PKL electricity - The Role of Physics

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Abstract

The physics is related to the electrochemical cell for electrochemical cell. Reactant ions and product ions are the main reasons for electricity production. In this research work the product ions are [Zn^{2+}] and the reactant ions are [Cu^{2+}] and [H^{+}]. It has been studied the different electrical properties like: Open circuit voltage, Load voltage, Short circuit current, Load current, Internal resistance, voltage regulation, Maximum power, energy efficiency, voltaic efficiency, columbic efficiency, Pulse performance, Self discharge characteristics, Discharge characteristics with load, Power density, Specific power density, Energy density and Specific energy density.

Keywords: Energy efficiency, Maximum Power, Open circuit voltage, Short circuit current, Load voltage, Load Power, Voltaic efficiency.

Introduction

Renewable energy is one of the most important topic now a days. It is very necessary in our country especially in the un electrified areas. It does not have a limited source. It can be generated again and again and will never run out. PKL (Pathor Kuchi Leaf) is one of the renewable energy sources. It is called biomass energy. At present electricity is generated from fossil fuels, which is not eco-friendly and environmental friendly. But the renewable energy sources are environmental friendly. In spite of that electricity is generating fossil fuel. The gas based electricity is generating around 89% in Bangladesh. PKL electricity can be used side by side with Solar Photovoltaic electricity.

I. Methodology

Fig.1 PKL tree for leaf collection

Fig.1 shows a PKL tree.It has been cultivated for power generation. It has been blended for getting extract and then filtered with different filtered paper like 41 and 42 filtered papers.

Fig.2 An Experimental set up of PKL Electrochemical Cell

Fig.2 shows the Experimental set up of PKL Electrochemical Cell for power production. Zn and Cu plates were used as an electrodes and the filtered extract was used for electrolyte. The calibrated multimeter was used to measure the different parameters.

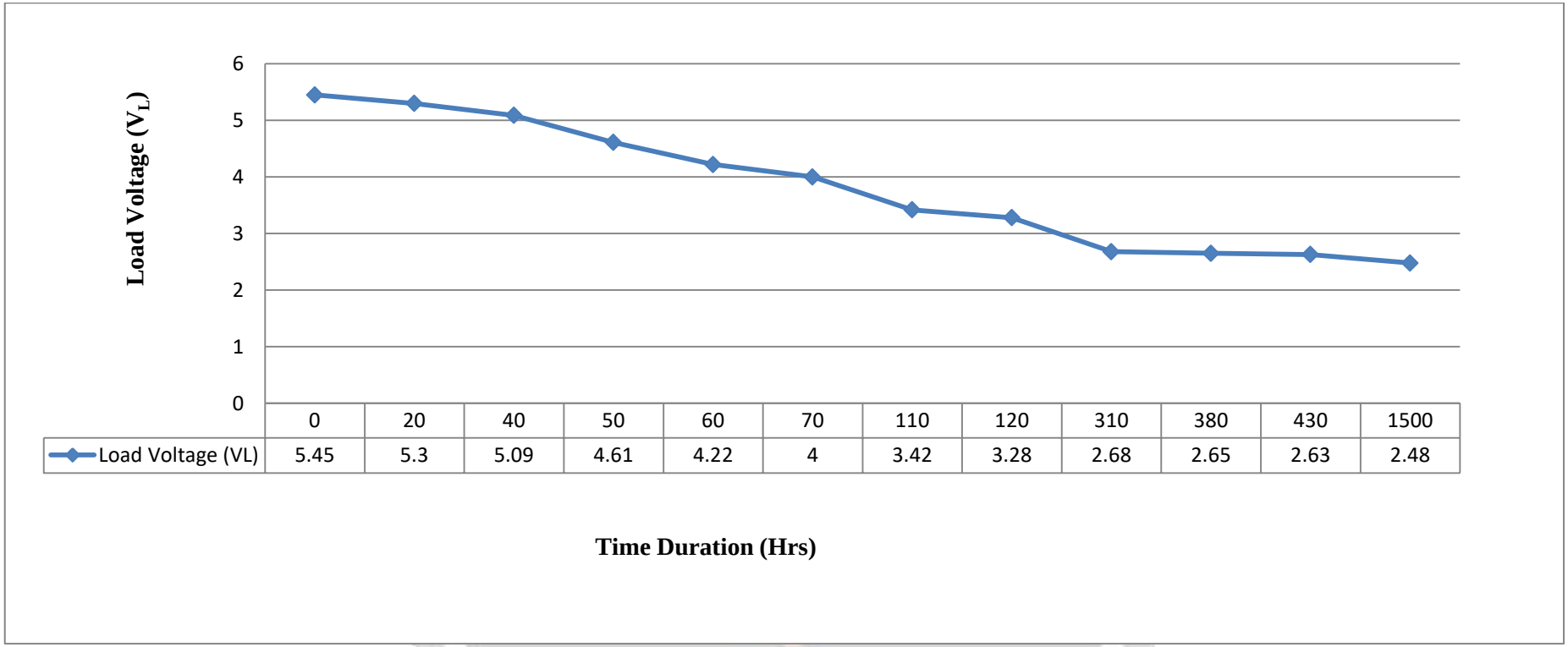
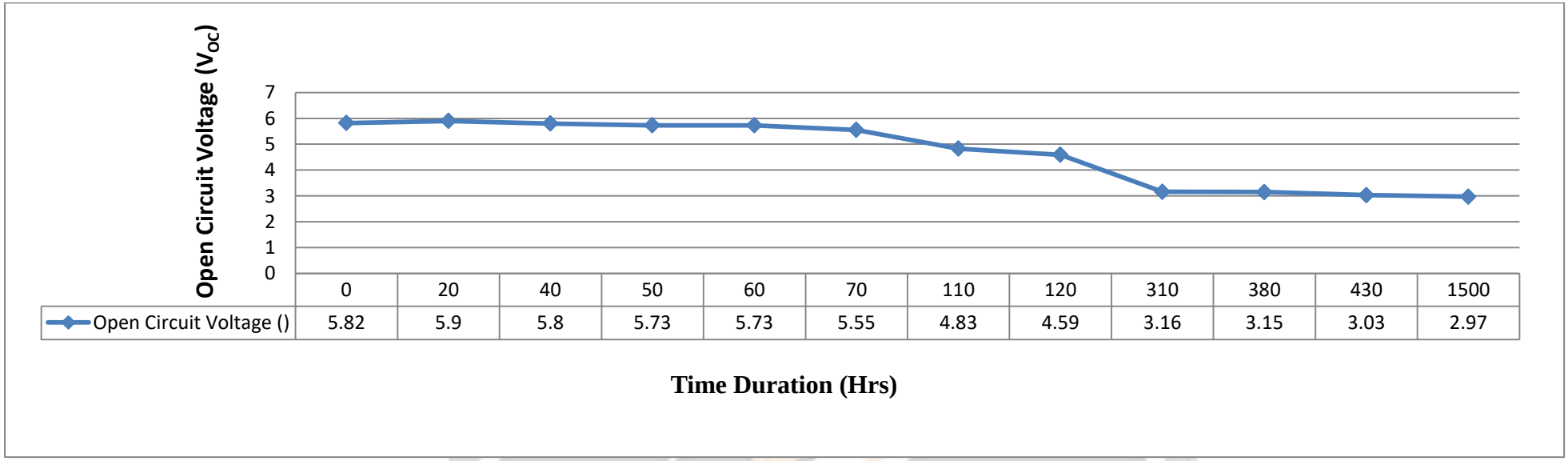


Fig.1 Load Voltage (V) VS Time duration (hrs)

Fig.1 shows the variation of Load Voltage (V) VS Time duration (hrs) for cell-1. It is shown that the maximum load voltage is 5.45 volt and the minimum load voltage is 2.48 volt. So the difference between the maximum and minimum voltage is 2.97 volt. It is also shown that the load voltage decreases linearly up to 110 minutes and then it decreases exponentially up to 310 minutes. Finally, it is shown that the load voltage was almost constant up to 1500 minutes.



	0	20	40	50	60	70	110	120	310	380	430	1500
Open Circuit Voltage ()	5.82	5.9	5.8	5.73	5.73	5.55	4.83	4.59	3.16	3.15	3.03	2.97

Fig. 2 Open Circuit Voltage (V_{oc}) VS Time duration (hrs)

Fig.2 shows the variation of Open Circuit Voltage (V_{oc}) VS Time duration (hrs) for cell-1. It is shown that the maximum Open circuit voltage is 5.9 volt and the minimum open circuit voltage is 2.97 volt. So the difference between the maximum and minimum open circuit voltage is 2.93 volt. It is also shown that the open circuit voltage is almost constant up to 70 minutes, then it

decreases linearly up to 310 minutes. Finally, it is shown that the open circuit voltage was almost constant up to 1500 minutes.

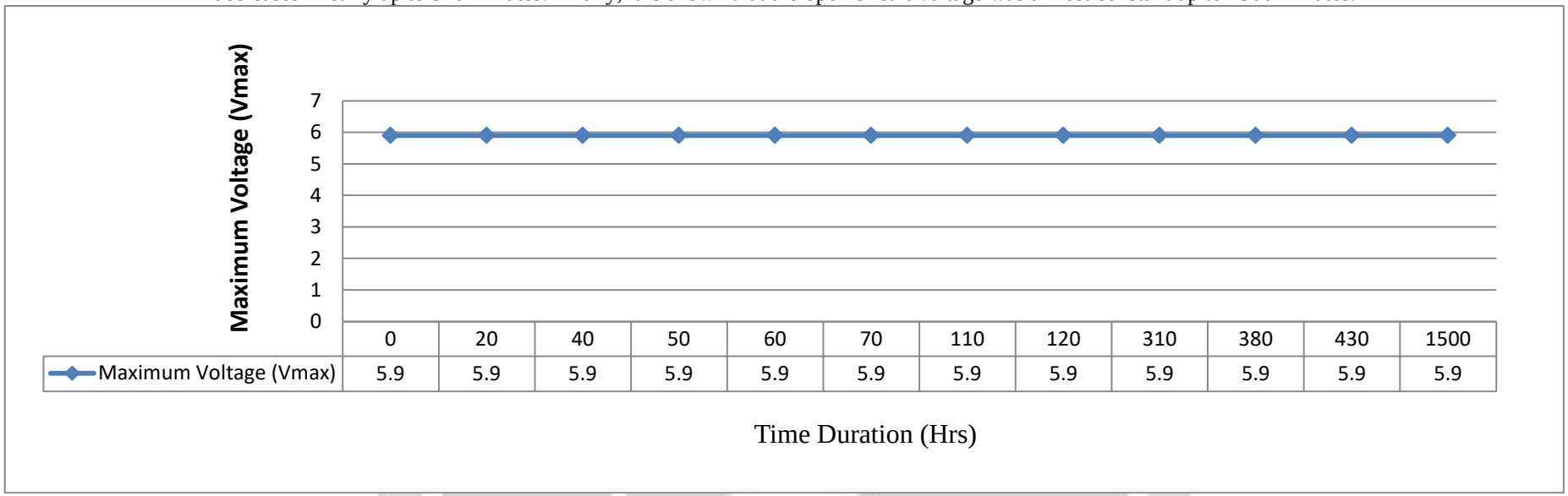


Fig.3 Maximum Voltage (V_{max}) VS Time duration (hrs)

Fig.3 shows the variation of Maximum Voltage (V_{max}) VS Time duration (hrs) for cell-1. It is shown that the maximum voltage is 5.9 volt and the minimum voltage is 5.9 volt. So the difference between the maximum and minimum voltage is 0 volt. It is also shown that the maximum voltage (V_{max}) is constant up to 1500 minutes.

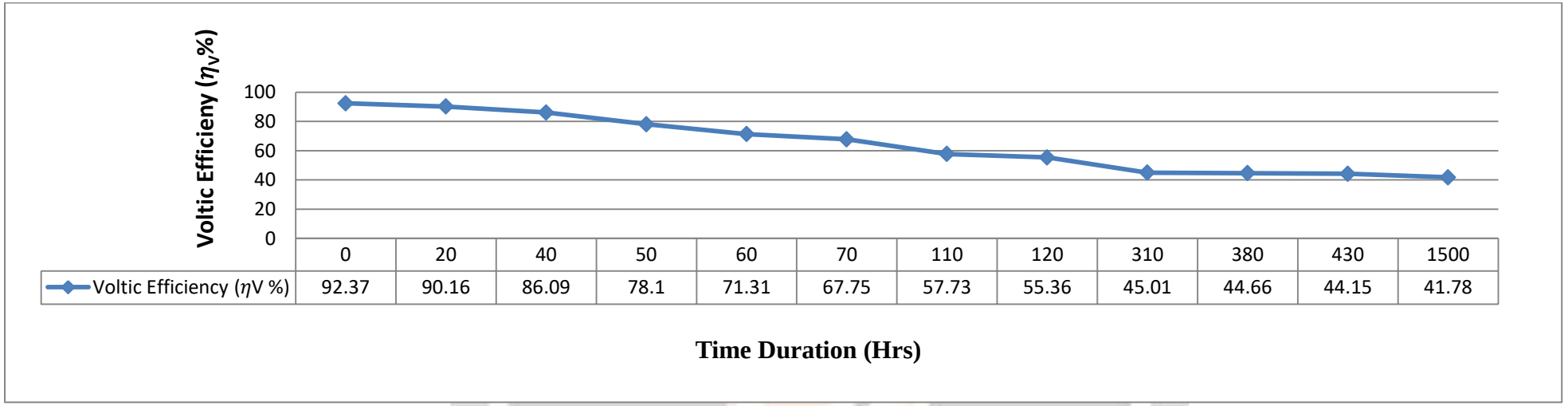


Fig.4 Voltaic efficiency (η_V %) VS Time duration (hrs)

Fig.4 shows the variation of Voltaic efficiency (η_V %) VS time duration (hrs) for cell-1. It is shown that the maximum Voltaic efficiency (η_V %) is 92.37% and the minimum Voltaic efficiency (η_V %) is 41.78%. So the difference between the maximum and minimum voltaic efficiency is 50.59%. It is also shown that the Voltaic efficiency (η_V %) decreases linearly up to 70 minutes and then it decreases exponentially up to 310 minutes. Finally, it is shown that the Voltaic efficiency (η_V %) was almost constant up to 1500 minutes.

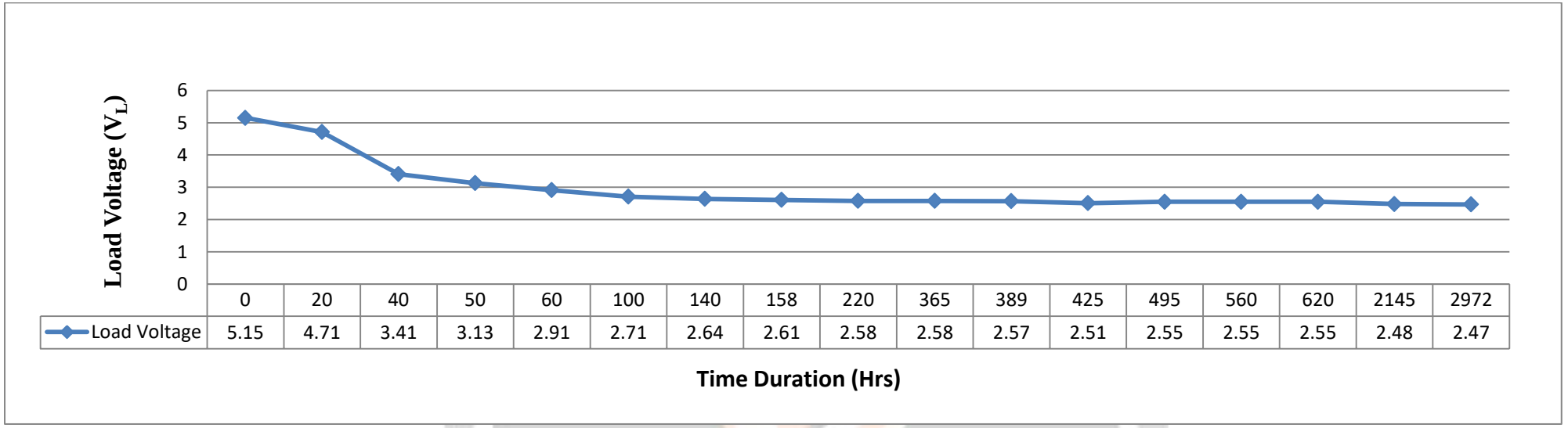


Fig. 5 Load Voltage (V) VS Time duration (hrs)

Fig.5 shows the variation of Load Voltage (V) VS Time duration (hrs) for cell-2. It is shown that the maximum load voltage is 5.15 volt and the minimum load voltage is 2.47 volt. So the difference between the maximum and minimum voltage is 2.68 volt. It is also shown that the load voltage decreases exponentially up to 50 minutes and then it decreases linearly up to 158 minutes. Finally, it is shown that the load voltage was almost constant up to 2972 minutes.

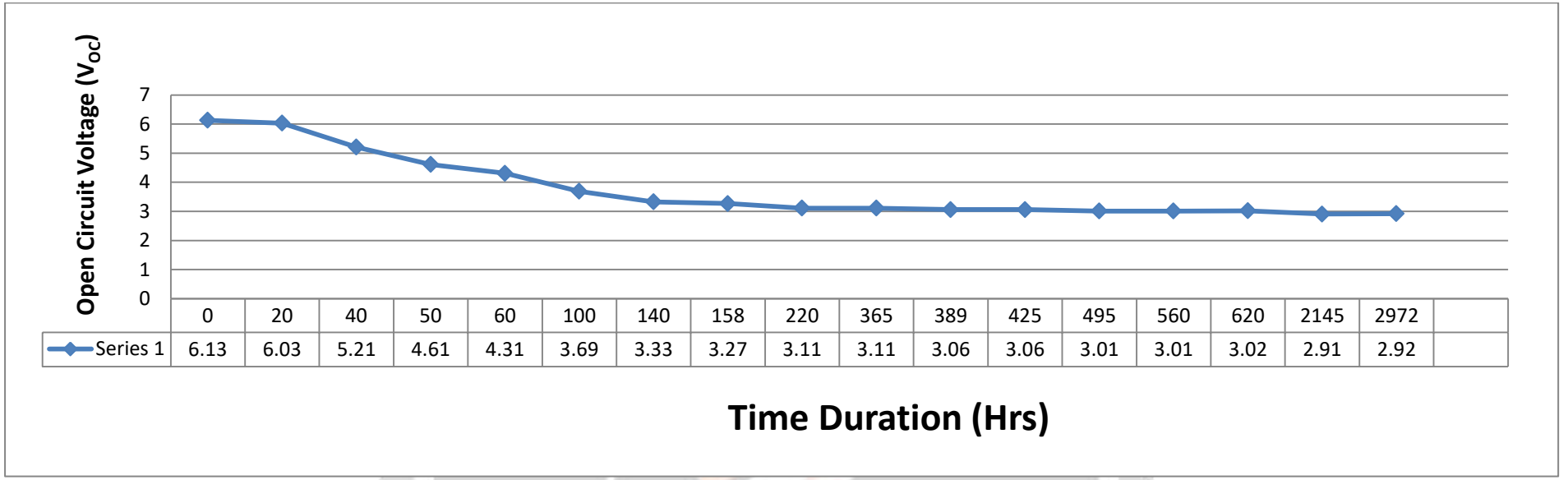
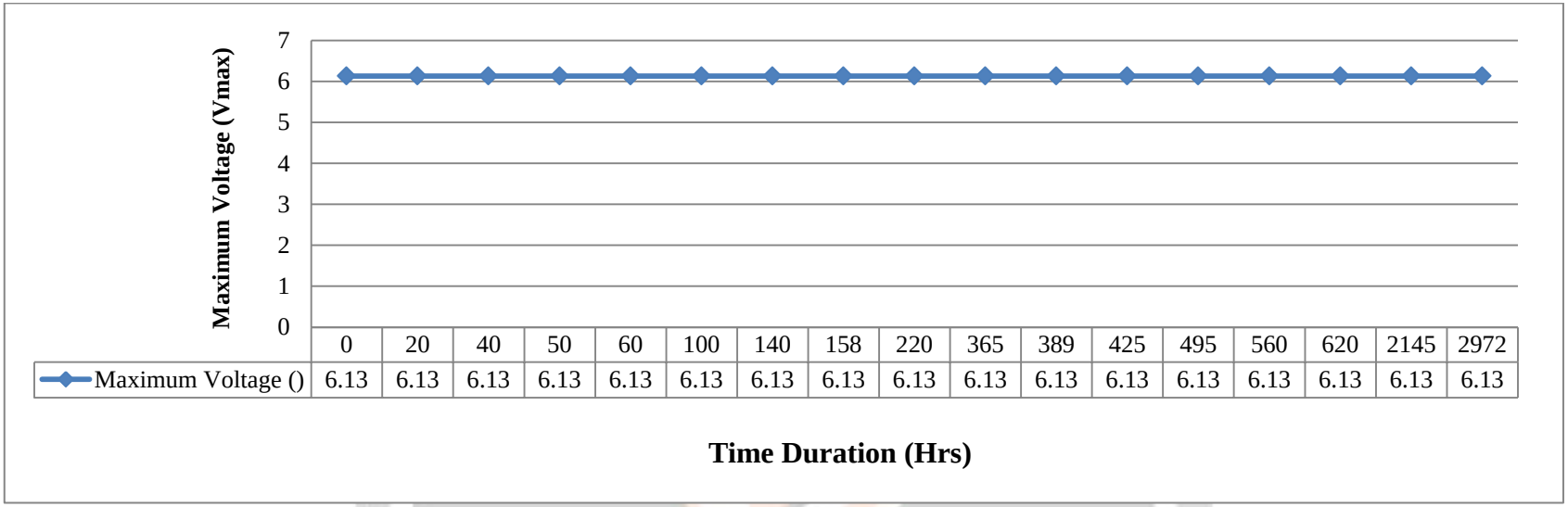


Fig. 6 Open Circuit Voltage (V_{oc}) VS Time duration (hrs)

Fig.6 shows the variation of Open Circuit Voltage (V_{oc}) VS Time duration (hrs) for cell-2. It is shown that the maximum Open circuit voltage is 6.13 volt and the minimum open circuit voltage is 2.92 volt. So the difference between the maximum and minimum open circuit voltage is 3.21 volt. It is also shown that the open circuit voltage decreases exponentially up to 100 minutes, then it decreases linearly up to 220 minutes. Finally, it is shown that the open circuit voltage was almost constant up to 2972 minutes.



	0	20	40	50	60	100	140	158	220	365	389	425	495	560	620	2145	2972
Maximum Voltage ()	6.13	6.13	6.13	6.13	6.13	6.13	6.13	6.13	6.13	6.13	6.13	6.13	6.13	6.13	6.13	6.13	6.13

Fig. 7 Maximum Voltage (V_{max}) VS Time duration (hrs)

Fig.7 shows the variation of Maximum Voltage (V_{max}) VS Time duration (hrs) for cell-2. It is shown that the maximum voltage is 6.13 Volt and the minimum voltage is 6.13 volt. So the difference between the maximum and minimum voltage is 0 volt. It is also shown that the maximum voltage (V_{max}) is constant up to 2972 minutes.

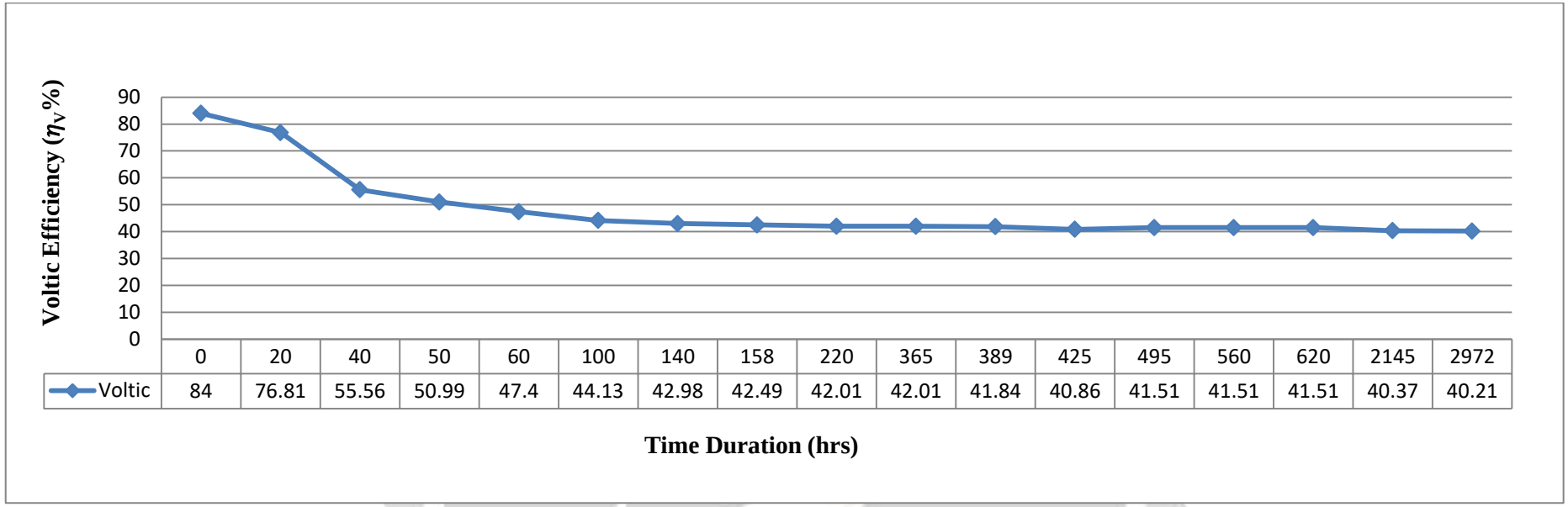


Fig 8 Voltaic efficiency (η_V %) VS Time duration (hrs)

Fig.8 shows the variation of Voltaic efficiency (η_V %) VS time duration (hrs) for cell-2. It is shown that the maximum Voltaic efficiency (η_V %) is 84% and the minimum Voltaic efficiency (η_V %) is 40.21%. So the difference between the maximum and minimum voltaic efficiency is 43.79%. It is also shown that the Voltaic efficiency (η_V %) decreases exponentially up to 50 minutes and then it decreases linearly up to 140 minutes. Finally, it is shown that the Voltaic efficiency (η_V %) was almost constant up to 2972 minutes.

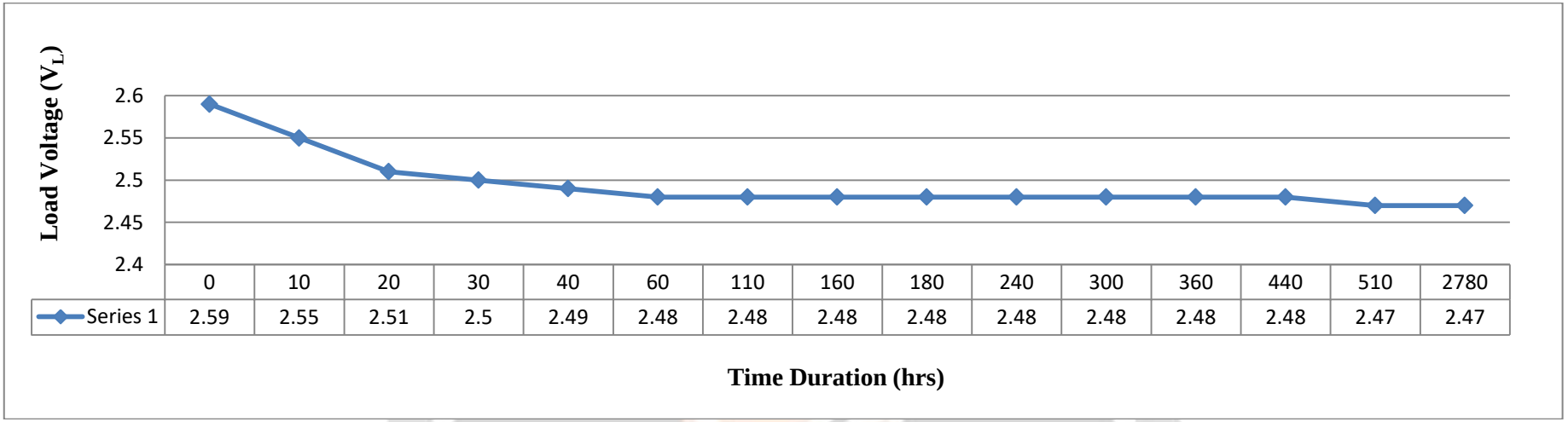


Fig.9 Load Voltage (V) VS Time duration (hrs)

Fig.9 shows the variation of Load Voltage (V) VS Time duration (hrs) for cell-3. It is shown that the maximum load voltage is 2.59 volt and the minimum load voltage is 2.47 volt. So the difference between the maximum and minimum voltage is 0.12 volt. It is also shown that the load voltage decreases linearly up to 30 minutes and then it decreases exponentially up to 60 minutes. Finally, it is shown that the load voltage was almost constant up to 2780 minutes.

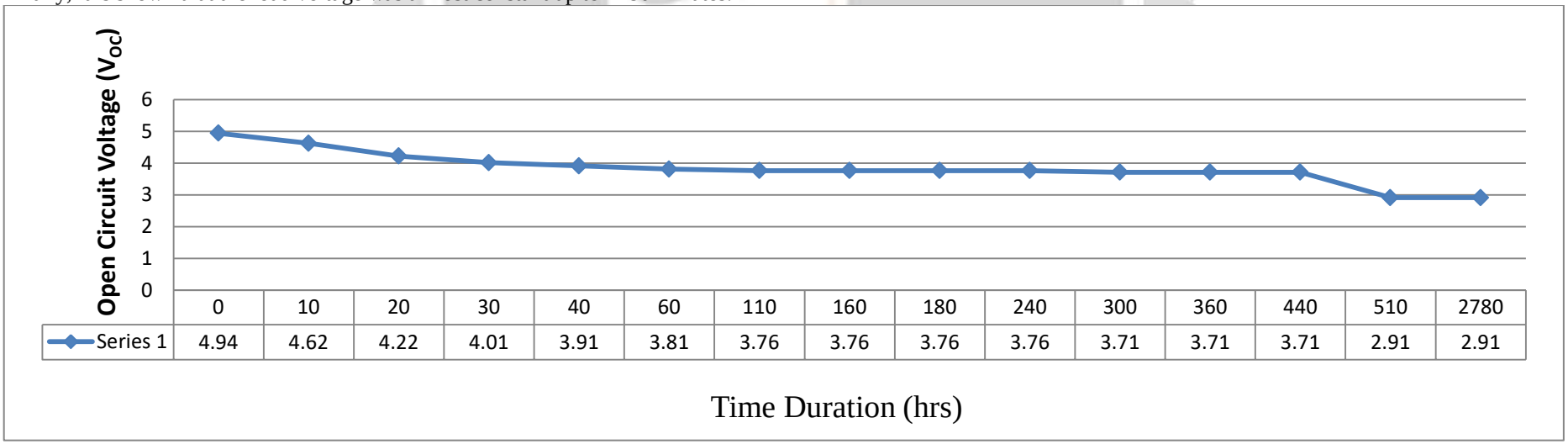


Fig. 10 Open Circuit Voltage (V_{oc}) VS Time duration (hrs)

Fig.10 shows the variation of Open Circuit Voltage (V_{oc}) VS Time duration (hrs) for cell-3. It is shown that the maximum Open circuit voltage is 4.94 volt and the minimum open circuit voltage is 2.91 volt. So the difference between the maximum and minimum open circuit voltage is 2.03 volt. It is also shown that the open circuit voltage is decreases linearly up to 30 minutes, then it decreases linearly up to 110 minutes. Finally, it is shown that the open circuit voltage was almost constant up to 2780 minutes.

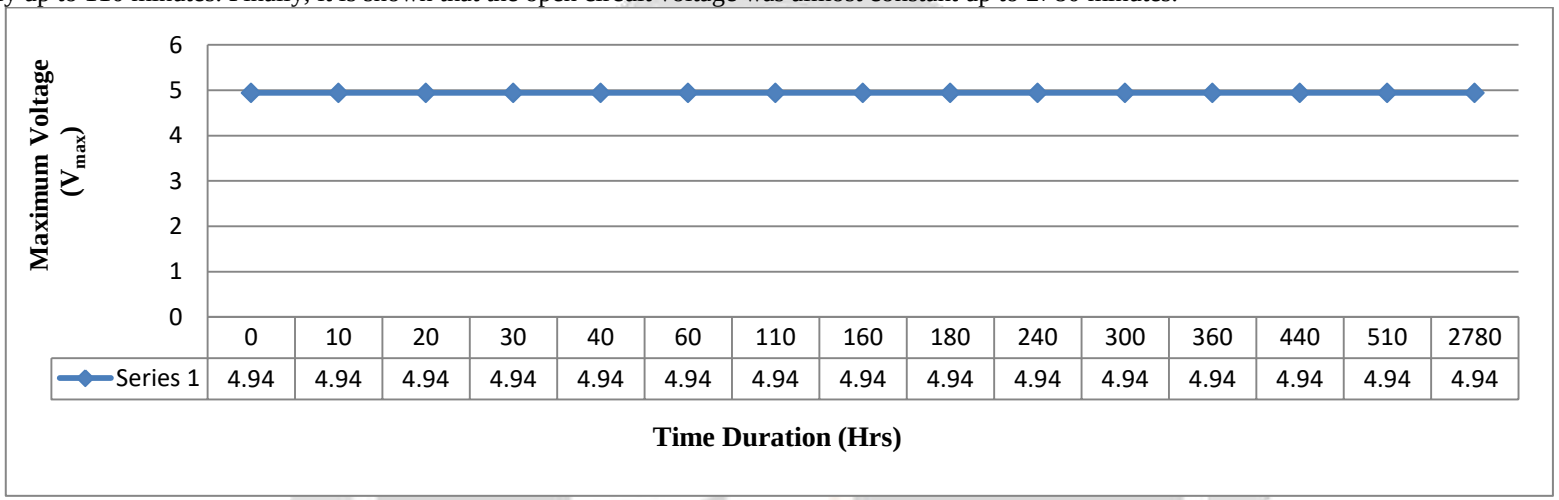


Fig. 11 Maximum Voltage (V_{max}) VS Time duration (hrs)

Fig.11 shows the variation of Maximum Voltage (V_{max}) VS Time duration (hrs) for cell-3. It is shown that the maximum voltage is 4.94 volt and the minimum voltage is 4.94 volt. So the difference between the maximum and minimum voltage is 0 volt. It is also shown that the maximum voltage (V_{max}) is constant up to 2780 minutes.

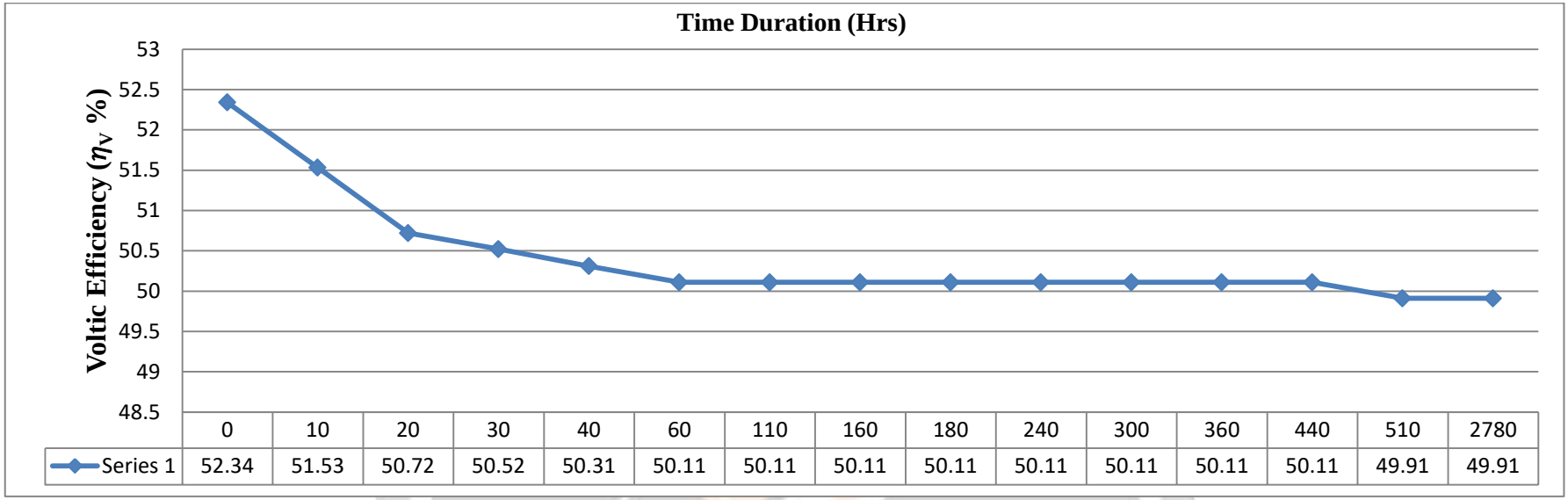


Fig 12 Voltaic efficiency (ηV %) VS Time duration (hrs)

Fig.12 shows the variation of Voltaic efficiency (η_V %) VS Time duration (hrs) for cell-3. It is shown that the maximum Voltaic efficiency (η_V %) is 52.34% and the minimum Voltaic efficiency (η_V %) is 49.91%. So the difference between the maximum and minimum voltaic efficiency is 2.43%. It is also shown that the Voltaic efficiency (η_V %) decreases linearly up to 60 minutes. Then Voltaic efficiency (η_V %) is almost constant up to 2780 minutes.

II. Conclusions

PKL electricity generation system follows the laws of physics. The developed parameters like Voltaic efficiency, internal resistance, voltage gain, open circuit voltage, short circuit current, load voltage, load current, energy efficiency follow the laws of physics.

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