W07

One way of preparing an chicken egg is boiling it. Before these can be enjoyed, they have to cool down to a comfortable temperature.

(a) Boiled eggs

(b) Potato

1. Based on which criteria can the lumped capacity model be applied?

2. For which of the two dishes is the lumped capacity model the most suitable to determine the cool down time? Explain why you come to this conclusion. Are there differences in properties?

A egg ($k = 3$ W/mK, $\rho = 1150$ kg/m^3, $c_p = 3600$ J/kgK) with a diameter of 3 cm, which initially has a surface temperature of 95 °C, is located outside with an ambient temperature of 20 °C. It cools down due to convection ($h = 40$ W/m^{2}K).

1. Using the lumped capacity model, determine the time that it takes for the egg to cool down to 35 °C.

1. Evaluate the accuracy of the found answer in c).

1. Determine the amount of energy that the egg has lost, when cooled down from 95 °C to 35 °C.

1. Determine the maximum diameter of the egg, for which the lumped capacity model is still valid.

1. Provide a sketch of the temperature profile as a function of time, in the case that we would have let the potato cool down in the room for a very long time.

Note: clearly indicate the temperatures for t=0 and t→∞