

ORDRE DES INGÉNIEURS DU QUÉBEC

MAY 2014 SESSION

14-AL-A4 Physical properties of biological materials and food products

Open-book examination

All answers requiring units shall be in accordance with the International System of Units (SI)

Calculators : only authorized models

Duration : 3 hours

-I- (20 points)

The Biot number is one of the most useful dimensionless numbers in heat transfer. What's this? Present the different value ranges of this number and their significance in a heat transfer process. Also present the applicability of this number in a food product room cooling process and explain your answer.

-II- (20 points)

Calculate the error in percentage when neglecting the heat of respiration in the calculation of the thermal load to be extracted from a mass of broccoli at 25°C to be cooled down at 0°C at a constant cooling rate within 24 hours.

-III- (20 points)

The responsible of a slaughterhouse has to freeze chicken carcasses at -10°C after being precooled at an average temperature of 12°C. The average production is 3500 kg/h. Calculate the cooling capacity of the system freezing.

-IV- (20 points)

You need to propose a produce simulator for generating data during experimenting of a new forced air cooling system for fresh spherical horticulture produce:

- Present five physical or thermal properties you should consider for determining the best produce simulator for the experiments?
- What is the relative importance of each property?
- What is the range of values of each property you considered as acceptable for simulating a fresh spherical horticulture produce? Justify your choice.

-V- (20 points)

You have to design a new bottling system for tomato juice having a very high energy efficacy. The client informs you that his chemist confirmed that the viscosity of the liquid does not follow the Newtonian fluid law but performs as a pseudo plastic fluid. What is the effect of this property on the design of the bottling system design? Justify your answer in a few sentences.