An experimental investigation on determining Proton Preve manual transmission alternator potential to power hydrogen separator cell

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ABSTRACT – This paper presents measurement of alternator output current at idle speed to find the potential of the alternator to power a hydrogen separator cell. Proton Preve 1.6L manual transmission with alternator power rating of 12V/90A is used for the experiment. The car engine was running at idle speed and a digital AC/DC clamp was used to measure the current at the alternator output. A k-type thermocouple was used to measure the temperature at the alternator stator. The loads were applied by turning on the available electrical devices in the car in sequence. Meanwhile, the hydrogen separator cell was tested by turning it on power using a DC power supply. The DC power supply gives the current amount the hydrogen separator cell required to produce the desired amount of at least 100 ml/min hydrogen gas. The alternator has the potential to support the current demand by the hydrogen separator cell even after turning on all of the available electrical devices at idle speed. Although the temperature at the alternator stator rises due to the added load, but the temperature is still within safe temperature ranges. The result shows that Proton Preve has the potential to install the hydrogen separator cell.

1. INTRODUCTION

Global warming which cause by air pollution around the world has motivated scientists to find solutions and encouraged researchers to develop products of which can reduce air pollution. One of the inventions is the hydrogen separator cell. Hydrogen has been known as clean fuel and can help reduce the air pollution [1, 2, 3].

The electrical power demands in vehicle have been rising rapidly for many years along with the introduction of many automobile devices [4, 5]. The alternator is getting bigger in power to support the power demand. For this research, a car, Proton Preve 1.6l manual transmission was used to test whether it can power a hydrogen separator cell without doing any harm to the engine and the battery.

The objective of this study is to investigate and determine the potential (chance) of the alternator to power the hydrogen separator cell. The result is significant to prove that the car can operate as usual and won't have problem after installing the hydrogen separator cell.

2. RESEARCH METHODOLOGY

There are two separate experiments for this study. First is to measure the alternator current produced at the alternator output, measured at engine idle speed, and the second experiment is to measure the current required to power the hydrogen separator cell, to produce hydrogen gas at minimum 100 ml/min. Figure 2.1 shows the set up for the first experiment, while Figure 2.2 shows the set up for the second experiment.

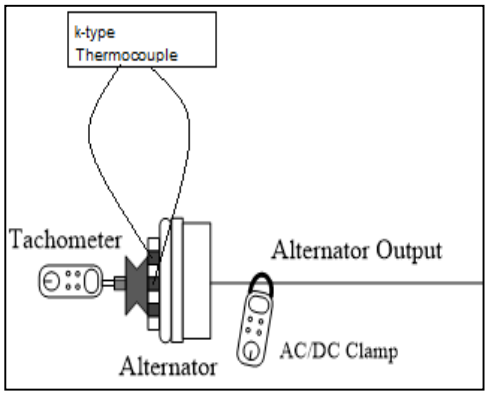

Figure 2.1 Schematic diagram of alternator output current measurement

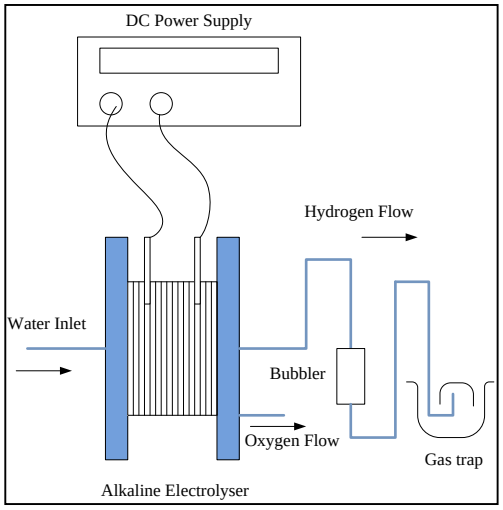

Figure 2.2 Schematic diagram of measurement of hydrogen separator cell gas output

3. RESULTS AND DISCUSSION

3.1 Alternator output

Table 3.1 shows the obtained results from the experiment. The result is the average of 5 repeated experiments. All the devices listed in Table 1 are being turned on one by one in sequence. For the case of rear

lamp, hazard, power window, wiper and horn, it is decided to turn them on all at the same time.

Table 3.1 Current at alternator output. Temperature at alternator stator

Electrical devices (Turn on in sequence)	Electrical devices (Turn on in sequence)	Electrical devices (Turn on in sequence)
Engine start	Engine start	Engine start
Radio	Radio	Radio
Air-conditioner	Air-conditioner	Air-conditioner
Front light	Front light	Front light
High-beam	High-beam	High-beam
Fog lamp	Fog lamp	Fog lamp
Passenger light	Passenger light	Passenger light

3.2 Hydrogen separator cell current demand

Table 3.2 shows the result for the hydrogen separator cell test. 14 V of voltage is supplied as to match the voltage output by the alternator. While the 12 V of voltage is set as the minimum voltage.

Table 3.2 Hydrogen separator cell output

Voltage (V)	Current (A)	Hydrogen Produced (ml/m)
12.0	3.2	175
12.5	3.9	225
13.0	4.7	250
13.5	5.5	300
14.0	6.3	325

3.3 Discussion

The current cannot be obtained the exact value because the moving of current is too fast, the data keep on changing on the screen every second. But the gap between each value is not too far, about ±1.5A.

The alternator has a power rating of 12V/90A, this means that the alternator can produce current up to 90A. From the experiment, after all the electrical devices have been turned on, the value is 62A. This shows that the alternator still can generate another 28A of current. The increase of load (current) also contribute to increasing of temperature at the alternator stator. This conforms to the laws of physics. The test of hydrogen separator cell was done using voltage range of 12V to 14V. This is to simulate the voltage usage of the car. When the car engine is off, the voltage reading at the battery is 12V, and when the engine is running, the reading is 14V.

The hydrogen separator cell can produce more hydrogen gas at higher voltage. But with increase of voltage, so does the current.

4. SUMMARY

This study was done to determine whether local made car such as Proton Preve can install the hydrogen separator cell. The hydrogen separator cell has been used at foreign countries such as America, Japan and UK. The benefit of the hydrogen gas to the car performance and emission control has been proved.

From the results obtained, it shows that the Proton Preve alternator is capable to support the current demand by the hydrogen separator cell. Although the temperature at the stator will increase, but it is still in the safe temperature range.

Although the alternator can produce current up to 90A, it is not recommended to fully use the alternator. This is because the increasing of current will decrease the voltage. When the alternator voltage is less, the battery will be charged slower or may not be charged at all. This action will cause problem to the starting of the engine. Also, the increase of current will increase the temperature. Higher temperature will affect the performance.

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