated from electrolysis process by using a filter for voltage 9 V is 409.34 ppm, for voltage 11 V is 502.25 ppm, for voltage 13 V is 863.12 ppm, for voltage 14 V is 964.11 ppm, for voltage of 15 V is 737.89.

1. Introduction

Energy demand in the world's increasing large led to greenhouse gas pollution. Dwindling energy reserves also makes the price of fuel is very expensive [2]. The energy savings is one of the best ways.Nevertheless, not enough to overcome the energy crisis. Therefore, need to do research to find other renewable energy sources, one of them with the utilization of hydrogen gas.

Hydrogen is one element in the content of water (H2O) can be used as an alternative fuel. In many ways, hydrogen is the perfect fuel. The source of abundant, highly efficient, produce without emissions when used in fuel cells, non-toxic, can be produced from renewable resources, and is not a greenhouse gas. Hydrogen can be produced from a variety of systems such as the supply of fossil fuels, biofuels, alcohol, nuclear reaction, biomass, and water. Nearly 96% of hydrogen is produced directly from fossil fuels and about 4% through other sources use electron.

Electrolysis is a method that will transform electrical energy into chemical energy. On the process of electrolysis will occur the process components come from the chemical compound electrolyte solution. In the electrolysis process reduction and oxidation reactions take a place. Hydrogen gas resulting from the process of electrolysis will be accommodated and will be filtered until it reaches maximum concentration levels of purity. How big is the percentage

value of the purity of the hydrogen can be detected by the sensors in the hydrogen? Electricity [6].

As for hydrogen sensor's will be used in this research is hydrogen gas sensor TGS 821 Microcontroller-based Arduino Uno R3. Hydrogen gas sensor TGS 821 is easy to use, has high sensitivity and high selectivity towards hydrogen gas, has high stability, using a simple electric circuit, resistance to environmental change as well as TGS 821 can detecting the concentration of hydrogen gas at least 50 ppm. If Hydrogen gas molecules on the surface of the sensor resistance unit will then shrink in accordance with gas concentrations, conversely, if the concentration of gas declines will be followed by the increasing resistance of the output voltage will then decline. Influence of gas concentration changes can change the value of the resistance of the sensor and will affect the output voltage, so the difference this referred for the detection of hydrogen gas.

2. Data and Method

2.1 Data

This research was conducted in four phases of research, namely the creation of a series of electronic data acquisition system microcontroller-based DAQ ATMEGA 328, testing a series of data acquisition, preparation of natural zeolite-based hydrogen filter Pahae and system select rolysis hydrogen-producing, Testing and detection of hydrogen in the hydrogen-producing system.

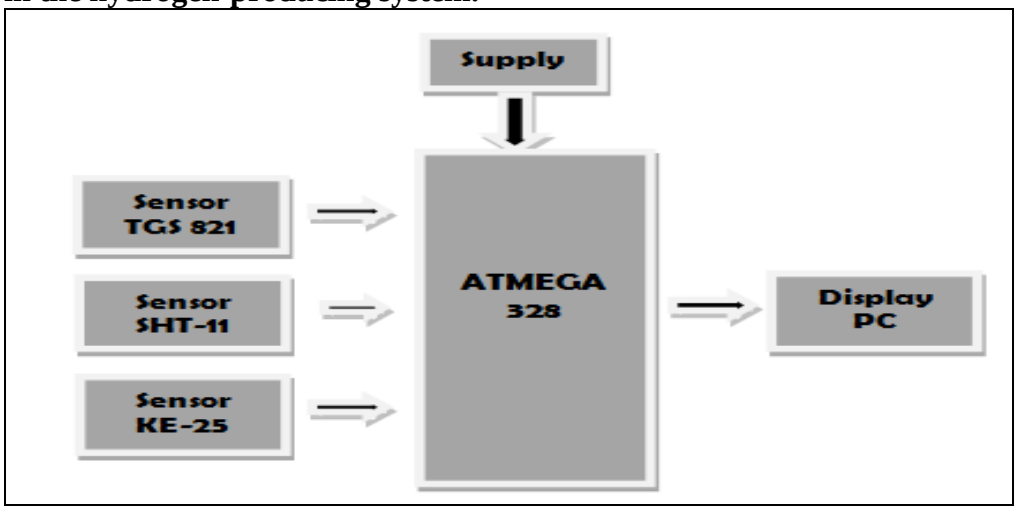

Figure 1. Block Diagram Circuit

For the series of Hydrogen sensor, TGS 821 connected to microcontroller can be seen in Figure 1. In the output are hydrogen sensor pinis connected to pin microcontroller ADC1. VCC on hydrogen sensor TGS 821 is connected to a voltage source + 5. The hydrogen sensor TGS 821 ground connected to a ground source.

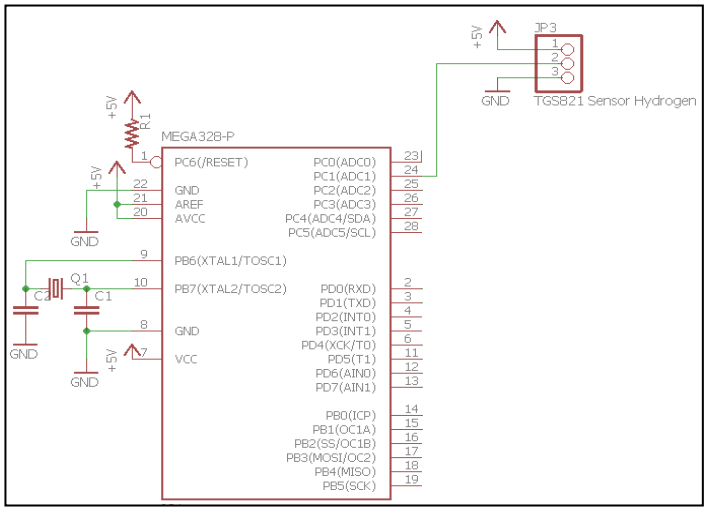

Figure 2. Hydrogen Sensor TGS 821

SHT11 Sensor circuit that connects to the microcontroller can be seen in From the figure 2 can be seen that the sensor Data pin SHT 11 linked to PC2 micro controller ATMega 328 and Pullup Resistor is given as a current amplifier. Then the SCK Pin of the sensor is connected to the PC 11 SHT 3 microcontroller ATMega 328. VCC pins on the sensor are connected to 11 SHT voltage source. Pin and Ground sensors linked to Ground 11 SHT voltage source.

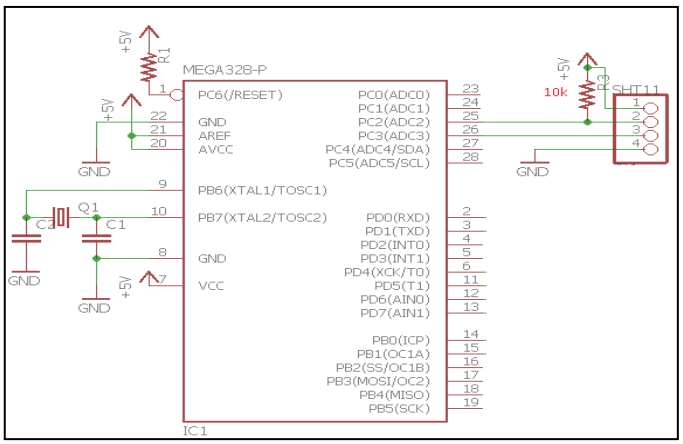

Figure 3.SHT 11 Sensor Circuit

Series oxygen Sensor KE-25 is connected to the microcontroller can be seen in Figure 3, the Output pin oxygen sensor KE-25 is connected to ADC 0. The ground on oxygen sensor KE-25 is connected to a Ground source.

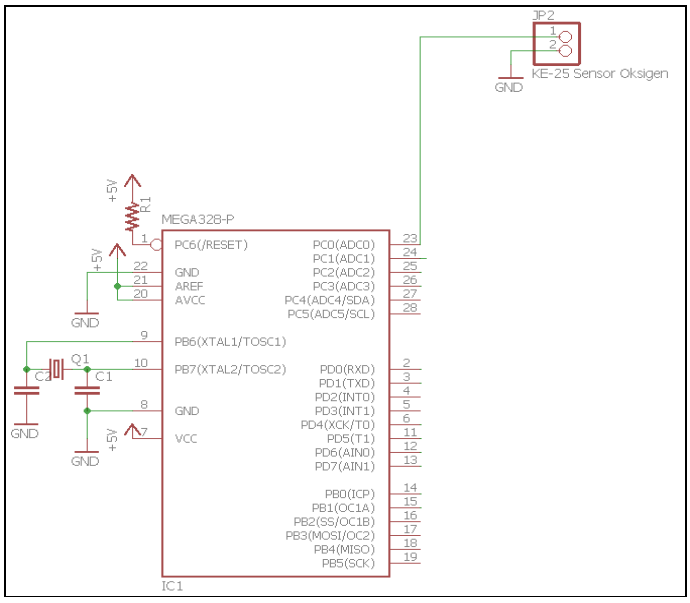

Figure 4.Oxygen KE-25 Sensor Circuit

As for the full set of in a third sensor i.e. Hydrogen sensor TGS 821, SHT11 sensor and oxygen KE-25 sensor is connected on the ATMega 328 microcontroller can be seen as in Figure 5 below.

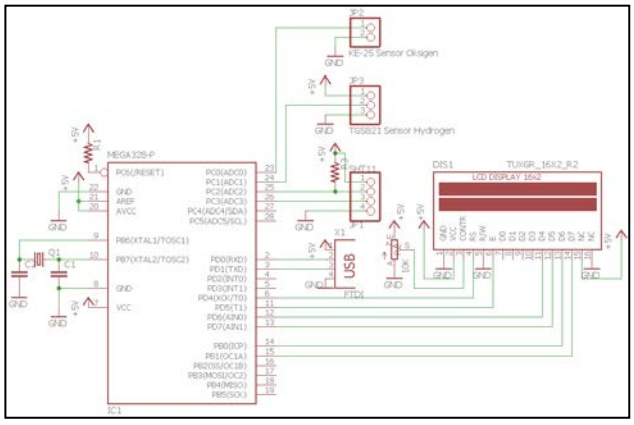

Figure 5. ATMega 328 Microcontroler Circuit

2.2 Methods

As for the full set of in a third sensor i.e. Hydrogen sensor TGS 821, SHT11 sensor and oxygen KE-25 sensor is connected on the ATMega 328 microcontroller can be seen as in Figure 5.

2.2.1 Testing Data Acquisition Circuit

Testing data acquisition circuit-based microcontroller with the look of a PC, the microcontroller into storage and execution of a program that is embedded into the PC interface between pc and microcontroller, this research on sensor gas sensors are used, temperature and humidity sensors. The resulting output voltage is not directly be attributed to the microcontroller, microcontroller in order to be able to know the gas, temperature, and humidity should be through a series of analog to digital converter that is already built-in in the

microcontroller. Then the output voltage will be converted to 8 bits of digital data. 8 bits of digital data in the form of the 8-bit binary will then be given to the microcontroller. The microcontroller will transmit data of gases, the temperature, and humidity in the series to a PC.

In this research used filters hydrogen made from natural zeolite Pahae.Natural zeolite phase from the region of North Tapanuli, Pahae Village, North Sumatra. Chunks of the zeolite obtained are then processed into powder with some stage is smoothing, sifted, and phase zeolite activation. Refinement of the zeolite is used by using mortar or clay, then sifted by using zeolite sieve measuring 200 mesh. Pahae zeolite powders obtained with 200 mesh size after the sieving process and feathered. Pahae zeolite powder is then activated by using a chemical solution of sulfuric acid (H2SO4). And drying is done against the powder with the temperature of combustion, and the powder 105 C printed using hot press then the resulting hydrogen filter based natural zeolite pahae.

Electrolysis hydrogen-producing system, hydrogen filter based zeolite Pahae entered into the chamber and then linked the system sensor by using a hose. The sensor system next hooked up application PLX-DAQ Spread Sheet, so that the sensor detection results can be displayed via a laptop (computer) or LCD. The process of electrolysis of water obtained through water electrolyser with the help of PSA (Power Supply Adapter) provided voltage. Then the voltage given on the water electrolysis solution so aquades put on water electrolyser will be shaped bubbles. Bubbles on the surface of the water electrolyser produce hydrogen and oxygen will be forwarded to the system then detected using a sensor system. On the process of electrolysis not only hydrogen and oxygen are produced but there is water vapor when electrolysis process occurs, thus used filter zeolite for holding water vapor that goes so pure hydrogen is obtained on the process electrolysis

3. Result and Discussions

Testing a hydrogen sensor TGS 821 series is done at a time when the process of electrolysis takes place. Testing is done by placing the sensor TGS 821 in the holding room of hydrogen results from the process of electrolysis. Sensor TGS 821 will detect the hydrogen out of the filter and then into a reservoir of hydrogen. Detection results will then be deinterlaced to the PC in the form of an excel document with a USB-based data acquisition system TTL. The following is a program Arduino.

In the process of testing this, data was acquired with a span of 11 minutes the performed for 4 hours. On the process of electrolysis on this research, used three filters i.e. filter 1, filter 2 and 3 filters as sample 1 and sample 2, sample 3 respectively. This testis carried out three times the voltage variations one achrepetitioni.e. 9 V, 11 V, 13 V, 14 V, and 15 V to facilitate the analysis of the results, the results of this testing is made into a form of test code thatis HS-1 HS-2 and HS-3 for results testing phase sample (filter) the first, second and third respectively.Testing the circuit sensor SHT 11 done by testing a series of sensor SHT11 who have constructed before his. The sensors that connected to the microcontroller will detect the moisture and temperature sensors in space at a time when the process of electrolysis takes place. The sensors provide data output 11 SHT of humidity and temperature on the data pin in turn in accordance with the given microcontroller clock so that the sensor can work. Sensor SHT 11 has the ADC in it so that the output data converted in the form of digital data and does not require an external ADC microcontroller data management.

The results of the testing nature of the sensing voltage variations on each sensor produce five-parttest results the test results in a response, linear, cross-sensitivity (selectivity), performance, and the purity of hydrogen.

The results of the test sensor response are defined as the ability of the sensor to distinguish a material or content that is presented to him (Ikhsan et. all. 2013). On the results of the response, the test shows the reason. In response to the test results showed response sensor TGS 821 in delivering value to the output against the concentration of hydrogen produced through the process of electrolysis and streamedinto the shelter of hydrogen.

Following is the result of test response sensor TGS 821 on the system of electrolysis using the filter.

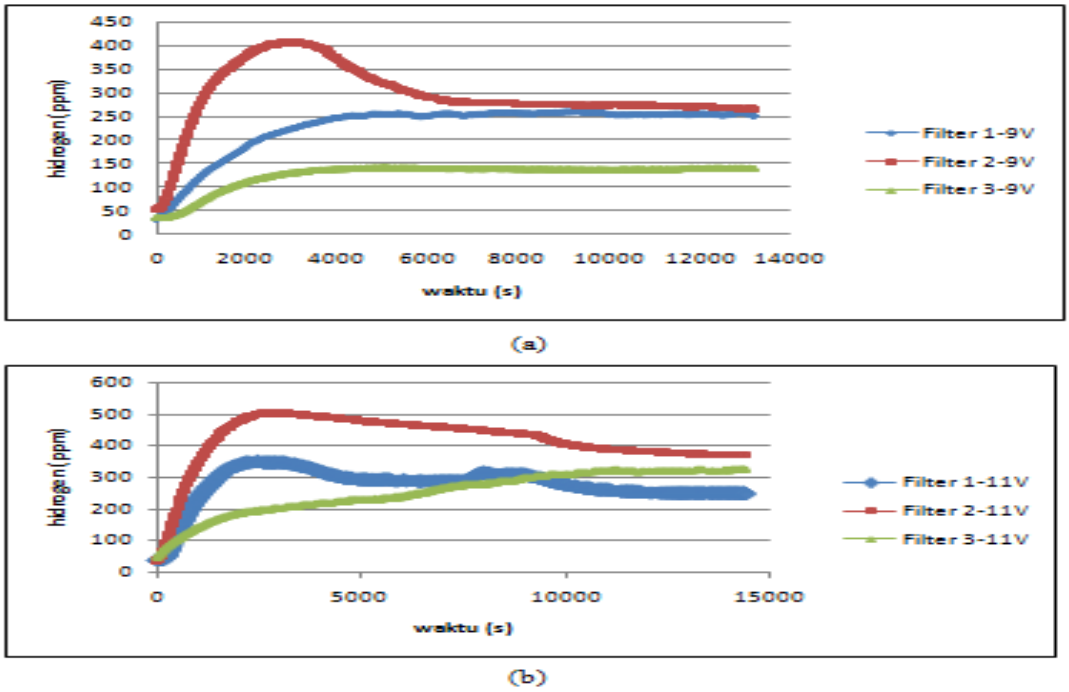

Figure 6. The results of Testing the response of the Sensor TGS-821 on the process of Electrolysis using the Filter with Input Voltage Variations (a) 9V, (b), (c) 11V 13V, 14V, (d) and (e) 15V.

Figure 6 results of testing the hydrogen absorption detector sensor response designed in this study against the hydrogen concentration resulting from the process of electrolysis using the filter.The process of electrolysis as a hydrogen result.

In this study using the three filter, there are filter 1, filter 2 and 3. Filter with input voltage variations i.e. five 9V, 11V, 13V, 14V and 15V respectively.

The response to the test results obtained and shown in Figure 3.1 and then more clearly shown in table 1 below .

Table 1.The results of testing the response of the Sensor TGS-821 against concentration of Hydrogen that is linked to the input Voltage Variations

Filter	Input Voltage				
	9V	11V	13V	14V	15V
Filter 1	258,53 (ppm)	350,1 (ppm)	725 ,77 (ppm)	925,06 (ppm)	704,23 (ppm)
Filter 2	409,34 (ppm)	502,25 (ppm)	863,12 (ppm)	964,11 (ppm)	655,76 (ppm)
Filter 3	142,73 (ppm)	367,6 (ppm)	801,18 (ppm)	962,76 (ppm)	737,89 (ppm)

Porosity filter that is the entrance of hydrogen will be narrowed due to the snapping of water vapor, which is a big on the walls of the filter from the remains of the process of electrolysis because of the input voltage a very high process.

4. Conclusion

In this study, the saturation voltage electrolysis process is obtained using this filter started of the voltage of 15V can be seen happening decrease hydrogen from 925.06 into 704.23 in the filter 1, the decrease in concentration of hydrogen from 964.11 be 655.76 on filter 2 and a decrease in concentration of hydrogen from 962.76 into 737.89 in the filter 3.Based on the law of conservation of energy then electrical energy can be turned into heat energy and vice versa heat energy can be changed into electrical energy.

In the process of electrolysis using the filter then the water vapor will held by filters and that is passed is hydrogen, when the sensor will detect not using a filter then the water vapor along with the hydrogen. Here the association between time and temperature with voltage input 9V, 11V, 13V, 14V, and 15V to electrolysis process used hydrogen filter.

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