# Calorimetric Insights From Fleischmann Letters

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I received many letters from Martin Fleischmann over the time period of 1992 until about 2008 which were very helpful towards the understanding of the Fleischmann-Pons (F-P) Dewar cold fusion calorimetry. These letters are being converted to electronic form by Jed Rothwell to make them readily available to others interested in this topic [1]. Many more general topics relating to cold fusion were also discussed in these letters. My Fleischmann letters often focused on different calorimetry issues including the many errors in the 1989 publications by CalTech, MIT, and Harwell which were very influential in erroneously convincing most scientists that the reported cold fusion results were due to calorimetric errors.

Many types of calorimetry were considered before F-P settled on an open, isoperibolic system for their cold fusion experiments. The size of the calorimetric cell must be considered. If the cell is too large, then the effect of any excess power may not be detectable by the cell temperature measurements. If the cell is too small, then the changing electrolyte level due to electrolysis may cause large changes in the calorimetric cell constant. A properly designed calorimetric cell should contain between about 50 and 100 mL of electrolyte. Furthermore, the cell should be tall and narrow for proper stirring of the cell contents by the electrolysis gases. For example, CalTech used short and fat calorimetric cells where an electric stirrer was needed, and false statements were carelessly made by Lewis about stirring problems for the F-P cells. Harwell used large calorimeters up to 1000 mL in some experiments where any typical excess power would be impossible to detect by their cell temperature measurements.

Equations used to model the calorimetric system must include all possible energy transfers between the cell and its surroundings [2]. For example, the effect of temperature changes of the cell must involve the heat capacity of the cell as given by the differential power term, $P_{calor} = C_pMd(\Delta T)/dt$. Therefore, the F-P calorimetric analysis always involves the use of a differential equation. In one letter, Fleischmann provides a long, mathematical derivation to prove that there is never a steady state where $d(\Delta T)/dt = 0$ for open isoperibolic calorimeters. Many calorimetric publications, including CalTech, MIT and Harwell fail to include this important heat capacity term. Therefore, large negative excess powers have been reported when the cell temperature is increasing which have been confused with calorimetric errors. This neglect of the power being used to heat the cell contents is readily apparent in the Harwell publication.

Other topics include Fleischmann's various methods for obtaining cell constants accurate to five significant figures, the loss of $D_2O$ due to evaporation, the re-fluxing of $D_2O$ in the cell and gas exit tube, the use of the Stefan-Boltzmann constant for determining a minimum value for the cell constant, errors made by NHE in their analyses, and the fact that a changing excess power will always make it impossible to accurately calibrate a cell. These various topics all illustrate Fleischmann's remarkable abilities in the mathematical modelling and data analysis of cold fusion calorimetric cells as well as in many other areas of science [2].

1. See LENR-CANR, Fleischmann Letters.

2. M.H. Miles and M.C.H. McKubre in "Developments In Electrochemistry: Science Inspired by Martin Fleischmann", D. Pletcher, Z.- Q. Tian and D. Williams, Editors, Wiley, West Sussex, U.K., pp. 245-260, 2014 (see also the other book chapters).