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6th April 2009

Ty Saville,
The Double Carbon Battery Company,
5th Floor
8 / 12 Camden High Street,
London NW1 0JH

Dear Ty,

Evaluation of Double Carbon Batteries

I am writing in response to your request to give a summary of progress to date on the development of the Double Carbon Battery. As you know, we have tested a number of prototypes for you, the most recent being prototype 8. We have devised figures of merit for various aspects of the battery's performance and our view is that the energy (or charge) stored per unit volume is the prime indicator of merit. Attached with this letter are graphs showing how this measure has improved over time.

As we detailed in our report dated 19th December 2008, the most recent battery (prototype 8) was able to store. We have now compared the double carbon battery with a super capacitor of approximately the same capacitance namely, the Maxwell BCAP1200 P270. In terms of energy stored per unit volume, the most recent Double Carbon Battery is approaching the value of its Maxwell counterpart, the precise figure being 37%.

It is worth noting that the figures of merits for the prototypes have improved as the development of the batteries has progressed. We would recommend that the construction of the battery be modified to remove unnecessary material (e.g. by reducing spacer thicknesses) to further improve the figures of merit. In terms of commercialisation of the product, it is our view that in many applications it would be acceptable to have an energy density lower than that found in state-of-the-art products provided the overall cost of the battery (with similar capacity) was more favorable.

To expand this point, in electric vehicle applications, energy density is crucial in spite of the cost. In static or marine applications, however, volume, i.e. size, is not so critical. Examples might be evening out fluctuations of power flow in fuel cell powered systems or in a wave power device.

We have looked at two other figures of merit that we have developed since the last report. One concerns the series resistance. Firstly, the Maxwell device has a very low resistance (approx 0.6 milliohm) whereas the best double carbon device is around 100 milliohms. We would recommend that efforts are made to reduce this value as much as practical as the internal resistance can lead to voltage loss and limitations to the charge and discharge rates. The second figure of merit is the self-discharging behaviour and in this respect the Maxwell and Double Carbon devices have similar values.

As you know, we are currently conducting research programmes in renewable energy generation, particularly in the marine industry, and are working, in conjunction with Trident Energy Ltd, on the construction of a point absorber type wave machine at Lowestoft. We have constructed a scale electrical system in our laboratory and are very interested in exploring the potential of the Double Carbon Battery as an energy storage device for this application. We would need a battery of around 300 V rating for this purpose.

To get the most out of the beneficial characteristics of the Double Carbon Battery we would also suggest the use of a bi-directional converter between it and a nominally constant voltage DC system. A converter of this kind enables the battery to be deeply discharged thereby enabling a larger fraction of the stored energy to be utilised. We would be very happy to look at a project to develop such a converter. This addition would further increase the range of capabilities for the Double Carbon Battery.

Notwithstanding the above project, we look forward to evaluating further prototypes supplied by the Double Carbon Battery Company and to offer comments on their performance. In addition, we would be very willing to work with electro-chemists in gaining a better understanding of the basic principles of the double carbon battery and thereby further improving its performance. Our colleagues in the University Chemistry Department have informed me that in their view Professor Phil Bartlett of Southampton University would be the person most able to help. We are happy to make the introduction.

Yours Sincerely,

Dr Richard McMahan