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Preparation of Hydrogen Dry Cell

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Abstract: The objective of this research is to prepare an electrolyser, hydrogen dry cell to reduce green- house gas effect and air pollution. This research presents the results obtained from the experiments concerning electrolyser producing efficiency. These test emphasized the possibility of reducing fuel consumptions and pollutants from exhaust gases offered by the gaseous fuel.

Keywords: pollution; hydrogen; electrolyser; fuel; HHO

1. INTRODUCTION

Pollution is the most dangerous case in the world. Pollution is caused because of the factories and transportations. The combustion of carbon releases the harmful gas such as carbon monoxide, carbon dioxide etc. Almost all of the uses of fossil fuel in factories and transportation is for combustion. There has another problem for fossil fuels.. That is why, we need to find renewable energy for the world. Nowadays, there has plenty of renewable energy such as solar energy, wind turbine energy, biomass, biogas, hydrogen, etc. Among them, the hydrogen dry cell preparation is one of the most hydrogen technology for renewable energy hydrogen fuel cell is an electrolyser that is completely enclosed base on electrolysis of split water into oxygen and hydrogen. The resulting gas is called 'hydroxy' gas, as it is a mixture of hydrogen and oxygen. In today's power savvy world, dry cell is one of many types of electrochemical cells available for consumer use, but it was a great innovation when it was invented.

2. MATERIAL AND METHOD

2.1 Material

The materials for the construction of hydrogen dry cell are stainless steel plates, gaskets, PVC end plates, PVC pipe, bolt and nuts.

2.2 Sample of Electrolyser Construction

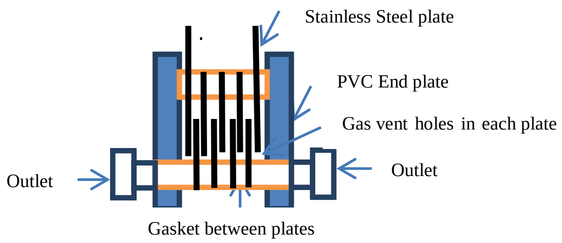

Figure 2.1 Series-Cell Electrolyser Cross-Section

2.3 Method

The thirteen electrolyser plates (Figure 2.2a) are about 0.5 mm thick 127 mm x 127 mm stainless steel (SS) (304 grade). A 6 mm gas vent hole is drilled in each plate. The electrolyte level is always about 25 mm below the gas vent hole. There is 3 mm diameter liquid level equalization holes drilled in the bottom corner of each plate (not shown) in such a way that adjacent plates have holes in opposite corners. Staggering and using small holes minimizes any efficiency loss due to current leakage between cells, but makes electrolyte refilling and level equalization significantly easier. The two end plates have a small SS piece welded for electrical contact.

Fourteen spacers (Figure 2.2b) were cut out of 3 mm thick soft gasket sheet with a knife. The wall thickness is 3 mm. The gasket sheet is originally designed for door material for large room-size refrigerators. The small square gasket blocks were meant to keep proper distance between SS plate centers, but they turned out to be unnecessary and were not used.

The end plates (Figure 2.2c) were cut out of 13 mm thick PVC plate. The size of the plates was 203 mm x 203 mm. Sixteen 3 mm holes were drilled for stainless steel through-bolts. A 1/2" pipe thread was tapped in 6 mm gas vent hole. A valve and gas hose connector was epoxy glued to the 1/2" tapped hole in both plates. Other thread sealants may not be compatible with the electrolyte so it is best to use epoxy or teflon tape. The valve was lined up with gas vent hole in SS plates. When the electrolyser stack is tightened up the PVC end plates tend to bend and bulge. Some form of metallic bracing should be used to prevent bending or the end plates made out of thick stainless steel plate.

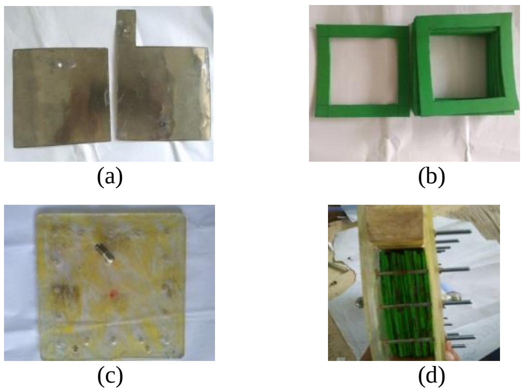

Figure 2.2 (a) Stainless Steel Electrolyser Plates (13 total)
(b) Soft Gasket Spacers Rings (14 total)
(c) PVC End Plate with Gas Valve Attached
(d) Assembled Stack

The finished electrolyser is shown in Figure 2.1d. The two PVC end plates are clamped together with 76 mm long stainless steel bolts and nuts. This softened the gaskets and allowed the stack to be tightened up even further to provide an excellent seal.

3. RESULT AND DISCUSSION

3.1 Hydroge Dry Cell Electrolyser Test

The finished electrolyser equipped was joined with the battery and filter (bubbler) is shown in Figure 3.1a. The bubbler is absolutely essential to prevent backfires from blowing up the electrolyser. The electrolyser may be filled with slightly acidic water (use vinegar) to neutralize any residual NaOH or KOH vapors in the output gas.

This test work done on stainless steel dry cell as shown below:

(a) (b)

Figure 3.1 (a) Finished Electrolyser with Bubbler
(b) Hydrogen Dry Cell

The hydrogen dry cell of actual flow rates were measured at various ammeter readings. The Ammeter readings and the actual flow rates are tabulated below:

Table 3.1 The Ammeter readings and the actual flow rates for hydrogen dry cell

Test	Amp	Q_{act} (ml/min)
1	10	130
2	15	220
3	20	300
4	25	433
5	30	586
6	35	670
7	40	886
8	45	1040
9	50	1230

3.2 Sample of Calculations

The calculation for the efficiency is as follows:

For theoretical maximum production of hydrogen hydrogen oxygen (HHO) gas for hydrogen dry cell,

The temperature in Kelvin's is 35+273 = 308 K

Q_{theo} = 0.627*308/273 LPH/A*15A*7 = 74.275 Liters/hour.

For actual gas production of HHO gas for hydrogen dry cell,

Q_{act} = 220*60/1000 = 13.2 Liters/hour.

Production efficiency for hydrogen dry cell: The efficiency is calculated by comparing the actual production to the theoretical maximum production.

η production = Q_{act}/Q_{theo} = 13.2/74.28 = 0.1778 = 17.78 %

3.3 Hydrogen Dry Cell Results

The efficiency of the hydrogen dry cell were calculated and shown in Table 3.2.

Table 3.2 Hydrogen Dry Cell Results

Test	Amp	Q_{act} (L/h)	Q_{theo} (L/h)	η
1	15	7.8	49.52	15.75
2	20	13.2	74.28	17.70
3	25	18	99.034	18.18
4	30	25.98	123.792	20.99
5	35	35.16	148.55	23.67
6	40	40.2	173.31	23.195
7	45	53.16	198.07	26.84
8	50	62.4	222.83	28.00
9	55	73.8	247.58	29.8

The production efficiency for hydrogen dry cell is shown in Figure 3.2.

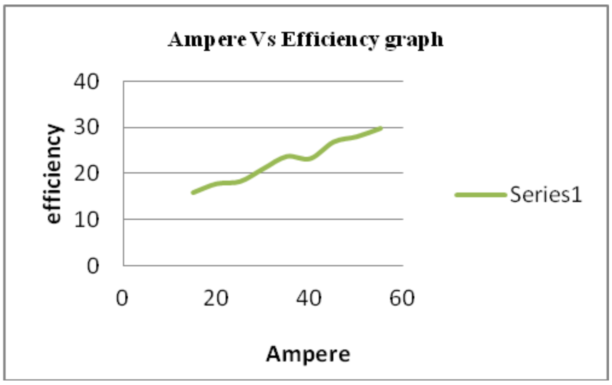

Figure 3.2 Production Efficiency for Hydrogen Dry Cell

4. CONCLUSION

We need to find an easy affordable way to reduce the fuel consumption, green- house gases effect and air pollution. On the dry cell test, the electrolyser production efficiency is not too high because most of the energy is transferred to heat due to the electrical resistance and the large size of the electrolyser and the loss happened due to the circulation of the electrolyte to generate hydrogen hydrogen oxygen (HHO) gas.

5. RECOMMENDATIONS

Recommendations for further research works are outlined as follow.

- Experiment with rapid study in change the number of stainless steel electrolyser plates.
- Experimental words on hydrogen dry cell preparation with efficiency need to be studied.

6. ACKNOWLEDGEMENTS

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