

The situation is complicated by the fact that the electrochemical cell generates hydrogen and oxygen, approximately according to the electrochemical process that requires 1.53 volts drop in near-equilibrium. Thus, the gas which is catalytically recombined within the electrochemical cell produces a very substantial amount of recombination power (typically 4-6 W) at the top of the cell, well above the compensating heater. A primary criterion of the cell design is to ensure that essentially the only place for this heat to go is into the calorimetric fluid, and the purpose of the venturi is to ensure that the RTDs are sensitive only to total power and not more sensitive to power produced at one point in the cell than at another.

Only certain cells provide excess heat. Those are stated to be ones in which the cathode surface is treated appropriately, either by minor chemical constituents in the electrolyte (Si or Al), or by ion-beam bombardment. Furthermore, it is thought that one batch of cathode Pd works, and another does not produce excess heat. We were told that the silica rods that support the anode are essential to observe excess heat—presumably because of silica dissolution in the electrolyte. So many influences are thought to be at work that it would be easy enough to excuse the lack of excess power in a particular cell.

In any case, it takes hundreds of hours of conditioning of the cell before a reduction to near-zero current and a subsequent ramp up of current appear to yield some excess heat. The magnitude of excess heat is deduced by subtracting from the measured calorimetric power the sum of the heater power and the electrochemical cell power ( $I \times V$ ).

The uncertainty in excess power measurement is about 50 mW, but the excess power appears to be on the order of 500 mW or even 1 W peak. However, excess power is still a deduced quantity and depends upon the calibration of the calorimeter.

A desirable feature of the experiment is that the calorimeter is to a considerable extent self-calibrating. That is, if it were possible to maintain the total power within the calorimeter the same, the output temperature (or temperature  $\times$  flow rate) should be constant, and RTD and mass measurements are near enough absolute that there is little chance for error there. An additional complexity comes from heat leakage from the calorimeter to the bath, which is determined routinely by the difference between the heater input (in case of no or insignificant power to the electrochemical cell) and the measured flow calorimeter power. A small complication enters because it is important to keep the cathode from "de-loading", and that requires the continued passage of some minimum current through the cell.

The temporary detection of excess power (particularly if it returns to zero after a period, and never goes negative) can be measured quite sensitively. However, there are a number of potential confounders (dirt effects) that could mimic such an excess power. One would be an increased apparent temperature of the RTDs, which are nominally 100-ohm platinum resistors.

The single digital meter used to measure the parameters of the experiment, steps from one to another within a 4-minute measuring interval. To a considerable extent (particularly with the RTDs), the use of a single meter reduces substantially the prospect for error. However, because some of the measurements are far more susceptible than others to corruption, the use of a single meter does not totally eliminate the possibility of measurement error. For instance, with a one percent effect on a 12 W power level, the total temperature span is about 3 K, and the one percent about 30 mK. An RTD has a resistance proportional to temperature, so that the