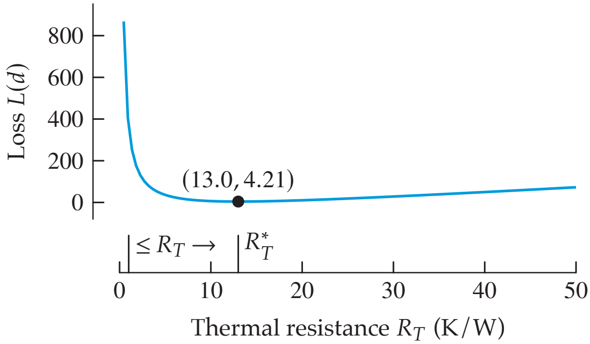

Figure 6.4. The constrained loss function $L(d)$ versus a single adjustable, the thermal resistance R_T.

Note that the hard parameter constraint $R_T \geq 1$ K/W is satisfied by R_T^*. From the equality constraint, this corresponds to an optimal feed rate of $r^* = 14.1 \cdot 10^{-3}$ m/s. In summary, the optimal design d^* is

$$d^* = (\boldsymbol{u}^*, \boldsymbol{p}^*) = \left(\begin{bmatrix} r^* \\ v^* \end{bmatrix}, \begin{bmatrix} R_T^* \\ C_T^* \\ R^* \\ c_p^* \\ \rho^* \\ \delta^* \end{bmatrix} \right) \approx \left(\begin{bmatrix} 14.1 \cdot 10^{-3} \text{ m/s} \\ 24 \text{ V} \end{bmatrix}, \begin{bmatrix} 13.0 \text{ K/W} \\ 0.5 \text{ W} \cdot \text{s/K} \\ 20 \ \Omega \\ 1590 \text{ J/(kg·K)} \\ 1240 \text{ kg/m}^3 \\ 1.75 \cdot 10^{-3} \text{ m} \end{bmatrix} \right).$$

This corresponds to a locally optimal output of

$$\boldsymbol{y}^* = f(d^*) = \begin{bmatrix} T^* \\ r^* \\ t_C^* \end{bmatrix} \approx \begin{bmatrix} 200 \text{ K} \\ 14.1 \cdot 10^{-3} \text{ m/s} \\ 32.5 \text{ s} \end{bmatrix}.$$

If, in the loss function L, we had weighted the cooldown time t_C more, then t_C^* would have been shorter and r^* would have been slower. This type of tradeoff among soft constraints is common.

It is possible that another design with another set of input variables and parameters could achieve a lower loss than $L(d^*) = 4.21$. However, we have achieved an optimal design d^* given the single design set given here.

6.2 Representing Design Constraints

6.3 Representing Design Problems

6.4 Solving Design Problems