It's always sunny in Puerto Rico [1]

Submitted by Robert James Allsopp [2] on 5 August 2016 - 5:00pm

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Nike

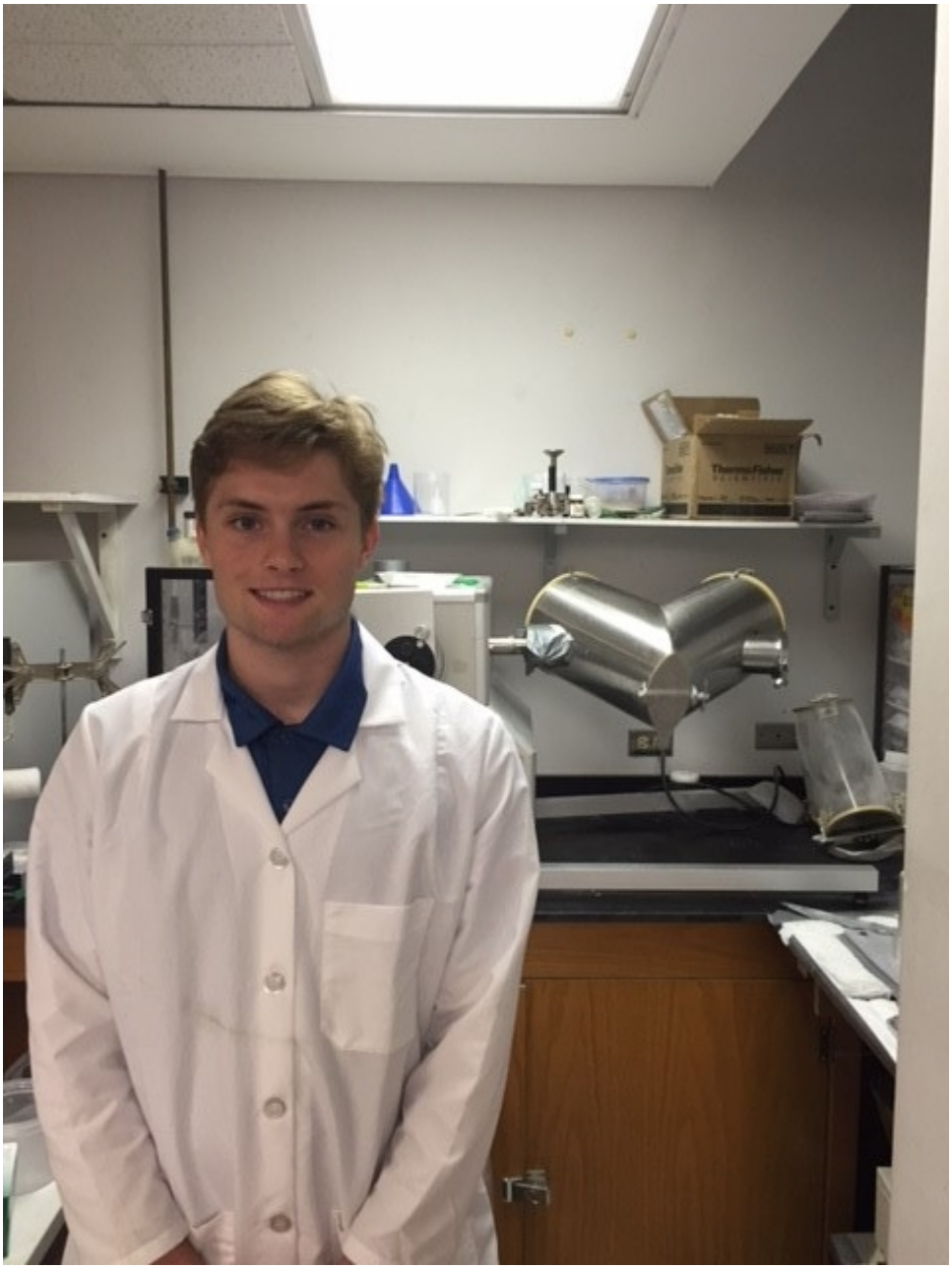

Photo of my room mate from Maryland in front of Gozalandia, The 5 US interns preparing for Cueva Ventana, and me in front of the V-Blender

My ten week stay in the town of Mayagüez has been quite the adventure. With all the people, places, and things to do there is never a dull moment. After visiting many of the beaches on Puerto Rico I have a new appreaction for Sun Screen and I realize that the sun is always shining here in Puerto Rico. The people on the island are also really nice and they are always happy and fun to be around. So between the actual climate as well as the people, it's always sunny in Puerto Rico.

Over the course of the summer I’ve been working with Professors Rafael Mendez and Rodolfo Romañach on the continuous pharmaceutical manufacturing process. One of the major benefits

of the continuous process is adjusting production to meet consumer needs as it eliminates over-production, and the storage facilities that go along with it. This makes the tablets more affordable to those who need them. Considering these benefits there are relatively few continuous pharmaceutical manufacturing processes, and a limited understanding of how to control the tablet properties. After hearing the major cost benefits of the continuous process I was shocked to hear there were only a few continuous pharmaceutical processes in current practice. The goal is to increase the number of continuous manufacturing processes to help reduce costs. The purpose of our research was to create a model that predicts the mean residence time of a continuous feed frame.

The continuous process involves mixing active ingredients with other powder that serve as diluents. Diluting the active ingredient helps prepare the drug for consumption. Without this process, consumers would be left to slice off 300 mg of drug on their own. As my professor once explained to me, “instead of talking about how big your TV is, people would talk about how many digits their analytical balance reads”, luckily that is not our reality. Instead, lactose and cellulose are used to dilute the drug, which I found curious because some people are lactose intolerant. It is safe however because it is a small enough amount of lactose to be harmless. In addition, colloidal silicon dioxide is added to the blend of powder as a glidant to help the powder move quickly through the process. Lastly, magnesium stearate is added as a lubricant to prevent the powder from sticking to tablet punches. These powders are important for the manufacturing process to manufacture tablets at a fast rate without the powder getting stuck.

After the powder is mixed it is sent to the feed frame which prepares the powder for molds to be compressed into solid tablets. The molds are called dies, and the dies used in lab are about 1 cm in diameter. The feed frame combines the challenges of the mixing process as well as the die filling process. It is important to have a deep understanding of the feed frame to develop the most efficient process. There are many factors to look at including the weight variability, dissolution rate, tablet hardness, and concentration of the active ingredient. These factors are impacted by the mixing and die filling process, and the challenge is to find how different operating parameters relate to final product properties. The mean residence time is calculated to achieve this purpose. The mean residence time is the average amount of time it takes a particle to enter and exit from the feed frame. The concept was a bit abstract the first time I heard about it, but the logic makes since. The longer the powder stays in the feed frame, the more likely the powder properties are going to be changed.

To conduct our research a near infrared model was constructed to correlate concentration of caffeine to the near infrared spectra. Every chemical has a unique infrared spectrum, and it is possible to relate concentration with the strength of a particular signal in the spectra. The model is used to predict a concentration vs time graph of a trace of caffeine exiting the feed frame. The graph looks something like the sharp peak of a mountain, but the information in the graph is used to calculate the mean residence time. This experiment is conducted several times with different operating conditions including the speed of the mixing blades, the speed of the dies, and the type of material. Conducting the experiment with so many different conditions develops a spectrum of values with known MRT, and the model is capable of using that information to predict the value of mean residence time for any condition in between. This model provides a deeper understanding of the feed frame and makes mean residence time information easily accessible so researchers

can more quickly resolve problems with tablet properties.

Tags:

- soft matter [3]
- Pharmaceutical sciences [4]
- Continuous Process [5]
- Mean Residence Time [6]

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