Relationship of Power Ratio and Temperature Rise Rate Ratio Based on Energy Conservation

Ignoring enthalpy changes due to gas through-flow and denoting the local cell temperature and heat capacity by T' and C'_p, energy conservation requires

$$P_{In} + P_{Pl} - Q_L = \frac{d}{dt} \int_{Cell} C'_p (T' - T_0)\,dm$$

where T_0 is a reference temperature. Ignoring the temperature dependence of heat capacity, the mean cell temperature T and heat capacity C are defined by

$$MC(T - T_0) = \int_{Cell} C'_p (T' - T_0)\,dm$$

$$M = \text{cell mass},\ C = \frac{1}{M} \int_{Cell} C'_p\,dm$$

So, energy conservation reduces to

$$P_{In} + P_{Pl} - Q_L = MC\dot{T}$$

In Run 1 and Run 2, the cell was the same, therefore

$$\frac{\dot{T}_2}{\dot{T}_1} = \frac{P_{In2} + P_{Pl2} - Q_{L2}}{P_{In1} + P_{Pl1} - Q_{L1}}$$

Using $P_{In1} = P_{In2}$ and conservatively assigning $P_{Pl1} = 0$ kW wherein actually non-zero hydrino power is required to maintain a plasma under the experimental conditions, the power ratio relationship is

$$\frac{\dot{T}_2}{\dot{T}_1} = \frac{\frac{P_{In2}}{P_{In1}} + \frac{P_{Pl2}}{P_{In1}} - \frac{Q_{L2}}{P_{In1}}}{1 - \frac{Q_{L1}}{P_{In1}}}, \text{ or}$$

$$\frac{P_{Pl2}}{P_{In1}} = \frac{\dot{T}_2}{\dot{T}_1}\left(1 - \frac{Q_{L1}}{P_{In1}}\right) - 1 + \frac{Q_{L2}}{P_{In1}}$$

Since $Q_{L1} < P_{In1} << Q_{L2}$, a conservative approximation to the power ratio is

$$\frac{P_{Pl2}}{P_{In1}} = \frac{\dot{T}_2}{\dot{T}_1}$$

Then, using the measured $P_{In1} = P_{In2} = 30$ kW and $\frac{\dot{T}_2}{\dot{T}_1} = \frac{202.13\ °C/s}{5.91\ °C/s} = 34.2$, the power for Run 2 is

$$P_{Pl2} = \frac{\dot{T}_2}{\dot{T}_1} P_{In1} = (34.2)(30\ kW) = 1.026\ MW$$

Wherein the gain is

$$\text{Gain} = \frac{\dot{T}_2}{\dot{T}_1} = 34.2$$