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REVIEW ARTICLE

PORTABLE PKL POWERED LANTERN

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ABSTRACT

It has been designed and developed the portable PKL (Pathor Kuchi Leaf) lantern for practical utilization for smart grid where grid electricity is absent. The PKL converter has been made with an insulated box and electrodes. The electrolytes were prepared by PKL extract. It was found that the portable lanterns were appropriate for PKL electric system. It is found that PKL Powered Lantern has been working well. The novelty of this research work shows that this type of work is very new one in the world. It can be used instead of solar PV sometimes. There are some advantages of this PKL systems compare to SPV (Solar Photo Voltaic) System. This PKL system can be used equally both for the rainy and night time. Whereas SPV system is not possible to use at the rainy and night time.

KEYWORDS

Portable, lantern, PKL, SPV, Eco friendly, Open circuit voltage, Short circuit current.

1. INTRODUCTION

The traditional sources of energy like oil, gas and coal have been decreasing rapidly around the world. So that the world will face the energy crisis within the 21st centuries (Khan et al., 2020a; Khan et al., 2020b; Rab et al., 2020a; Khan and Ressel, 2019; Khan and Salek, 2019). Although Bangladesh will face the energy crisis within 2050 (Khan and Reza, 2019; Khan et al., 2019; Khan and Salek, 2019). So we have no time in our hand and we should not destroy our time. We have to search new and renewable energy sources immediately. Bangladesh has a great lack of electricity. A lot of People of Bangladesh are not getting grid electricity (Hassan and Khan, 2019; Hasan and Khan, 2019). As a result entire development of the society is hampering. Govt. of Bangladesh has declared "The electricity for all by 2021" but due to shortage of gas it is impossible to perform by the Govt. of Bangladesh by 2021 (Khan et al., 2019a; Khan et al., 2019b). In Bangladesh around 80% electricity comes from gas based electricity generator. But the experts of gas-based electricity generator have declared that within 2050 Maximum gas based electricity generator will be inactive. That is why although some experts in this field are suggested to use the compressor to generate electricity. To keep this in mind pathor kuchi leaf have been used to produce electricity. The electricity generation by Pathor Kuchi Leaf (PKL) was prototype. It has been observed that the longevity of the voltage generation from Pathor Kuchi Leaf (PKL) very satisfactory (Rab et al., 2019). So we can cultivate the Pathor Kuchi Leaf (PKL) in our unused Agricultural land like coastal areas, hilly areas, two sides of the roads etc. This PKL system can generate more electricity by setting up a power plant by using Pathor Kuchi Leaf (PKL). This research work can show a guide line to the nation of any country. It is very new one research project in Bangladesh (Khan and Reza, 2019).

2. METHODOLOGY

The PKL lantern has a great future in the Rural area in Bangladesh. The

PKL lantern consists of 10 LED. One can use a storage battery in the lower section of the PKL lantern for store PKL electric energy.

Figure 1: (a) PKL module; (b) PKL tube light; (c) PKL lantern; (d): PKL lantern - Experimental set up of PKL Lantern.

Figure 1 (a) shows the PKL module made Zn and Cu electrodes. It has been set up parallel combinations to increase the current in each compartment by connecting wires. The arrangement of each compartments were connected in series combinations to increase the voltage. Figure 1(b) shows the a small tube light for practical utilizations. Figure 1(c) shows a small hurricane made by LED for practical utilizations. Figure 1(d) also show the a small hurricane with other designs for practical utilizations along the remote off grid areas across the world.

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3. RESULTS AND DISCUSSION

Date: 05.02.2009

Table 1: Current voltage relations with different loads

Number of cell	Open Circuit Voltage, Voc (V)	Short Circuit Current, Isc (A)	Resistance, R (Ω)	Load Voltage, V (V)	Load Current, I(A)
12	13.89	1.02	100	0.05	.5
			200	0.08	.4
			300	0.12	.4
			400	0.18	.45
			500	0.22	0.44
			600	0.27	0.45
			700	0.28	0.4
			800	0.31	0.39
			900	0.34	0.38
			1000	0.38	0.38
			1100	0.41	0.37
			1200	0.42	0.35
			1300	0.45	0.46
			1400	0.48	0.34
			1500	0.50	0.33
			1600	0.53	0.33

Figure 2: Current –Voltage relationship for different resistances

Figure 2 shows the current voltage relationship of a PKL module. It is shown that for different resistances the current voltage is almost constant for the variation of resistances between 100 ohms to 1600 ohm

Date: 16.10.2009

Table 2: Variation of load voltage with the variation of local time.

Open circuit Voltage, Voc (Volt)	Time duration (hr)	Load Voltage (Volt)
12	0	7.24
	1	7.15
	2	7.09
	3	7.02
	4	7.05
	5	6.99
	6	6.99
	7	6.97
	8	6.94
	9	6.94

Figure 3. Variation of load voltage with the variation time duration(hr)

Figure 3 shows the variation of load voltage with the variation of load current. It is shown that the load voltage varies 0.30 volt from 6.94 Volt to 7.24 Volt.

Date: 23.10.2009

Table 3: Consuming time Versus Consuming voltage table.

Consuming time duration (hr)	Consuming voltage (v)
0	4.57
1	4.18
2	3.71
3	4.32
4	4.91

Figure 4: Variation of consuming voltage with the variation of consuming time duration(hr)

Figure 4 shows the Variation of consuming voltage with the variation of consuming time duration(hr). It is shown that the consuming voltage has decreased slightly firstly and then after it has been increased slightly.

Date: 01.11.2009 - 04.11.2009

Table 4: Table for Minimum load voltage variation with different dates of the Month.

Date of the month of the year	Minimum Load voltage (V)
1.10.09	6.91
2.10.09	7.07
3.10.09	6.98
4.10.09	7.02

Figure 5: Variation of minimum load voltage with the variation of date of the month of the year.

Figure 5 shows the Variation of minimum load voltage with the variation of date of the month of the year. It is shown that the minimum voltage has been increased firstly and then decreasing and finally it has been increased.

Date: 01.11.2009 — 04.11.2009

Table 5: Variation of maximum voltage PKL module with the variation of different dates of the month for PKL lantern

Date of the month of the year	Maximum Load Voltage (LED Bulb) (V)
D1 = 1.10.09	7.04
D2 = 2.10.09	7.02
D3 = 3.10.09	7.03
D4 = 4.10.09	7.05

Figure 6: Variation of maximum load voltage with the variation of the date of the month of the year

Figure 6 shows the Variation of maximum load voltage with the variation of date of the month of the year. It is shown that the minimum voltage has been decreased firstly and then it has been increased. Comparing Fig.5 and Fig.6, it is shown that two figures are opposite.

Date: 18.11.09

Table 6: Variation of maximum load voltage with the variation of time duration

Time duration (hr)	Voltage without load (Volt)
0	12.15
1	11.72
2	11.52
3	11.28
4	11.20
5	10.89
6	10.75

Figure 7: Variation of voltage without load with the variation of the time duration(hr)

Figure 7 shows the Variation of voltage without load with the variation of the time duration(hr). The voltage without load decreased with time directly but the decreasing rate was slowly.

Date: 20.11.2009

Table 7: Table for consumed voltage by PKL lantern with the variation of local time.

Time duration (hr)	Consume load Voltage (Volt)
0	4.91
2	4.57
3	4.43
4	4.26
5	4.15
6	3.9
7	3.76

Figure 8: Variation of consuming load voltage with the variation of the time duration(hr).

Figure 8 shows the Variation of consuming load voltage with the variation of the time duration(hr). It is seen that it is directly proportional with time.

Date: 15.09.09

Table 8: Current-Voltage relationship with different loads of different date for the same PKL module

Number of cell	Open circuit Voltage (V)	Short circuit Current, Isc (A)	Resistance, R (Ω)	Load Voltage, V (V)	Load Current, I (A)
12	13.20	1.02	100	0.002	.08
			150	0.007	.07
			200	0.006	.06
			250	0.014	.05
			300	0.020	.05
			350	0.024	.05
			500	0.053	.04
			550	0.061	.04
			600	0.068	.04
			650	0.074	.04
			700	0.078	.03
			750	0.087	.03
			800	0.098	.03
			850	0.106	.02
			1000	0.123	.02

Figure 9: Current -Voltage relationship for different date

Figure 9 shows the Variation of current with the variation of the voltage. It is seen that the current decreases with the variation of voltages.

Date: 16.09.09

Table 9: Current-Voltage relationship with different loads different date for the same PKL module

Number of Cell	Open circuit Voltage, Voc (v)	Short circuit Current, Isc (A)	Resistance (Ω)	Load Voltage, V (V)	Load Current, I (A)
12	13.69	1.03	100	0.01	.015
			150	0.02	.015
			200	0.03	.015
			250	0.04	.014
			300	0.05	.013
			350	0.06	.013
			500	0.08	.012
			550	0.09	.011
			600	0.10	.011
			650	0.11	.010
			700	0.11	.010
			750	0.12	.009
			800	0.13	.008
			850	0.14	.007

Figure 10: Current –Voltage relationship for different date

Figure 10 shows the Variation of current with the variation of the voltage for different day. It is seen that the current decreases with the variation of voltages

Date: 05.11.09

Table 10: Utilization of PKL electricity with different PKL Lantern.

Time duration (hr)	PKL module load voltage load (V)	No. of shining of LED
0	7.02	10
1	7.04	10
2	7.05	10
3	7.05	10
4	7.05	10
5	7.06	10
6	7.04	10
7	7.04	10
8	7.04	10
9	7.05	10
10	7.06	10
11	7.06	10
12	7.05	10
13	7.04	10
14	7.03	10
15	7.02	10
16	7.01	10
17	7.01	10
18	7.00	10
19	6.99	10
20	6.98	10
21	6.97	10
22	6.96	10
23	6.95	10
24	6.93	10
25	6.93	10
26	6.92	10
27	6.91	10
28	6.90	10
29	6.90	10

Figure 11: Variation of Load Voltage with variation of time duration(hr)

Figure 11 shows the Variation of Load Voltage with variation of time duration(hr). It is seen that the load voltage increased firstly and then decreased almost linearly.

Date: 08.11.09

Table 11: Utilization of PKL electricity with different PKL Lantern.

Time duration (hr)	Voltage with a load (V)	No. of Shining of LED
0	7.25	10
1	7.25	10
2	7.25	10
3	7.24	10
4	7.25	10
5	7.25	10
6	7.25	10
7	7.26	10
8	7.27	10
9	7.27	10
10	7.25	10
11	7.26	10
12	7.27	10
13	7.27	10
14	7.27	10
15	7.26	10
16	7.27	10
17	7.28	10
18	7.27	10
19	7.25	10
20	7.25	10
21	7.24	10
22	7.24	10
23	7.25	10
24	7.23	10
25	7.23	10
26	7.22	10
27	7.22	10
28	7.21	10
29	7.20	10

Figure 12: Variation of Load Voltage with variation of time duration(hr)

Figure 12 shows the Variation of Load Voltage with variation of time duration(hr) for other day for the same module. It is seen that the variation pattern of the load voltage is different from other day. The load voltage increased firstly and then decreased but not linearly.

4. COST ANALYSIS

Table 5: Table for Cost per Watt in USD (1\$ = 85 Tk)

Items	Price
Pkl	20(Tk.)
Gas	100(Tk.)
Solar	800(Tk.)

From Table-5, it is seen that the compariso costs among the PKL, Gas and Solar PV system. It is seen that PKL cost is the lowest price which is acceptable price among the 3 items.

5. FURTHER STUDY

1. NPs (CuO, ZnO and Fe₃O₄) production from PKL leaf extract
2. Characterization: SEM, FESEM, TEM, VSM, TGA, AAS, XRD, FTIR etc
3. Electrochemical conversion of CO₂ into useful chemicals and PKL electricity
4. Determination of energy efficiency, Voltaic efficiency, Voltage regulation, Self discharge characterization, Pulse performance and Internal Resistance, coulombic efficiency, self discharge characteristics, Discharge characteristics with load after adding different NPs with the PKL extract.
5. Preparation of modified surface electrodes like paper electrodes.
6. Preparation of pencil batteries using PKL (Pathor Kuchi Leaf)

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