

**MEMORANDUM**

**DATE: August 26, 2009**

**TO: Laboratory Group E**

**FROM: Tony Butterfield**

 **Engineering Training Supervisor**

**SUBJECT: Instant Tea**

Our client is a small producer of tea leaves. To date they have only sold their product as loose leaves, but they are considering the addition of instant tea to their catalogue. To explore this possibility they have requested that we investigate spray drying as a means to create granulated instant tea.

I will provide you with the tea leaves they wish to use. In conducting your experiments it is recommended that you use a concentrated solution of tea. I found that typically one uses 2 grams of leaves per 8 oz of water for a normal cup of black tea; I would recommend starting with significantly higher concentrations, such as 1 gram/oz. You will want to make, at least, 5 L of concentrated tea per run. Boil the water and leaves while stirring for at least 5 min, and filter the solution to remove the solids before you transfer it to the spray dryer feed tank.

Because each tea is different, one of the first pieces of data you will need in your analysis is the concentration of non-volatile solutes in our tea after brewing and removing the leaves. This may be estimated in a number of ways. For example, you might weigh what is left after evaporating off the water from tea in a container with a known weight.

With the spray dryer, collect and characterize dried samples. Adjust temperature and flow rates until you get a good yield of particles. Collect data at as many operating conditions as time allows, leaving plenty of time to write your report. You may find recommended temperatures for food products in the spray dryer’s SOP. I recommend you read all the online documentation for the spray dryer before you begin.

For your analysis, the client has several concerns to be addressed. Firstly, our client wishes for the dry product to be easily dissolved back into hot water and they wish for it to have a tight distribution of particle sizes. You are therefore asked to determine the particle size distribution obtained under each spray drying condition you use. There is image analysis software in the lab that should be able to help you with this. Please include images of your dried product in your report. Assume each particle has the same density and also determine the average particle weight. If the particles are too small, you may not be able to get this data, and that is okay.

Secondly, our client does not want to waste tea. The yield should be estimated at your operating conditions.

Finally, they are concerned the harsh conditions within the spray drier will diminish the quality of the resulting tea, through thermal degradation. While your sensory organs are arguably the best pieces of equipment you could use here, **do not taste the tea**. You have no idea what has been in that same spray dryer in the past. However, the tea’s appearance and aroma, both before and after spray drying, are important qualities on which you should comment.

Keep in mind that you do not need to model the entire spray dryer in your theory section. Given the particle distribution of dried tea, you should, though, try to estimate the original droplet size (which, again, you may not be able to do if you cannot get the particle weight). Assume each particle came from a single droplet, droplets do not interact with each other while drying, and each droplet has the concentration of dissolved solids found in your preliminary results. Though you are to make the assumptions I’ve stated, please give your opinion regarding their validity in your report.

Some empirical equations for average droplet sizes may be found in Perry’s section on spray dryers. Can such an equation predict your findings within error? Furthermore, the maximum droplet diameter is an important spray dryer design consideration, as it is the largest droplets that take the longest to dry. From your particle analysis, what would you estimate the largest droplet size to be for each operating condition you used? It is also often estimated that the maximum droplet diameter should be 3 times the average diameter. Do your data confirm this rule of thumb?

If you have any question regarding this project or what is expected of you, I hope you will feel free to contact me at any time. I look forward to our meeting on or before Wednesday, September 9th, 2009.