Name: **Nathan LeRoy**

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| **In-class activity 1 (Individual working w/ group): Prepping the Model (due end of class 9/13)** | | | | | | |
| **What properties are needed/not needed for the model? For each property of the food, give reasoning as to why.** | | | | | | |
| *Food Property:*  DT, Decimal Reduction Time  ρ, Density  μ, Viscosity  cp, Heat Capacity  xw, water content  aw, water activity  k, heat conductivity  z-value  pH  % production  Emissivity  Light Transmittance  Can Size  Ea, activation energy | Why Is/Is Not Used:  Used to determine process time  Fundamental to heat transfer characterization  Will not use (probably)  Fundamental to heat transfer characterization  Will assist in heat transfer calculations  Will not use (probably)  Fundamental to heat transfer characterization  Used to determine how to adjust to new process  Will not use  Use to adjust process at the end to optimize process.  Will not use  Will not use  Fundamental to our heat transfer  Might be needed, depending on assumptions | | | | | |
| **For each property where a range or raw data is given, how do you intend to address this in the final model? For each property listed please give reasoning as to why you are choosing your current strategy.** | | | | | | |
| *Food Property:*  Xw, moisture content  D250-value (microorganism)  z-value (microorganism)  z-value (Vitamins)  Ea (microorganism)  Ea (Vitamins) | How will you use or address? Why?  -Choose the higher number, assume highest heat capacity as this will be the hardest to sterilize.  -Choose the highest number, assume that the organisms are extremely hard to kill and take the longest time to kill, this maximizes safety.  -Choose the lowest number, we want to assume that are microbes are elastic and when we go to low temperatures, our log-reduction times drastically increase.  -Choose the highest number, assume that our vitamins are inelastic and when we go to low temperatures, the log-reduction time stays the same.  -Choose the highest Ea, as an increase an activation energy correlates to an increase in the decimal-reduction time. Assuming the largest decimal reduction time ultimately maximizes safety.  -Choose the lowest Ea, as a decrease an activation energy correlates to a decrease in the decimal-reduction time. Assuming the lowest decimal reduction time maximizes product quality. | | | | | |
| **Are there any properties of the food that are needed that are not given in the problem statement? If any, please justify why it is needed and what source you will obtain it from.** | | | | | | |
| Food Property Needed:  ρ, density  k, thermal conductivity  Xi, Macromolecule mass fractions  Cp, heat capacity | Why is it needed?  All of these parameters are fundamental to heat transfer, and subsequently related to sterilization and the characterization of the process | | | Why did you use the source you did?  Density, thermal conductivity, and heat capacity can all be calculated with the Choi-Okos equation.  We will obtain macromolecule composition from the USDA food database.  **(THESE SOURCES WERE USED AS THEY ARE VALIDATED AND RELIABLE AND SIMPLE)** | | |
| **What assumptions will you make to solve the problem? For each assumption explain why you made the assumption and what it may limit about your model.** | | | | | | |
| Assumption(s):  -No external temperature gradient  -Constant Pressure  -Conduction through can wall is negligible  -Heat transfer occurs on all sides  -Heat transfer parameters for now are constant | | | Why did you choose?  Simplifies heat transfer  Constant density.  Simplifies heat transfer to one material.  More accurate analysis  -Simplifies the solution a lot | | | What will this limit?  Might introduce error  Might introduce error  Might introduce error  Our ability to solve the problem (Solving time increases)  Might introduce error |
| **The mathematical equations necessary to solve the problem. For each equation please explain why it was chosen and any assumptions your model will make about the equations. Please list all equations necessary. Feel free to use the course textbook or online materials.** | | | | | | |
| Equation Needed:  Choi-Okos Equation  Energy Balance with respect to time and position  Microbial Sterilization  Food Component Degradation | | Why is this needed?  Estimate Heat Transfer parameters  Find temperature gradients  Safety of product    Maximize product quality | | | What assumptions does this equation make?  None?  None? | |
| **What computational technique will you use to solve the system? Explain why this technique was chosen, what the benefits are, and what the limitations are. (For example, implicit finite difference, explicit finite difference, finite element method, Crank-Nicolson method, Monte Carlo method, etc).** | | | | | | |
| Computational technique chosen:  **Explicit finite difference method.**  What are the benefits of this technique?  **Relative simplicity in the understanding of the method and its coding. Simple calculations that facilitate quick computational time.**  What are the limitations of this technique?  **Might not be as accurate, converges slowly, and could become unstable and produce wildly outlandish results.**  Why did you choose this technique over alternatives?  **This method gives us a lot of control over the parameters and the “machinery” of the program, we are experienced with it, and it should give us reasonable results.** | | | | | | |
| **Please show how you intend to combine the properties, equations, assumptions, and numerical techniques in your final solution (provide a “roadmap” of how you believe you will solve the problem). Feel free to include diagrams, drawings, or maps.** | | | | | | |
| 1. Make assumptions on material properties 2. Find relevant properties of materials used in process 3. Find relevant equations to calculate material properties 4. Calculate said properties using said equations 5. Set up equations to solve for transient temperature analysis 6. Using numerical integration and finite difference methods to solve equations 7. Analyze solutions and assess validity and results | | | | | | |
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