Materials Handling for Oilseed Press and Requirements for Pressing Food Grade Oil

Overview
Penn State Farm Operations has an expeller press for producing meal and oil from various seeds. The oil from the press is currently being used as biodiesel and the meal is being used as animal feed. Originally, when the meal came off of the press, it filled one bag that needed to be replaced every two hours. The oil is worth two dollars per gallon as fuel, but if it can be used as a food product in a deep fryer first it will be worth about seventeen dollars per gallon.

Objectives
Penn State Farm Operations posed two problems for the team to solve. First, the team had to find a way to produce food grade oil from the current oilseed press. This included researching different refinement techniques, learning how to perform those techniques, test what was done, and make recommendations for future tests or apparatuses. Second, the team had to create a bagging system that would not require bag changes as frequently as the current system. The new bagging system had to use the current bags, and it had to have the capacity to run continuously throughout the night.

Approach

- **Food Grade Oil**
  - Research was done to find what is required from the Food and Drug Administration and the Pennsylvania Department of Agriculture.
  - Extensive research was done to find what processes are typically done to reach the objective.
  - Research was done to determine what is important to measure when testing the oil, and what levels those values should be. It was determined that the free fatty acid level was most important.
  - Initial testing of filtering with diatomaceous earth and performing a water wash was done to determine an approach for creating a design of experiments (DOE).
  - A DOE was created to test which of the refinement processes are important, what levels of each process work, and what the interactions are between each process.
  - Two 55 gallon barrels of oil were used for testing.
  - Each barrel of oil was filtered using a filter press with different levels of diatomaceous earth.
  - After the oil was filtered a water wash process was done for each level of interest.
  - The results of these processes were titrated to determine the free fatty acid level.

- **Meal Collection System**
  - Created several concept drawings for the system.
  - Decided on most efficient design and made a detailed SolidWorks drawing of it.
  - Components of the system were chosen, ordered, and assembled.
  - Once assembled, the system was ran to test its function and troubleshoot any problems.

Outcomes

- **Food Grade Oil**
  - Using the filter press with 15g/L alone, or using the water wash alone yields the best results.
  - It is more beneficial to use the filter press because it also removes particles and makes the oil more clear and presentable.
  - It is recommended to do more research on other refinement methods such as: performing a citric acid wash, using a centrifuge to aid in water washing, and having the titration testing validated by a laboratory.

- **Meal Collection System**
  - The drop tubes clogged once the bags were full due to the meal being hot and moist off of the press.
  - Test runs were completed, and it was found that cool meal does not clog, so a set of timers were added to allow the meal to cool before reaching the bags.
  - It is recommended to add a fan to further cool the meal in the system.