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Pot Plant Batteries, PPB: Results for a LED-lamp on a Li-battery and a fuel cell made by a PPB and a capacitor.

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Abstract. A LED-lamp, with power supply from a Li-battery and a fuel cell is studied. The fuel cell consists of a PPB where water and soil is the electrolyte, and a capacitor. The result gives a response by the fuel cell, such that, the power and life-time for the entire device, are increased. A device for amplification of electric current is constructed and the usage with a Li-battery is evaluated. The novelties of the paper are electric hardware and results, together with modeling and analysis.

Keywords. More electricity from electricity, components and water, enhanced battery usage, capacitor, power reservoir, fuel cell.

1. Introduction

The present study concerns Flower-Power [1] (aka sub-power, since small), consisting of a pottery battery with a capacitor attached to a LED-lamp and a Li-battery. With this, amplification of current measured in Ampere (A), and increased life-time for a device (mAh), are achieved. A future issue is to find if/how the ideas can be upscale and amplify current and power in a network.

A review of related subjects is given in [2], where e.g., piezo-electricity on a leaf is noticed.

In [3], Al-metal-waste is used to increase the capacity of Solar Cells.

Recent development made batteries more dense and the possibility of providing electric power with solar cells in PhotoVoltaic, PV. In the present work, these two energy sources will be addressed and new hardware is constructed and analyzed. The results are enhancements in terms of lifetime for a battery application (and possibly increased power from a PV-system).

2. Experimental materials and Results

Two couplings that possibly adds lifetime to a battery CR2032, 3V will be analyzed.

2.1. Al-membrane Drum Capacitor

Cupper coils on an Al-foil-membrane, provides a Drum Capacitor which is also an inductor due to the two interacting coils, c.f. Figure 1. One of the coils goes down to an Al&Cu-electrode in the pot and the other similar, but to Fe. Isolated (without other components), the device displays 0.6V and 0.17mA. This was tested with a Li- battery and 2 LEDs, seen at right in Figure 1.

Figure 1. Two lamps are attached to the -pole of the Li-battery.

The +pole is connected to the Ferro-cathode in the plant. *A cupper wire directly from the soil and one from the coil at the Aluminum-foil goes to the LED +side.* Hereby, the two devices may communicate. The plant device is weaker in Voltage but has more capacitance (impedances) and resistance. The lamp pair twinkles and change between blue and yellow light depending on the situation in the pot plant device, e.g., tapping motion of the left drum-capacitor with cupper coils, and water content. It lasted <2 days on that battery; probably since the drum is relatively large i.e., consume power. Alternative couplings are possible, while connecting to the +-side. The coil-drum might work individually, to increase the power of the PPB, without participating directly in the input/output LED-circuit.

It could be expected that the impedances may save battery if it reduces the power load. If the current from the plant, adds to the one obtained from the battery, lamps requiring more than the battery-capacity may be lighted. However, it appears that the arrangement in Figure 2, were the more successful and stable. There, the main capacitor (red) is slender and less heavy, consisting of an Al-foil.

2.2. Al-foil-Capacitor with pot plant-cell, 3V-battery and LED

Figure 2. Li - battery cathode to LED with other side to the red capacitor

The Li -battery anode is coupled to the cathode of the pot battery at right, via the small silver-white capacitor. In a later version (after 2 months) the latter was sinned in the moss next to the cathode.

Since the bog moss battery with capacitor, Figure 2, provided a stable lamp -light, a similar with a living plant was constructed, c.f. Figure 3.

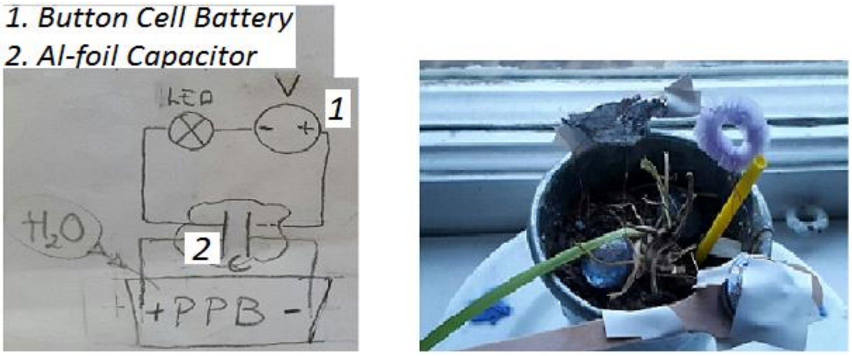

Figure 3. 1st Feb-22

The minus and the plus on the PPB are attached with a foil capacitor (at the rear of the photo at left of the decoration ring handle). One Cu-line goes from + on the Li- battery to the minus pole of the pot plant battery (PPB), or to the foil-capacitor. The LED-leg is directly attached to the Li-battery -pole, and on the other leg is a Cu-line which leads to the center (or some point) of the foil capacitor, but not directly to any Cu-line of the circuits.

2.3. Results

The lamp in Figure 4 right, still glow after 3 months. Data for the batteries are typical around 220mAh and the LED 3-10mA, i.e., <8 days. The lamp-light on the left one lasted 2.5 months, since it cannot be fueled in the same way without harming the plant.

Figure 4. The same 2 LED-devices as in Figure 2,3 after 2 months, i.e. 27/3-22.

3. Model for the Al-Capacitor

The loads connected to Voltage on the capacitors will be modeled as population dynamics, namely the function f(x) =Ax (1-x) with additional parameters. Instead of assuming a state dependency x_{n+1}=f (xn), we will consider the rate of x denoted x_t, in a similar distribution as f such that

$$x_{,t}(a-bx_{,t})\,T = x(c-x) \qquad (1)$$

where a,b,c and T are constant parameters. Comparing with the graphs of each side, the parameters get somewhat interpreted; e.g. a small b gives a wide curve for $x_{,t}$ since the zero is at a/b, c.f. Figure 5, left.

It is seen that (1) has a constant solution c.

Proposition. A time differentiation of (1), dividing with $2bTx_{,t}$ and assuming $T<0$ gives a harmonic oscillator and a nonlinear term (generalised function), such that

$$-a/(2b)d_t\ln(x_{,t}) - x_{,tt} + x/(bT) = c/(2bT) \qquad (2)$$

Proof. Insertion in (1) and evaluation.

Hypothesis. The function $a/(2b)\, d_t\ln(x_{,t})$ and other nonlinearities will act as input and dependent on the spatially distributed wave due to loading and unloading of the capacitor, Figure 5, right. Following the flow, the field experiences an oscillation which we approximate sinusoidal. Since the remainder of (2) is a harmonic oscillator with Eigen frequency $1/(-bT)^{1/2}$, an oscillator-input gives a forced vibration. The solution has the same frequency as the input and the amplitude is magnified increasingly, close to resonance.

Remark. It is seen that the parameter b appears both in the Eigen frequency and the input. Both these increase with a decreasing b, such that a large Eigen frequency, i.e., small time scale, corresponds to a larger input amplitude, (however the input might also depend on the load level for the capacitor which may not build up equally much for small times).

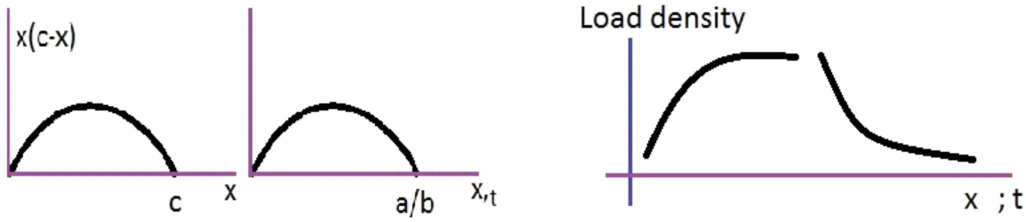

Figure 5. Left. The functions of each side in equation (1), indicating load density and rate of load density. Right: Wave-shape, spatially and time-distributed over the Capacitor

4. Concluding remarks

Bio-electro-mechanical devices coupled to Li-batteries and LED-lamps were invented and constructed. An arrangement was found to prolong the life-time of a LED-light, primarily loaded by a 3V-button-cell-battery, c.f. Figure 2-4. The plant at left communicated with the lamp circuit such that it occasionally responded on/off when touching a leaf. The first 2 months, not so much fueling in terms of water was needed.

Batteries are dense energy packages, but they have a limited life-time. PV-systems based on solar cells last while lighted which could admit multiplied increase of current as that obtained in Section 2.1. Therefore, the PPB with Drum-Capacitor could be a solution to increase Power/m2 in PV. Serial coupling of several Drums might provide a stable rectified source. Then, to obtain significant power alone, there is need for many cells, as for solar power, but possibly less energy dense I.e., more spatially extended. If a device with a few cells became stable and amplified that of a source instead of consuming, it would be a true hardware in producing more electricity from PV.

Models for the coupling of electricity to controllable observable properties in thermo-mechanics are valuable, e.g., to develop new solutions. For loads on a gain-capacitor, an analogy with a current of particles were outlined, in terms of its location and velocity on the Capacitor'-length-time-equivalent', [4].

In conclusion: An electric circuit (small network), in this application, was supplied with energy from its own mass and hardware (i.e., E=mc2, [5]) by adding mechanical work in terms of small rearrangements, water and salt. The novelty are the constructed hardware arrangements in circuits with traditional electricity, and the mathematical model with solutions.

The behavior suggests that the Fuel Cell adds power proportional to what the Button Cell delivers to the LED-lamp. This since the PPB alone is around 0.6V and almost no current, so the power U*I is low compared to the Button Cell battery and the requirements for the LED.

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