Intermediate Food Dehydration and Drying

Assignment 3: (Worth a total of marks)

Based on “Chapter 3: Calculating the Heat to Dry a Product” and “Chapter 4: Drying Mechanisms” in the Intermediate Course in Food Dehydration and Drying manual. As usual, you will need to use information presented in the previous chapters.

1. This question is basically the same as Case Study #2 in Section 3.5 of the Course Manual. You may want to use the case study as a pattern to follow.

500 kg of green beans with an initial moisture content of 87% (wet basis) are stored under refrigerated conditions at 8°C. How much heat would be required to dry this material to a final moisture of 10% (wet basis) if the temperature at which the drying was done was 65°C? ( marks)

2. Calculate the values for X and Y in the following diagrams. (3 marks each for a total of 9 marks)

Part a:

225 kg at 92% moisture → DRYER → X kg product at Y % moisture

Part b:

375 kg at 78% moisture → DRYER → 425 kg of product at X % moisture

Part c:

Y kg of water → DRYER → 26.7 kg of product at 10% moisture
3. A processor has 200 kg of fresh yams that are to be dried at 55°C. Their specific heat capacity is 3.316 kJ/kg °C and their moisture content is 74% by weight on a wet basis.

a. How much water must be removed? Express your answer in kilograms to one decimal place. ( marks)

b. How much heat would be required to raise the temperature of the 200 kg of yams from 10°C to 55°C (this is the drying temperature) and evaporate the water calculated in part a of this question? We will assume that it takes 2,257.1 kJ of heat energy to vaporize 1 kg of water. ( marks)

4. A processor has a rather old dryer in which the insulation is crumbling away. The seals around the doors are so badly worn that you can feel warm air blowing out of the cracks when you walk by. Your recommendation is to fix the door seals and replace the old insulation, but the owner says that the dryer is still working, so why bother to fix it.

Since you have taken a drying course, you understand heat use efficiencies. So, you design a little test to determine the heat use efficiency of the dryer.

You take the temperature and weight of the material going into the dryer. Knowing its specific heat capacity, you calculate the heat required to raise its temperature to 65°C which is the temperature at which the drying is being done.

By taking the difference between the weight of the material entering the dryer and the weight of the material leaving the dryer, you are able to estimate reasonably well how much water is being removed during the drying process.

You find that 325,000 kJ of heat energy are needed to raise the temperature of the material and 3,150,000 Kj of heat are required to evaporate the water.

Based on calculations associated with the consumption of fuel (do not worry about how these are done), you estimate that 8,250,000 kJ of heat energy are being supplied to the dryer.

What is the heat use efficiency of the dryer? ( marks)