

PRDCT - Powder Rheometric Device that Characterizes Torque



Angel Alvarado Perez, Robert Copsey, Kace Davis,
Noah Owens, Logan Smith
Florida State University Panama City



Abstract

The objective of this project is to design a test apparatus that can collect data for the torque required to “agitate” various powders. Upon collection of data, a predictive model will be developed. With this model, necessary feeder components can be specified using material properties and agitator geometry so that testing does not have to occur for every material.

Objectives

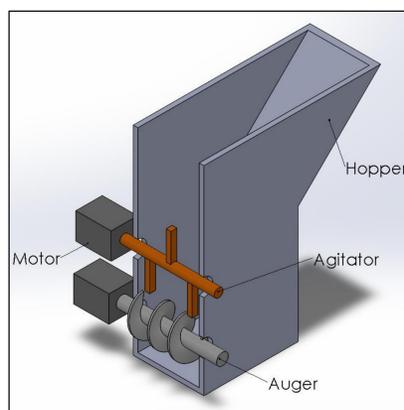
- Design a torque sensor and test apparatus that captures torque data.
- Create a system for collecting and logging torque data.
- Create a predictive model using torque data for use in component selection.

Merrick Industries

This project is partnered with MERRICK Industries. MERRICK offers premium-quality weighing and feeding systems that handle a variety of dry bulk materials and applications, including food, pet food, cement, pharmaceuticals and building materials.

Industrial Feeder Systems

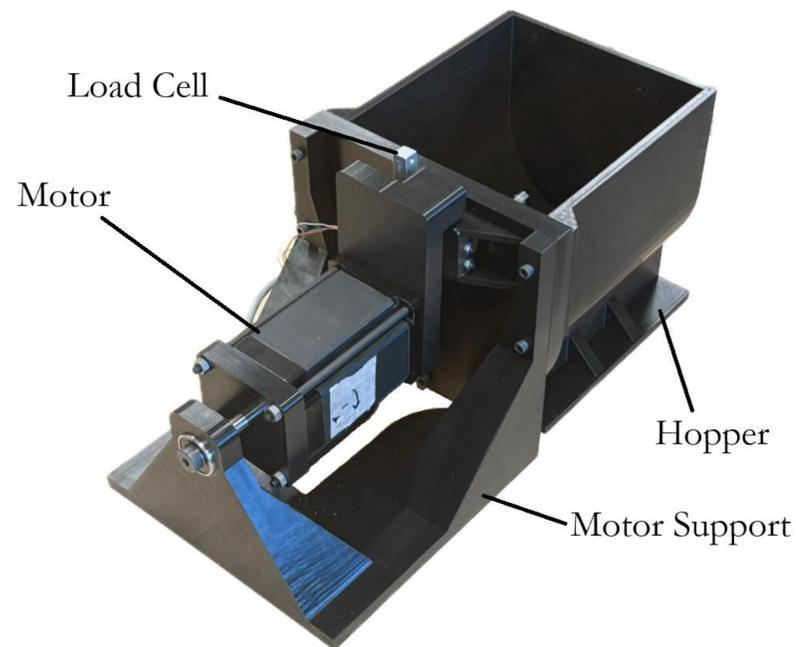
Feeder Systems regulate the flow of materials into production, manufacturing, or construction processes. Screw feeders rely on an auger to push materials at a controlled rate. An agitator is used to ensure consistent, material flow.



Problem

The motor needs to supply sufficient torque to rotate the agitator and material in the hopper. This torque is dependent on the feed material and agitator geometry. Torque is difficult to predict precisely, which makes agitator motor selection a challenge. This project aims to solve this problem by creating an instrument that finds experimental torques and feed them into a predictive model which then outputs a range of values to judge components by.

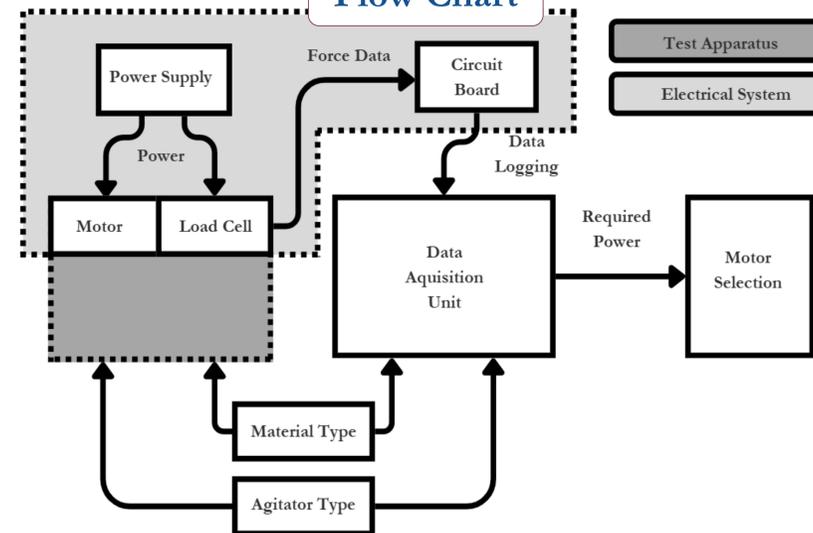
Test Apparatus Prototype



Main Functions

- Capture Torque Data
- Enclose Components
- Agitate Material
- Log Data
- Predict Power Required

Flow Chart



Prototyping

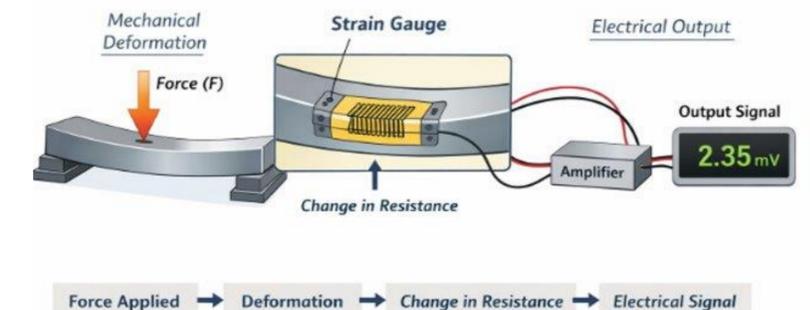
- Enclose Components
- Agitate Material

As seen in the center figure, a prototype has been constructed. This instrument will be used for testing of various materials and agitators. A built-in sensor will sense the applied force and a microcontroller will log the force data.

Calculating Power

- Capture Torque Data

When the motor is running it spins and contacts the load cell (strain gauge) and applies a force. The force causes a change in resistance and the sensor outputs this change in a electrical signal. The signal is then calibrated so that it displays the actual force felt by the load cell. Force data can then be used to calculate torque and power. It is logged and sent to the predictive model.



Predictive Modeling

- Log Data
- Predict Power

Predictive modeling is the process of creating a mathematical model that predicts an outcome based on input data. The model is trained on a dataset that includes both the input variables and the known outcome, allowing it to learn the relationships between the input variables and the target variable. In this case the known data is the material and agitator types. Once the model is trained, it can be used to make predictions on new data where the target variable is unknown.

Future Work?

The next steps will be testing materials and agitators with the initial prototype. Then we will log the data and feed it into the predictive model, verifying that the model correctly predicts values that can be used to source components. A second prototype will be developed to address shortcomings of the initial prototype.