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Conduction Maize Drying for Emerging African Communities

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Problem Statement

Currently, in emerging African Communities, they are putting their maize out on mats to be dried under the sun. They are having problems with animals and humans stealing their produce along with maize weevils destroying their crops. Our objective is to create a mobile and efficient system that can dry grain on a need basis. It also needs to be made from materials that are easily obtained in these communities. The product will not be able to utilize electricity or gas to the main source of fuel will be fire. This is not the first time that this problem is a capstone project, and we have viewed some of the past results for reference, but we will need to collect our data to solve the problem.

Disciplines

Bioresource and Agricultural Engineering | Industrial Technology

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TSM 416 Technology Capstone Project

Conduction Maize Drying for Emerging African Communities

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Client: Dr. Carl Bern, University Professor, cjbern@iastate.edu

1 PROBLEM STATEMENT

Problem Statement

Currently, in emerging African Communities, they are putting their maize out on mats to be dried under the sun. They are having problems with animals and humans stealing their produce along with maize weevils destroying their crops. Our objective is to create a mobile and efficient system that can dry grain on a need basis. It also needs to be made from materials that are easily obtained in these communities. The product will not be able to utilize electricity or gas to the main source of fuel will be fire. This is not the first time that this problem is a capstone project, and we have viewed some of the past results for reference, but we will need to collect our data to solve the problem.

Business Case Statement

As emerging African Communities continue to harvest maize on a need basis for their communities, they have problems with animals and humans stealing their product as it sits out to dry under the sun. They also have to worry about maize weevils getting into each batch and ruining them. These communities would like a portable solution to dry their grain more quickly than the sun-dried method so that the maize can be put in storage. This product needs to be made by materials that they can obtain easily in Africa. We will create a working prototype so that we can test maize and get it from certain moisture content, similar to where it is harvested at, down to a moisture content to which it can be stored at. We are projecting that it will be 22% to 14% moisture percentage. We are specifically dealing with these 3 countries during their harvest season: Kenya, Malawi, and Uganda. We are doing this to improve the quality of the food.

2 GOAL STATEMENT

- The problem is the current method they are using to dry maize
  - The current method is laying out in the Sun and drying (Figure 1.1)
- They can measure by the amount of grain that they can keep after each harvest
  - How long it takes to dry the maize
  - Getting the maize from a certain moisture percentage to a lower percentage
- Reduce the amount of time it takes to dry the maize
  - Maximize yield of maize
- Providing a larger source of food for African communities
- We plan to send our designs and results over to Africa so that they can build and use this device on their own

Main Objective: Create a device that dries maize much quicker than the method of leaving the maize out in the sun to dry.

Specific objectives include:

1. The baseline of grain data (see Figure 2.1 and 2.2)
2. Possible design concepts (see Figure 3.1 and 3.2)
3. Finalized design for a product (see Figure 4.1 - 4.3)
4. Final test results and analysis of final design (see Figure 5.1)
5. Final Report and Presentation

Project Scope

- **Major Project Activities:**
  - Test grain samples at different temperatures
  - Come up with a design that can be built and used
  - Create a prototype of our design

3 PROJECT PLAN/OUTLINE

Methods/Approach

- **Reference Material(s):**
  - Using Data from the past group as a reference to get our data
- **Data collection:**
  - Collected data from a standardized process of drying maize on a hot plate and an electric scale to extract sufficient moisture percentage
  - Collected real-world data with our product using a luggage scale and a select amount of wood pellets for fuel
- **Skills:**
  - CAD design to come up with concepts and the final design for our product
  - Work with hands at the farm to bend, grind, and weld metal
  - Math to come up with measurements and angles for cuts
- **Solutions:**
  - Started by searching the internet for current solutions/methods for drying maize
  - Came up with four concepts and submitted them to our client to decide which one he preferred
  - Chose one idea and began thinking of ideas for how to make it and the materials necessary and the budget
  - Used Inventor to 3D CAD design the entire product for visualization and development of the product
  - Went to Ag farm to build and tweak product while only using materials that are easily found in African communities
- **Organization:**
  - Our team met at least once per week in person and consistently communicated over test or group message throughout each week
  - We also gave our client updates with pictures, emails, and in-person meetings on our progress and when we needed help or materials ordered
  - We responded to setbacks by quickly looking for alternatives so that we did not have to waste time waiting for things to happen for us instead of us taking care of the problem
  - Our major milestones:
  - Coming up with four solid concepts
  - Completing design of our chosen concept
  - Getting a location to build our product
  - Finishing the build of our product
  - Testing the prototype

4 RESULTS

Results/Deliverables

a. The baseline of grain data (see Figure 2.1 and 2.2)
b. Possible design concepts (see Figure 3.1 - 3.3)
c. Finalized design for a product (see Figure 4.1 - 4.3)
d. Final test results and analysis of final design (see Figure 5.1)
e. Final Report and Presentation

5 BROADER OPPORTUNITY STATEMENT

Due to the nature of our project, there is no potential market for our final design. This is because the main intention of our project is from a charitable standpoint to help those who are less fortunate. The objective is to use materials that people in emerging economies can accumulate with little or no cost. Therefore, each replication of our product may be altered slightly depending on what tools, materials, craftsmanship level, and economic level are available to each farmer or village.

Our final design will help to improve their livelihood by providing an alternative and more effective method for drying maize. In result of improving these techniques, it can address other problems these same people face. Problems such: maize weevils, rats, birds, and other pests eating yields, mold growing on maize and causing aflatoxin poison to children, and crops being stolen by neighbors.

6 GRAPHICAL ABSTRACT

7 References

- Renoe, J., & Hoefling, H. (2017, December). *ABE 416: Conduction Drying of Maize for Third World Countries*[PDF]. Ames, IA: Department of Agricultural and Biosystems Engineering, Iowa State University.

- Bern, C. J., Hurburgh, C. R., Jr., & Brumm, T. J. (2014). *Managing grain after harvest*[PDF]. Ames, IA.: Department of Agricultural and Biosystems Engineering, Iowa State University.

8 Appendixes

***All calculations and files for data collected have been handed off to the sponsor (Dr. Carl Bern) for later reference and more in-depth look on the collected data. ***

Figure 1.1: Current Maize Drying Method

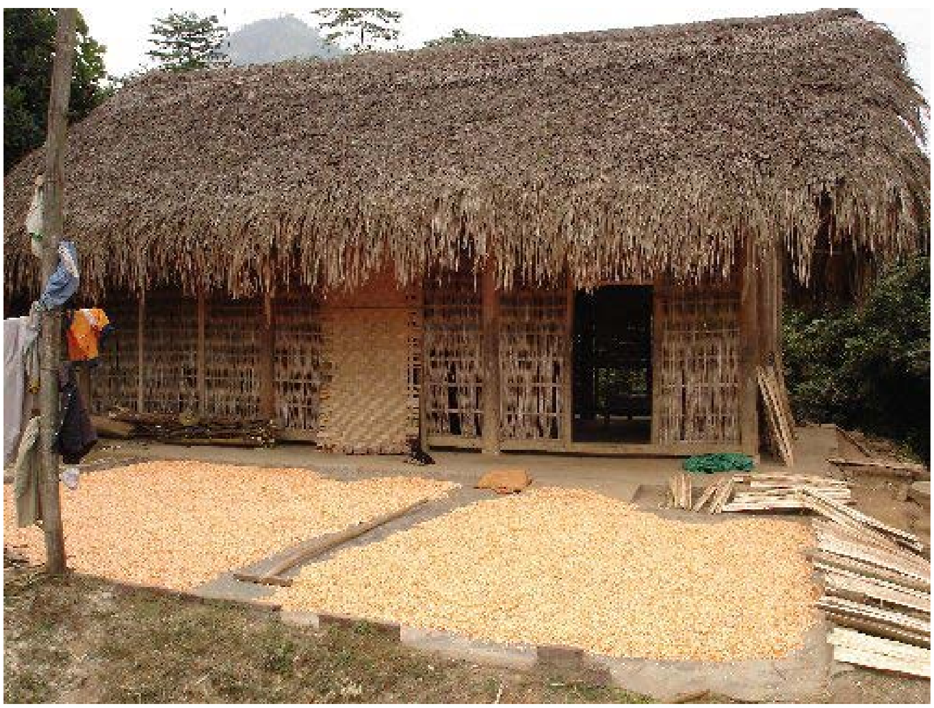

Figure 2.1: Baseline Data

Figure 2.2: Baseline Data

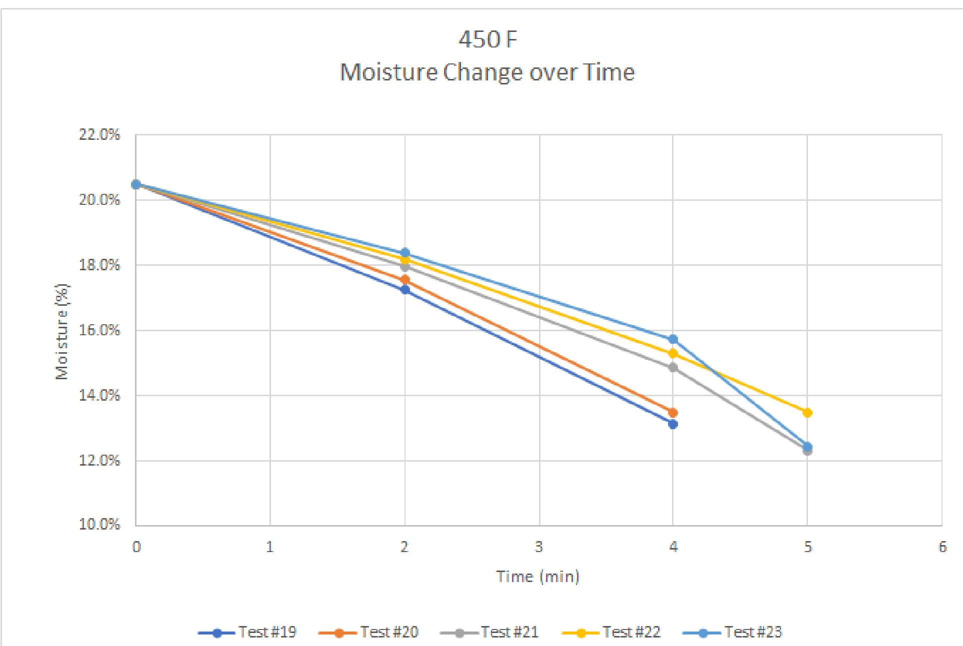

Figure 2.3: Baseline Data

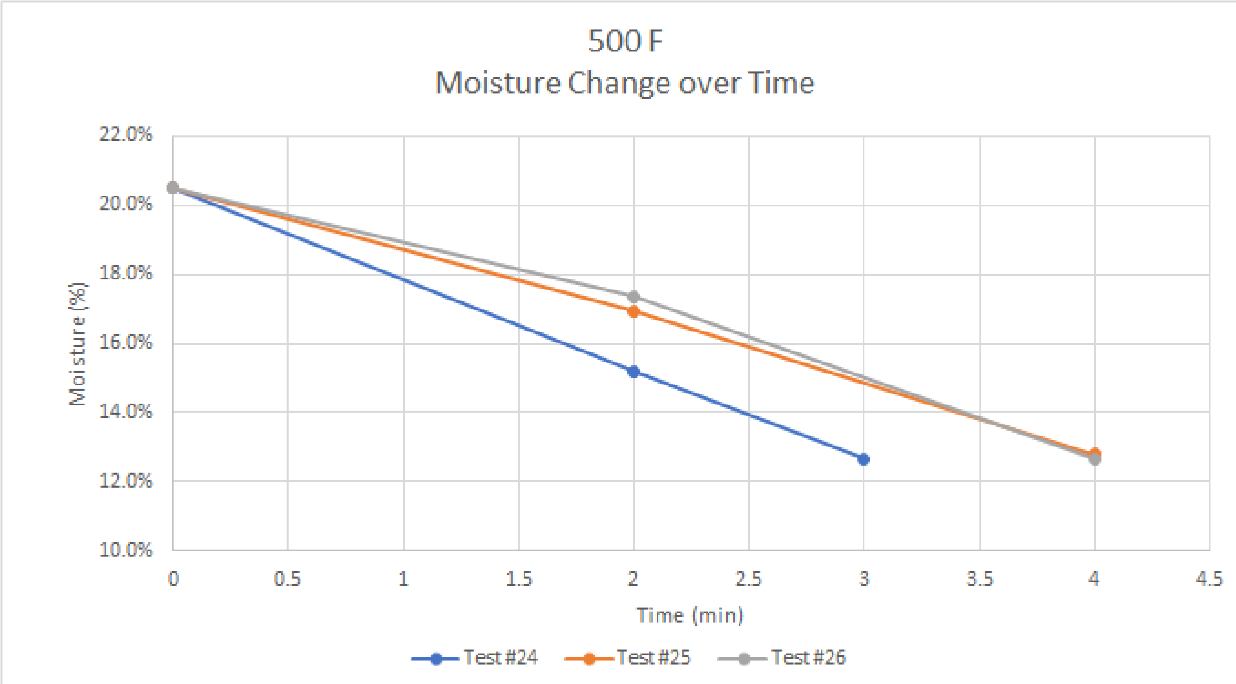

Figure 3.1: Alternative Design #1

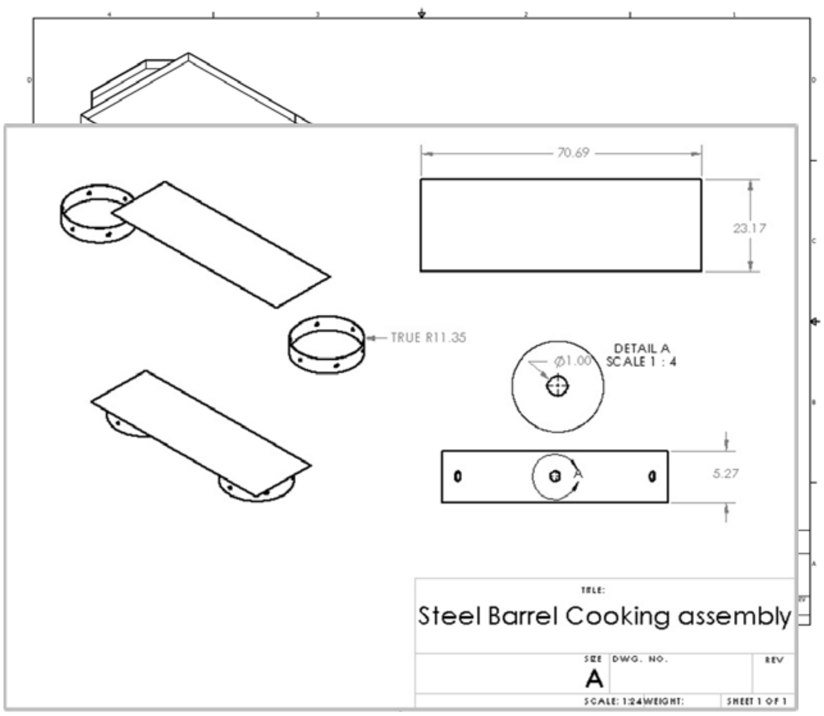

Figure 3.2: Alternative Design #2

Figure 3.3: Alternative Design #3

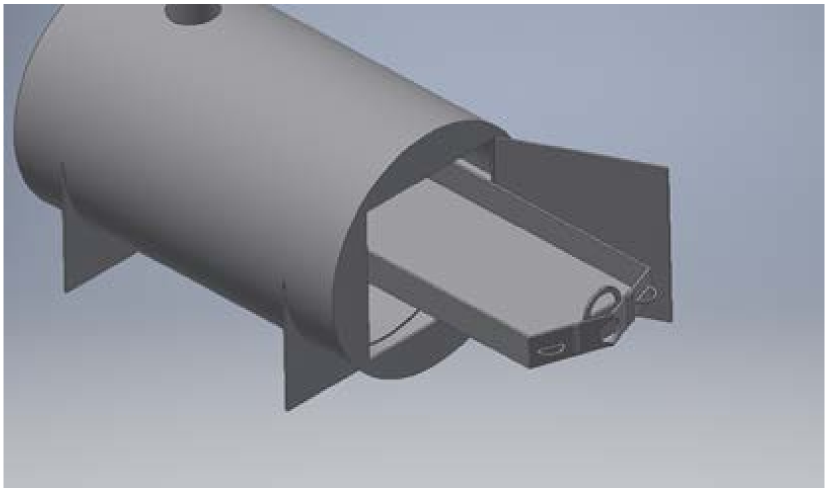

Figure 4.1: Final Design

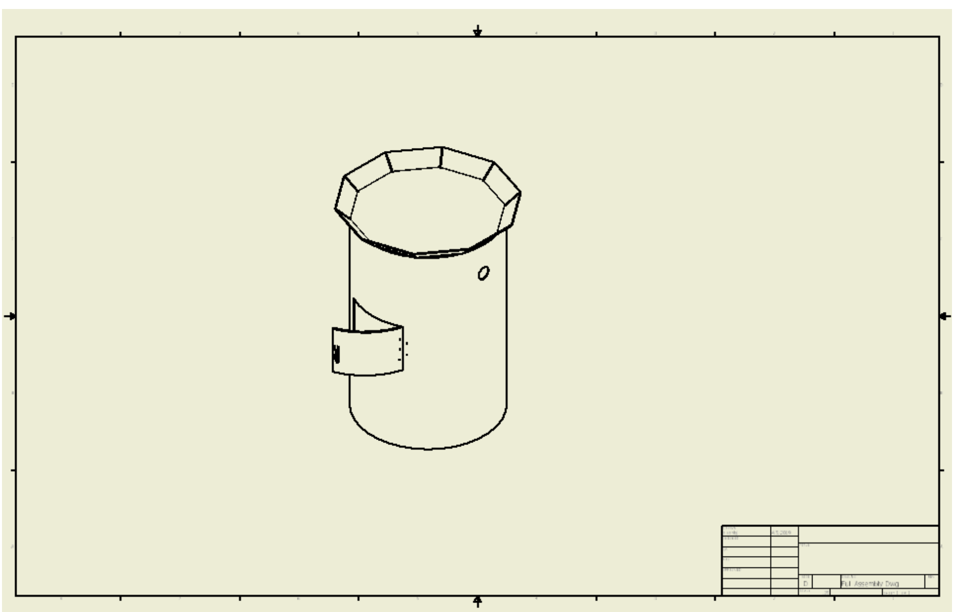

Figure 4.2: Final Design

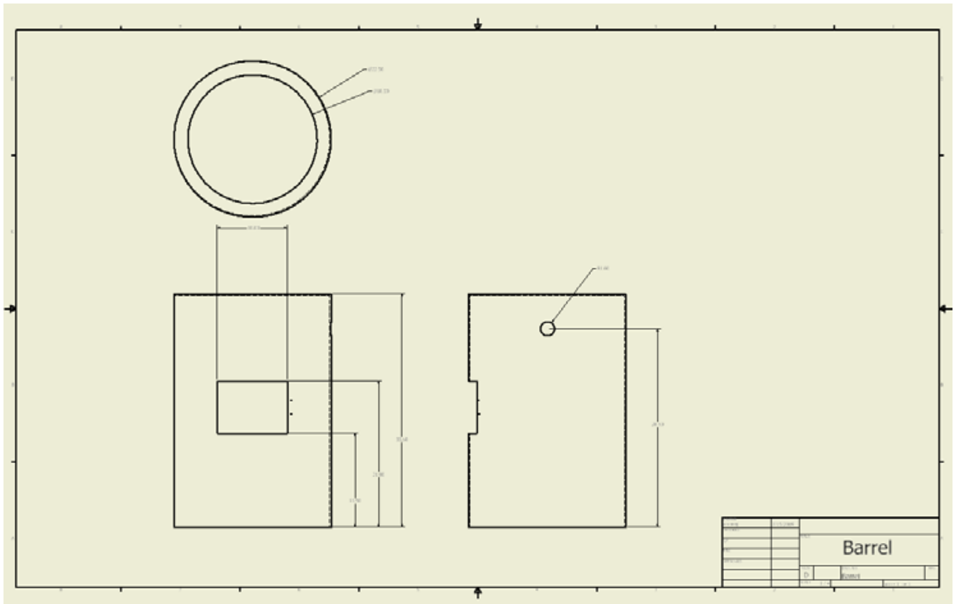

Figure 4.3: Final Design

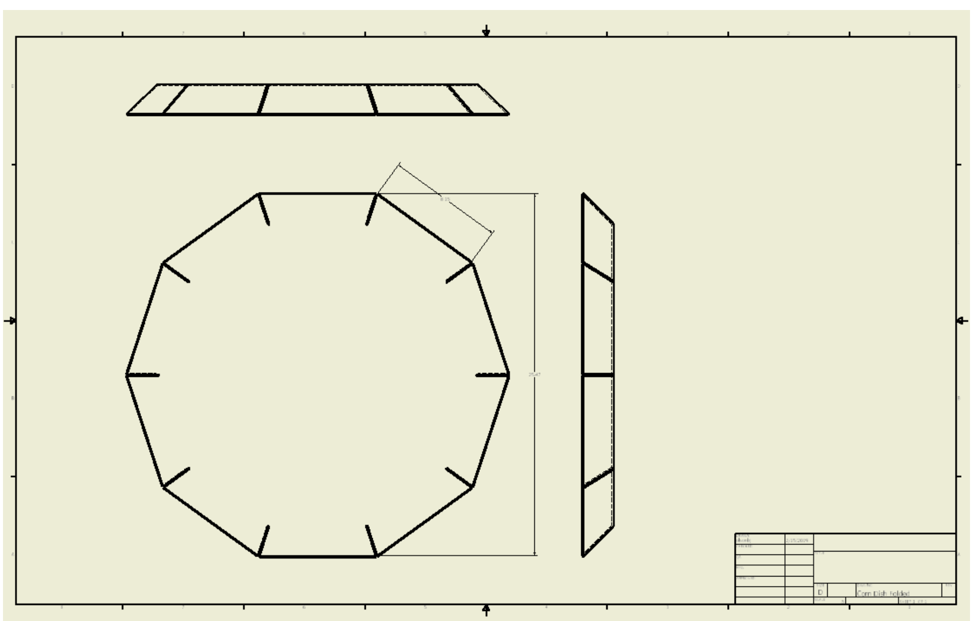

Figure 5.1: Final Test Results