PKL Electricity- A Step forward in Clean Energy

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Abstract

It is defined by some important parameters for PKL electrochemical cells. The parameters have been defined theoretically which are given by the following: (i) Open circuit voltage (V_{oc}) (ii) Short circuit current (I_{sc}) (iii)Voltage Regulation (V_R) (iv) PKL power density (PD) (v) Energy Density(ED) of PKL, (vi) Capacity of the PKL cell(AH) (vii) Energy efficiency of a PKL cell (η_c) (viii) Maximum Power(P_{max}) and ix) Load Power(P_L) etc. The variation of these parameters with the variation of time has been studied. In this paper the variation of open circuit voltage, short circuit current, load voltage and load current with the variation of time in hours have been studied. All has been tabulated and graphically discussed.

Keywords: *PKL electricity, Parameters, Performance, Capacity, Energy efficiency.*

I. Introduction

Pathor Kuchi leaf is known as a medicinal leaf from ancient time. Because it has a great medicinal value. It is used for different kinds of diseases like dysentery, kolhera, typhoid, kidney disease etc. in west Bengal, India there is no alternative about Pathorkuchi leaf for folk medicine. People are using the leaf as a folk medicine. But now a days, it is using to generate electricity for low and medium power production [1-18]. Generally Zn and Cu metal is used as an electrode and extract of the PKL juice is used as an electrolyte. To enhance the power of the PKL electricity some secondary salt is used. Copper sulfate ($CuSO_4$) is one of the important and popular secondary salt for PKL power production [19-29].

II. Methods and Materials

Fig. 1: PKL Electric converter with Glass box

Fig. 2: PKL Electric converter with Cu and Zn Plates

Fig.3 : PKL Juicer in bigger size

Fig.4: Application of PKL electricity

Fig.1 shows the converter of the PKL electricity made by glass. Copper and Zinc electrodes are used as anode and cathode respectively. PKL extract was used as an electrolyte. Fig.2 was shown the converter with copper and Zinc electrodes. Fig.3 shows the juicer for bigger size. It was used to prepare the PKL extract. PKL extract was put in to the converter which was fulfilled with the copper and Zinc electrodes [30-35]. Fig.4 shows the applications of the PKL electricity.

III. A. Define different Parameters:

(i) Open circuit voltage (V_{OC}) **:**

The voltage without load is called open circuit voltage[36-38].
Generally, it is denoted by V_{OC}.

(ii) Short circuit current (I_{SC}) **:**

The current without load is called short circuit current.
Generally, it is denoted by I_{SC}.

(iii)Voltage Regulation (V_R) **:**

It is defined by the following equation [39-45]:

$$V_R = \frac{V_{NL} - V_{KL}}{V_{KL}} \times 100\%$$

where, $V_R = \text{Voltage Regulation}$
$V_{NL} = \text{No load Voltage}$
$V_{FL} = \text{Full load Voltage}$

Generally, $V_R \approx 0$ is desire, which is practically impossible.

(iv) PKL power density (PD) :

It is defined as the power extraction per kg PKL (Pathorkuci leaf).

$$\text{The Power Density (PD)} = \frac{\text{Power extraction(watt)}}{\text{kg}}$$

(v) Energy Density(ED) of PKL:

It is defined as the Energy (KWh) per litter $\text{The Energy Density (ED)} = \dfrac{\text{Power extraction (KWh)}}{\text{Littre}}$

vi) Capacity of the PKL cell (AH):

How much current you will get for long time.
Generally, it is denoted by C.

$$\therefore \quad C = AH$$

Where, $A = \text{Current in Ampare}$ and $H = \text{Time in hour}$.

vii) Energy efficiency of a PKL cell (η_c) :

It is defined by the following equation:

$$\eta_C = \frac{P_{out}}{P_{in}} = \frac{V_{out} It}{V_{in} It} = \frac{V_D I_D t_D}{V_C I_C t_C}$$

Where, $\eta_C = \text{energy efficiency}$

$V_D =$ Discharging Voltage

$I_D =$ Discharging Current

$t_D =$ Discharging Time

$V_C =$ Charging Voltage

$I_C =$ Charging Current

$t_C =$ Charging Time.

viii) Maximum Power (P_{max}) :

It is defined by the following equation :

$$P_{max} = V_{OC} I_{SC}$$

Where, $P_{max} = \text{Maximum Power}$

$V_{OC} =$ Open circuit Voltage

$I_{SC} =$ Short circuit Current

ix) Load Power (P_L) :

It is defined by the following equation:

$$P_l = V_L I_L$$

Where, $P_L = \text{Load Power}$

$V_L =$ Load Voltage

$I_L =$ Load Current

II.B. Vernacular name of the PKL[46-49] :

(i) Stone chifs
(ii) Air Plant
(iii) Mircle Leaf
(iv) Mother of thousands
(v) Mother of Millions
(vi) Leaf of Life
(vii) Devil's Back bone
(viii) Pregrant Leaf

(IX) Monekey’s ear
(X) Moneky ear
(XI) Solri
(XII) Sotre etc.

II.C Land situation in Bangladesh for cultivation of PKL[24, 50-58]:

Total land = 55000 sq. miles

$1\ Square\ Mile = 640\ acres$

$= 3500000\, acrs / 2.5 = 14080000\, hectors$

Total land (TL) in hectors
Therefore, The NAL (Non Agricultural land)
= 5580000 hectors.
The 2% of NAL

$= 111600 \quad hectors \times 7.5 = 837000 \quad Bigha \quad [1\ hector = 7.5\ bigha]$

From 1 Bigha PKL, we can get $100\ kW$ electricity.
From 837000 Bigha PKL, we can get 83700000 kW electricity= 83700 MW.
The AL (Agricultural Land) is needed to cultivated foods and crops. The NAL is needed for housing, roads and other multipurpose use. So that the NAL of coastal areas, hilly areas and both sides of the road can be used for cultivation of PKL to generate electricity in Bangladesh, which would be approximately 2% of NAL.

II.D Cultivation of PKL in Bangladesh:

The cultivation of PKL is so much easy. This plants grow whether its leaf is kept on the ground and hence can be cultivated in a vasted land, roof top of the house, courtyard and tubs what so ever. Its leaves can be used for producing electricity within a month after cultivation of the plants [50-62].

III. Data Collection and Graphical Analysis:

i) Table for data Collection

Date	Local Time	Time Duration (H)	Open circuit Voltage V_{oc} (Volt)	Load Voltage V_L (Volt)	Short circuit Current I_{sc} (A)	Load Current I_L (A)	Immerse depth of the copper plate (cm)	Immerse depth of the zinc plate (cm)	Capacity C=AH	$P_{max} = V_{oc} I_{SC}$	$r_{in} = V_{oc} / I_{sc}$	Volume of PKL juice (m^3)	$P_L = V_L I_L$	$\eta_c = (P_{out}/P_{in}) \times 100\%$	$V_R = (V_{oc} - V_L)/V_L$
02 / 02 / 2018	12.15	3840	5.70	2.49	3	1.2	4.6	5	11520	17.1	1.9	2.157455×10^{-3}	2.988	17.47	1.289
	12.30	3840.25	5.55	2.61	2.4	0.9			9216.6	13.32	2.312		2.349	17.63	1.126
	12.40	3840.42	5.26	2.62	1.8	0.8			6912.7	9.468	2.922		2.358	24.90	1.007
	12.50	3840.59	5.28	2.16	1.7	0.9			6529.01	8.936	3.105		1.944	21.66	1.44
	1.00	3840.76	5.29	2.37	1.6	0.7			6145.21	8.464	3.306		1.659	19.60	1.232
	1.10	3840.93	5.34	2.9	1.8	0.8			6913.67	9.612	2.966		2.32	24.14	0.841
	1.20	3841.10	4.59	1.96	1.6	0.5			6145.76	7.344	2.868		0.98	13.34	1.341
	1.30	3841.27	5.24	2.3	1.1	0.5			4225.37	5.764	4.763		1.15	19.95	1.278
	1.40	3841.44	5.05	2.27	1.2	0.7			4609.72	6.06	4.208		1.589	26.22	1.224
	1.50	3841.61	5.19	2.59	0.8	0.6			3073.28	4.152	6.487		2.072	49.90	1.003
	2.00	3841.78	5.01	2.57	1.0	0.8			3841.41	5.01	5.01		2.056	41.03	0.949

	2.50	3842.61	5.56	2.34	2.3	1.3			8835.7	12.788	2.417		3.042	23.78	1.376
	3.00	3842.78	5.26	2.37	2.4	0.7			9222.67	12.624	2.192		1.659	13.14	1.219
	3.10	3842.95	5.32	2.32	1.9	0.6			7301.6	10.108	2.8		1.392	13.77	1.293
	3.20	3843.12	5.25	2.67	1.9	0.6			7301.92	9.975	2.763		1.602	16.06	0.966
	3.30	3843.29	5.06	2.31	2.0	0.7			7636.98	10.12	2.19		1.617	15.78	1.19
	3.40	3843.46	5.29	2.50	2.4	0.8			9224.8	12.696	2.204		2.00	15.75	1.116
	3.50	3843.63	4.84	2.34	2.7	0.7			10377.8	13.068	1.792		1.638	12.53	1.068
	4.00	3843.80	5.12	2.59	1.8	0.7			6918.84	9.216	2.844		1.813	19.67	0.976

ii) Open circuit voltage-Time duration Curve.

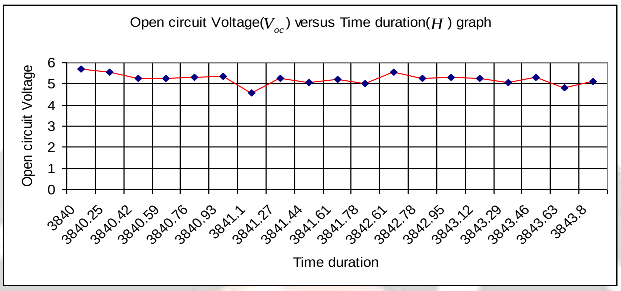

Fig.5 Open circuit voltage-Time duration Curve

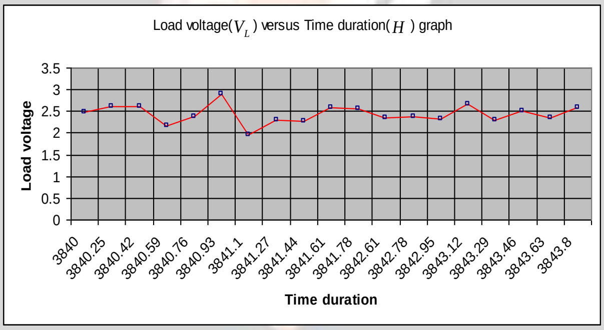

Fig.6 Load voltage-Time duration Curve

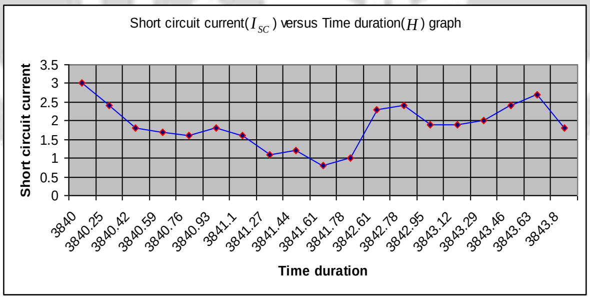

Fig.7 Short circuit current -Time duration Curve

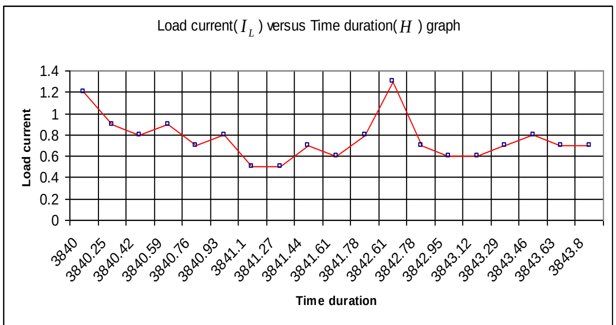

Fig.8 Load current -Time duration Curve

III. Results and Discussion:

Fig.5 shows the variation of open circuit voltage with the variation of time duration (hr) for 3843.8 hrs. It is shown that the variation of open circuit voltage was almost constant, although firstly the open circuit voltage was around 5.8 volt and finally it was dropped at around 5 volt.

Fig.6 shows the variation of load voltage with the variation of time duration (hr) for 3843.8 hrs. It is shown that the variation of load voltage was almost constant, although firstly the load voltage was around 2.5 volt and finally it was dropped also at around 2.5 volt. But it fluctuated from 2.5 volt to 2 volt between starting and finishing point.

Fig.7 shows the variation of short circuit current with the variation of time duration (hr) for 3843.8 hrs. It is shown that the variation of short circuit current was almost constant, although firstly the open circuit voltage was around 3A and then 1.5A and then after it increased 2.5 A and finally it was dropped at around 1.8 A.

Fig.8 shows the variation of load current with the variation of time duration (hr) for 3843.8 hrs. It is shown that the variation of load current was fluctuated from 1.2A to 0.7A, although firstly the open circuit voltage was around 1.2 A and then it increased up to 1.3A and then after it decreased 0.6 A and finally it was dropped at around 0.7A.

IV. Conclusion

The reading was taken after each 7 days. That is why it was zig zag form. The multi meters which were used are not calibrated properly. So that may be some errors during collection of the readings. In spite of that the authors tried to take readings very carefully.

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References

[1] Muhammad Riazul Hamid, Characterization of a Battery cell fueled by Bryophyllum Pinnatum sap, International Journal of Scientific & Engineering Research, Volume 4, Issue 3, ISSN 2229-5518, March-2013.

[2] Muhammad Riazul Hamid, Akib Yusuf, Abu Md. Abdul Wadud, and Md. Mosfiqur Rahaman, Design and Performance Test of a Prototype of a 12 Volt DC Battery Fueled by Bryophyllum Pinnatum Sap and Improvement of Its Characteristics, Department of Electrical and Electronic Engineering, Ahsanullah University of Science and Technology, Dhaka, Bangladesh, Email: {drhamidbd, shohan933}@gmail.com, {akib147, sshaon95}@yahoo.com, International Journal of Electronics and Electrical Engineering Vol. 4, No. 5, October 2016.

[3] K A Khan, " Electricity Generation form Pathor Kuchi Leaf (Bryophyllum pinnatum) " , Int. J. Sustain. Agril. Tech. 5(4): 146-152, July 2009.

[4] K A Khan and Md. Eyashir Arafat, "Development of Portable PKL (Pathor Kuchi Leaf) Lantern", Int. J. SOC. Dev. Inf. Syst. 1(1): 15-20 January 2010.

[5] K. A. Khan and Ranen Bosu, "Performance study on PKL Electricity for Using DC Fan", Int. J. SOC. Dev. Inf. Syst. 1(1): 27-30, January 2010

[6] K A Khan and Md. Imran Hossain," PKL Electricity for Switching on the Television and Radio",Int. J. SOC. Dev. Inf. Syst. 1(1): 31-36, January 2010

[7] Shuva Paul, K A Khan, Kazi Ahad Islam, Baishakhi Islam and Musa Ali Reza, "Modeling of a Biomass Energy based (BPL) Generating Power Plant and its features in comparison with other generating Plants ",IPCBEE vol. 44 (2012) @ (2012) IACSIT Press, Singapore DOI: 10.7763/ IPCBEE. 2012. V44. 3

[8] K. A. Khan, Shuva Paul, Md. Adibullah, Md.Farhat Alam, Syed Muhammad Sifat, Md. Rashed Yousufe, " Performance Analysis of BPL/PKL Electricity module ", International Journal of Scientific & Engineering Research Volume 4, Issue3, March-2013 1 ISSN 2229-5518

[9] K A Khan, Shuva Paul,Asif Zobayer,Shiekh Saif Hossain, A Study on Solar Photovoltaic Conversion, International journal of Scientific and Engineering Research ,Volume-4,Issue-3,March-2013,ISSN2229-5518, 2013

[10] Tania Akter, M H Bhuiyan, K A Khan and M H Khan, "Impact of photo electrode thickness and annealing temperature on natural dye sensitized solar cell", Published in the journal. of Elsevier. Ms. Ref. No.: SETA-D-16-00324R2, 2017

[11] K A Khan, Inventors, Electricity Generation form Pathor Kuchi Leaf (PKL), Publication date 2008/12/31, Patent number BD 1004907,2008

[12] K A Khan, Technical note "Copper oxide coatings for use in a linear solar Fresnel reflecting concentrating collector", Publication date 1999/8/1, Journal Renewable energy, Volume 17, Issue 4, Pages 603-608, Publisher – Pergamon, 1999

[13] K A Khan, Shuva Paul, A analytical study on Electrochemistry for PKL (Pathor Kuchi Leaf) electricity generation system, Publication date 2013/5/21, Conference- Energytech, 2013 IEEE, Pages 1-6, Publisher, IEEE,2013

[14]T.A.Ruhane, M.Tauhidul Islam, Md. Saifur Rahaman, M.M.H. Bhuiyan, Jahid M.M. Islam, M.K.Newaz, K A Khan, Mubarak A. Khan, "Photo current enhancement of natural dye sensitized solar cell by optimizing dye extraction and its loading period" , Published in the journal of Elsevier : Optik - International Journal for Light and Electron Optics, 2017.

[15] K A Khan, M S Alam, M A Mamun, M A Saime & M M Kamal, Studies on electrochemistry for Pathor Kuchi Leaf Power System, Ppublished in the Journal of Bangladesh J. Agric. And Envirin. 12(1): 37-42, June 2016

[16] Mehedi Hasan, Lovelu Hassan, Sunjida Haque, Mizanur Rahman, K A Khan, A Study to Analyze the Self-Discharge Characteristics of Bryophyllum Pinnatum Leaf Fueled BPL Test Cell, Published in the Journal of IJRET, Vol-6 Iss-12, Dec-2017

[17] J. Sultana, K A Khan, and M.U. Ahmed. "Electricity Generation From Pathor Kuchi Leaf (PKL) (Bryophillum Pinnatum)." J.Asiat Soc. Bangladesh Sci., 2011, Vol. 37(4): P 167-179

[18] M. Hasan, S. Haque and K A Khan, "An Experimental Study on the Coulombic Efficiency of Bryophyllum pinnatum Leaf Generated BPL Cell",IJARIIE, ISSN(O)-2395-4396, Vol-2, Issue-1, 2016

[19] K A Khan, Akhlaqur Rahman, Md Siddikur Rahman, Aniqa Tahsin, Kazi Md Jubyer, and Shuva Paul. "Performance analysis of electrical parameters of PKL electricity (An experimental analysis on discharge rates, capacity & discharge time, pulse performance and cycle life & deep discharge of Pathor Kuchi Leaf (PKL) electricity cell)." In Innovative Smart Grid Technologies-Asia (ISGT-Asia), 2016 IEEE, pp. 540-544. IEEE, 2016.

[20] M K A Khan, Shuva Paul, Md Siddikur Rahman, Ripon Kumar Kundu, Md Mahmudul Hasan, Mohammad Moniruzzaman, and Mohammad Al Mamun. "A study of performance analysis of PKL electricity generation parameters:(An experimental analysis on voltage regulation, capacity and energy efficiency of pathor kuchi leaf (PKL) electricity cell)." In Power India International Conference (PIICON), 2016 IEEE 7th, pp. 1-6. IEEE, 2016.

[21] MM Hasan, MKA Khan, MNR Khan and MZ Islam, "Sustainable Electricity Generation at the Coastal Areas and the Islands of Bangladesh Using Biomass Resources", City University Journal, Vol. 02, Issue. 01, P. 09-13, 2016.

[22] M Hasan and K A Khan, "Bryophyllum pinnatum Leaf Fueled Cell: An Alternate Way of Supplying Electricity at the Off-grid Areas in Bangladesh" in Proceedings of 4th International Conference on the Developments in Renewable Energy Technology [ICDRET 2016], P. 01, 2016. DOI: 10.1109/ICDRET.2016.7421522

[23] M Hasan, KA Khan, MA Mamun, "An Estimation of the Extractable Electrical Energy from Bryophyllum pinnatum Leaf", American International Journal of Research in Science, Technology, Engineering &Mathematics (AIJRSTEM), Vol. 01, Issue. 19, P. 100-106, 2017.

[24] K.A.Khan, Lovelu Hassan, A K M Obaydullah, S. M. Azharul Islam, M.A. Mamun, Tanjila Akter, Mehedi Hasan, Md. Shamsul Alam,M. Ibrahim, M Mizanur Rahman and M. Shahjahan , Bioelectricity: A new approach to provide the electrical power from vegetative and fruits at off-grid region, Published in the journal of Microsystem Technologies of Springer, manuscript number: 2018MITE-D-17-00623R2, Received: 14 August 2017/Accepted: 3 February 2018, Volumes-24,Issues-3, Impact Factor: 1.195, ISSN: 0946-7076 (Print) 1432-1858 (Online), Springer-Verlag GmbH Germany, Part of Springer Nature, DOI: 10.1007/s00542-018-3808-3, 2018.

[25] M K A Khan, M. S. Rahman, T. Das, M. N. Ahmed, K. N. Saha, and S. Paul, "Investigation on Parameters performance of Zn/Cu Electrodes of PKL, AVL, Tomato and Lemon juice based Electrochemical Cells: A Comparative Study,"In Electrical Information and Communication Technology (EICT), 2017 3rd International Conference on, pp. 1-6. IEEE, 2017. DOI: 10.1109/EICT.2017.8275150,IEEE, Khulna, Bangladesh, Bangladesh, 7-9 Dec. 2017.

[26] Md. Afzol Hossain, M K A Khan, Md. Emran Quayum,''Performance development of bio-voltaic cell from arum leaf extract electrolytes using zn/cu electrodes and investigation of their electrochemical performance'', International Journal of Advances in Science Engineering and Technology, ISSN: 2321-9009, Vol-5, Iss-4, Spl. Issue-1, Nov-2017

[27] K A Khan , M. A. Wadud , A K M Obaydullah and M.A. Mamun, PKL (Bryophyllum Pinnatum) electricity for practical utilization, IJARIIE-ISSN(O)-2395-4396, Vol-4, Issue-1, Page: 957-966

[28] K A Khan, A. Rahman, M. S. Rahman, A. Tahsin, K. M. Jubyer, and S. Paul, "Performance analysis of electrical parameters of PKL electricity (An experimental analysis on discharge rates, capacity & discharge time, pulse performance and cycle life & deep discharge of PathorKuchi Leaf (PKL) electricity cell)," In Innovative Smart Grid Technologies-Asia (ISGT-Asia), 2016 IEEE, pp. 540-544. IEEE, 2016.

[29] M K A. Khan, S. Paul, M. S. Rahman, R. K. Kundu, M. M. Hasan, M.Moniruzzaman, and M. A. Mamun, "A study of performance analysis of PKL electricity generation parameters:(An experimental analysis on voltage regulation, capacity and energy efficiency of pathorkuchi leaf (PKL) electricity cell)," In Power India International Conference (PIICON), 2016 IEEE 7th, pp. 1-6. IEEE, 2016.

[30] M K A Khan, M. S. Rahman, T. Das, M. N. Ahmed, K. N. Saha, and S. Paul,"Investigation on Parameters performance of Zn/Cu Electrodes of PKL, AVL, Tomato and Lemon juice based Electrochemical Cells: A Comparative Study,"In Electrical Information and Communication Technology (EICT), 2015 3rd International Conference on, pp. 1-6. IEEE, 2017.

[31] M. M. Haque, A.K.M.A. Ullah, M.N.L Khan, A.K.M.F. F. Kibria and K A Khan,"Phyto-synthesis of MnO2 Nanoparticles for generating electricity," In the International conference on Physics-2018, Venue-Department of Physics, University of Dhaka, Dhaka-1000,Bangladesh, Organizer-Bangladesh Physical Society(BPS, 08-10 March, 2018.

[32] Lovelu Hasan,Mehedi Hasan, K A Khan and S.M. Azharul Islam, "SEM Analysis of Electrodes and measurement of ionic pressure by AAS data to identify and compare the characteristics between different bio-fuel based electrochemical cell, " In the International conference on Physics-2018, Venue-Department of Physics, University of Dhaka, Dhaka-1000,Bangladesh, Organizer-Bangladesh Physical Society(BPS, 08-10 March, 2018.

[33] Mehedi Hasan and K A Khan, "Identification of BPL Cell Parameters to Optimize the Output Performance for the Off-grid Electricity Production, " In the International conference on Physics-2018, Venue-Department of Physics, University of Dhaka, Dhaka-1000,Bangladesh, Organizer-Bangladesh Physical Society(BPS, 08-10 March, 2018.

[34] K A Khan, M.S.Bhuyan,M. A. Mamun,M.Ibrahim,Lovelu Hassan and M A Wadud, "Organic electricity from Zn/Cu-PKL electrochemical cell ", Published in the Souvenir of First International Conference of Contemporary Advances in Innovative & Information Technology(ICCAIAIT) 2018,organized by KEI, In collaboration with Computer Society of India(CSI), Division-IV(Communication). The proceedings consented to be published in AISC Series of Springer,2018

[35] M K A Khan , A K M Obaydullah, M.A. Wadud and M Afzol Hossain, "Bi-Product from Bioelectricity", IJARIIE-ISSN(O)-2395-4396, Volume-4, Issue-2, Page-3136-3142 , 2018

[36] M K A Khan and A K M Obaydullah , "Construction and Commercial Use of PKL Cell", IJARIIE-ISSN(O)-2395-4396, Volume-4, Issue-2, Page-3563-3570, 2018

[37] M K A Khan, “Studies on Electricity Generation from Stone Chips Plant (Bryophyllum pinnatum)”, International J.Eng. Tech 5(4): 393-397, December 2008

[38] M K Alam Khan, "Copper Oxide Coating for use in Linear Solar Fresnel Reflecting Concentrating Collector",Published in the journal. of Elsevier, Renewable Energy, An International Journal, WREN(World Renewable Energy Network), UK, RE: 12.97/859,1998

[39] K A Khan, M Afzol Hossain, A K M Obaydullah and M.A. Wadud, “PKL Electrochemical Cell and the Peukert's Law ”, Vol-4 Issue-2, 2018 IJARIIE-ISSN(O)-2395-4396,Page: 4219 – 4227

[40] K A Khan, M.A.Wadud, M Afzol Hossain and A.K.M. Obaydullah, “Electrical Performance of PKL (Pathor Kuchi Leaf)Power”, Published in the IJARIIE-ISSN(O)-2395-4396,Volume-4, Issue-2, Page-3470-3478 ,2018.

[41] K A Khan, M Hazrat Ali, M. A. Mamun, M. Mahbubul Haque, A.K.M. Atique Ullah, Dr. Mohammed Nazrul Islam Khan, Lovelu Hassan, A K M Obaydullah, M A Wadud, “Bioelectrical Characteristics of Zn/Cu- PKL Cell and Production of Nanoparticles (NPs) for Practical Utilization’’ , 5th International conference on ‘Microelectronics, Circuits and Systems’, Micro2018, 19th and 20th May,2018,Venue: Bhubaneswar, Odisha, India, Organizer: Applied Computer Technology, Kolkata, West Bengal, India, Page: 59-66, www.actsoft.org , ISBN: 81-85824-46-1, In Association with: International Association of Science, Technology and Management, 2018

[42] M.M. Hassan, M. Arif and K A Khan, “Modification of Germination and growth patterns of Basella alba seed by low pressure plasma”, Accepted in the “ Journal of Modern Physics”, Paper ID: 7503531,2018

[43] K.A.Khan, S.M.Maniruzzaman Manir, Md. Shafiqul Islam, Sifat Jahan, Lovelu Hassan, and M Hazrat Ali. "Studies on Nonconventional Energy Sources for Electricity Generation" Internation Journal of Advance Research And Innovative Ideas In Education , Volume 4 Issue 4 2018 Page 229-244

[44] K A Khan, Mahmudul Hasan, Mohammad Ashraful Islam, Mohammad Abdul Alim, Ummay Asma, Lovelu Hassan, and M Hazrat Ali. "A Study on Conventional Energy Sources for Power Production" Internation Journal Of Advance Research And Innovative Ideas In Education, Volume 4 Issue 4 2018 Page 214-228

[45] M K A Khan ; Md. Siddikur Rahman ; Tanmoy Das ;Muhammad Najebul Ahmed ; Kaushik Nandan Saha ; Shuva Paul, Investigation on parameters performance of Zn/Cu electrodes of PKL, AVL, Tomato and Lemon juice based electrochemical cells: A comparative study, Publication Year: 2017, Page(s):1-6, Published in: 2017 3rd International Conference on Electrical Information and Communication Technology (EICT), Date of Conference: 7-9 Dec. 2017, Date Added to IEEE Xplore: 01 February 2018, ISBN Information: INSPEC AccessionNumber: 17542905,DOI: 10.1109/EICT.2017.8275150,Publisher: IEEE,Conference Location: Khulna, Bangladesh

[46] K A Khan and M. M. Alam, “ Performance of PKL (Pathor Kuchi Leaf) Electricity and its Uses in Bangladesh”, Int. J. SOC. Dev. Inf. Syst. 1(1): 15-20, January 2010.

[47] K A Khan, M. H. Bakshi and A. A. Mahmud, “Bryophyllum Pinnatum leaf (BPL) is an eternal source of renewable electrical energy for future world”, American Journal of Physical Chemistry 2014;3(5):77-83,published,online,November10,2014(http://www.sciencepublishinggroup.com/j/ajpc)doi:10.11648/j.ajpc.20140305.15,ISSN:2327-2430 (Print); ISSN: 2327-2449(Online),2014.

[48] M K A Khan, An Experimental Observation of a PKL Electrochemical Cell from the Power Production View Point, Presented as an Invited speaker and Abstract Published in the Conference on Weather Forecasting & Advances in Physics, 11-12 May 2018, Department of Physics, Khulna University of Engineering and Technology (KUET), Khulna, Bangladesh.

[49] Bapy Guha, Fakhrul Islam and K A Khan ,Studies on Redox Equilibrium and Electrode Potentials, IJARIIE-ISSN(O)-2395-4396, Volume-4, Issue-4, Page-1092-1102 , 2018

[50] Fakhrul Islam, Bapy Guha and K A Khan , Studies on pH of the PKL Extract during Electricity Generation for day and night time collected Pathor Kuchi Leaf , IJARIIE-ISSN(O)-2395-4396, Volume-4, Issue-4, Page-1102-1113 , 2018

[51] Mehedi Hasan and K A Khan, Dynamic Model of Bryophyllum pinnatum Leaf Fueled BPL Cell: A Possible Alternate Source of Electricity at the Off-grid Region in Bangladesh, Published in the Microsystem Technologies (2018), Springer, manuscript number, MITE-D-18-00800R1, DOI: https://doi.org/10.1007/s00542-018-4149-y, Publisher Name: Springer Berlin Heidelberg,Print ISSN: 0946-7076,Online ISSN: 1432-1858, First Online: 28 September 2018

[52] K A Khan, M.S.Bhuyan,M. A. Mamun, M. Ibrahim, Lovelu Hassan and M A Wadud, Organic Electricity from Zn/Cu-PKL Electrochemical Cell, Accepted in the Springer Nature, Series Title: Advs in Intelligent Syst., Computing, Volume Number:812, Book Title: Contemporary Advances in Innovative and Applicable Information Technology,ISBN:978-981-13-1539-8, https://doi.org/10.1007/978-981-13-1540-4, 2018

[53] K A Khan, Mohammad Lutfor Rahman, Md. Safiqul Islam, Md. Abdul Latif, Md. Afzal Hossain Khan, Mohammad Abu Saime and M Hazrat Ali, Renewable Energy Scenario in Bangladesh, Published in the journal of IJARII, Volume-4,2018, Issue-5, page : 270-279, ISSN(O)-2395-4396.

[54] K A Khan and Salman Rahman Rasel, Prospects of Renewable Energy with Respect to Energy Reserve in Bangladesh, Published in the journal of IJARII, Volume-4,2018, Issue-5, page : 280-289, ISSN(O)-2395-4396.

[55] K A Khan, Md.Shahadat Hossain, Md.Mostafa Kamal,Md.Anisur Rahman and Isahak Miah ,Pathor Kuchi Leaf : Importance in Power Production, IJARIIE-ISSN(O)-2395-4396 , Vol-4 Issue-5, 2018

[56] K A Khan, M.Hazrat Ali, M. A. Mamun, M. Ibrahim,A K M Obaidullah, M. Afzol Hossain and M Shahjahan, PKL Electricity in Mobile Technology at the off-grid region, Published in the proceedings of CCSN-2018, 27-28 October, 2018 at Kolkata, India.2018

[57] K A Khan and Afzol Hossain, Off-grid 1 KW PKL Power Technology: Design, Fabrication, Installation and Operation, Published in the proceedings of CCSN-2018, 27-28 October, 2018 at Kolkata, India,2018

[58] K A Khan, M. A. Mamun, M. Ibrahim, Mehedi Hasan, Md. Ohiduzzaman A K M Obaidullah, M.A Wadud and M Shajahan, PKL electrochemical cell for off-grid Areas: Physics, Chemistry and Technology, Published in the proceedings of CCSN-2018, 27-28 October, 2018 at Kolkata, India.2018

[59] K A Khan, and Salman Rahman Rasel. "Studies on Wave and Tidal Power Extraction Devices" International Journal of Advance Research And Innovative Ideas In Education Volume 4 Issue 6 2018 Page 61-70

[60] K A Khan, Sultan Mahiuddin Ahmed , Mousumi Akhter , Md Rafiqul Alam , and Maruf Hossen . "Wave and Tidal Power Generation" Internation Journal Of Advance Research And Innovative Ideas In Education Volume 4 Issue 6 2018 Page 71-82

[61] K A Khan, Md. Atiqur Rahman, Md. Nazrul Islam, Mahmuda Akter, and Md. Shahidul Islam. "Wave Climate Study for Ocean Power Extraction" Internation Journal Of Advance Research And Innovative Ideas In Education Volume 4 Issue 6 2018 Page 83-93

[62] K A Khan, Md.Sujan Miah, Md. Iman Ali, Sujan Kumar Sharma, and Abdul Quader. "Studies on Wave and Tidal Power Converters for Power Production" Internation Journal of Advance Research And Innovative Ideas In Education Volume 4 Issue 6 2018 Page 94-105