Designing A Closed Loop Feed/Return System

Texas Christian University

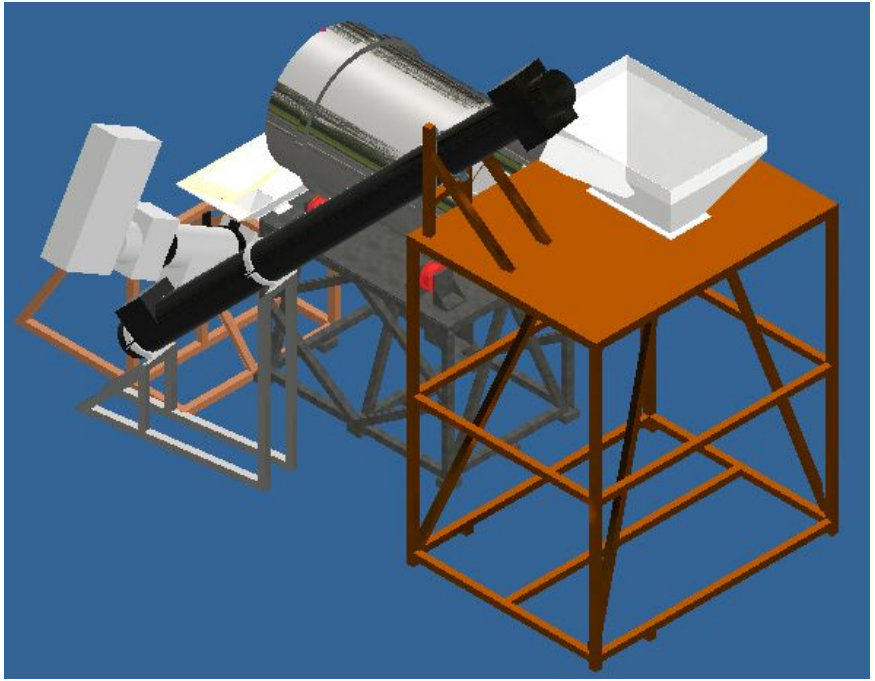
Department of Engineering

Jim Herendeen

j.herendeen@tcu.edu

Overview

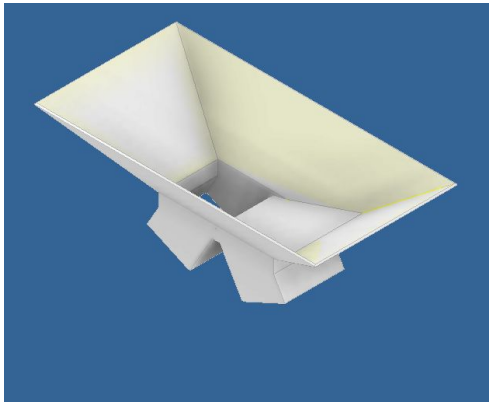
- Our client tasked us with creating a closed loop feed/return system
- This system will allow for continuous testing of drying mined limestone in the rotating cylinder
- This is important because Lhoist wants to be able to analyze the characteristics of the lifters/spirals inside the dryer to increase drying time efficiency

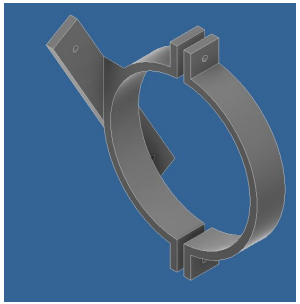


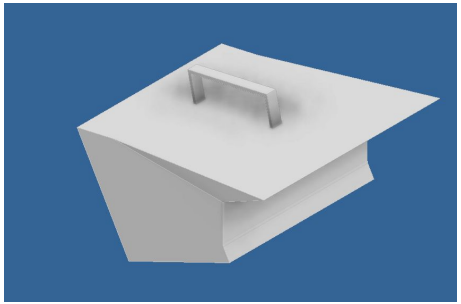
Client Specifications

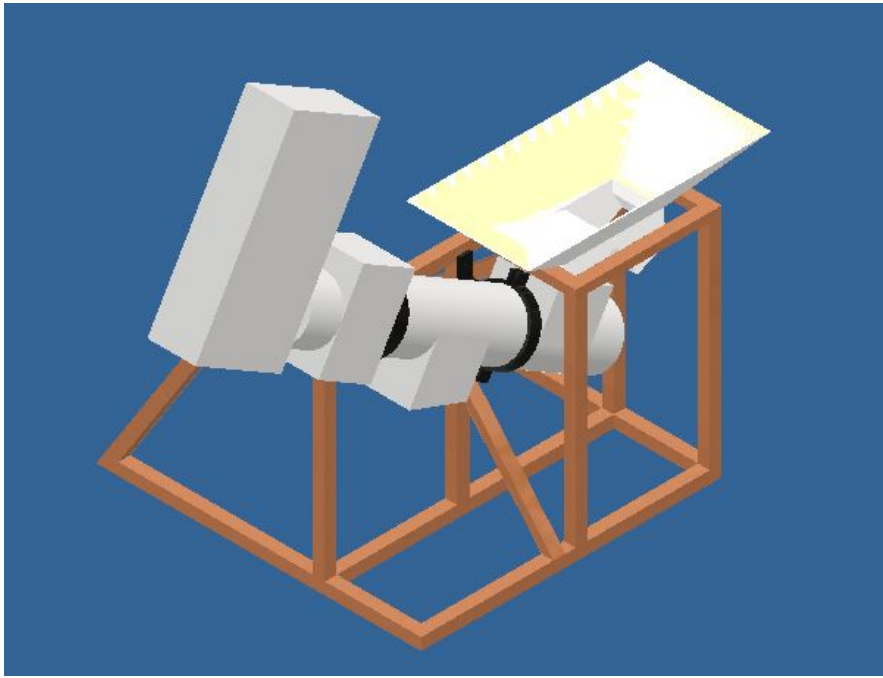
- **A batch or continuous process?**
  - Continuous process. We are building a small scale model to tests certain characteristics of the cylindrical dryer. Our goal is to determine what components of the dryer are most effective, and eventually build a full scale model.
- **What is the throughput of the system?**
  - High turndown and low throughput rates.
- **What level of feed accuracy is required?**
  - Our design requires the cylinder to be filled with limestone at 15% of the total Volume of the cylinder. We just got the motor mounted and the cylinder rotating, so we are unclear at what rate the limestone will move through the cylinder. We hope to have a definitive flowrate soon.
    - Volume Cylinder =~35.5 ft^3
    - MAX Volume of Limestone in Cylinder = 5.325 ft^3
    - Hopper size = 16ft^3
- **Material info**
  - - what is the bulk density
    - ρ_{ma}=2.71 g cm^{-3} ···· (generic value online of Limestone, _____)
- **Flow rate:**
  - 36 Tons Per Hour with high turndown and low throughput rates
- **Particle size:**
  - .
  - a 10 mesh x 0 particle size distribution
- **Moisture content:**
  - Up to 10% moisture content
- **PACKED Bulk density:**
  - We calculated a bulk density of the limestone to be 113.85 (lbm/cubic foot).

Short Screw Base







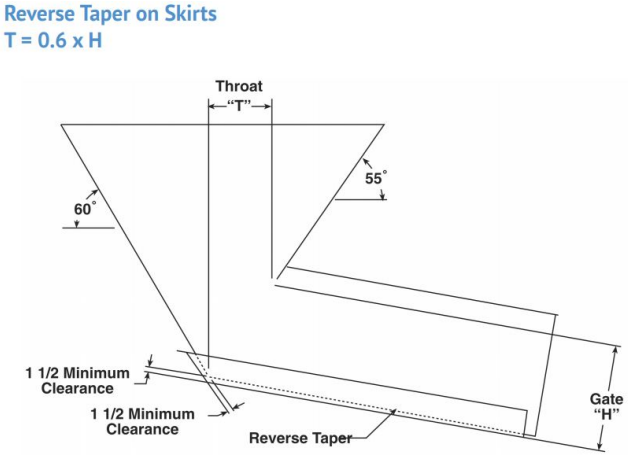


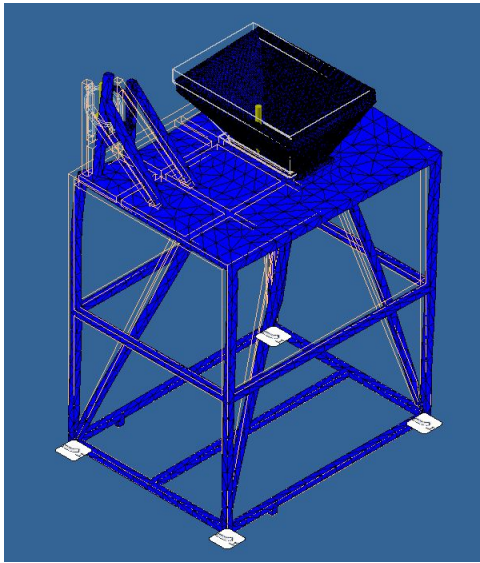
Screw Conveyors

- Feed Rate = 20 tons/hour
- Short Screw Feeder -
  - 5 Ft Effective Length
  - 30 Degree Angle
  - 2 HP - 3 Phase
  - VFD
- Long Screw Feeder
  - 14 Ft Effective Length
  - 45 Degree Angle
  - 5 HP - 3 Phase
  - VFD

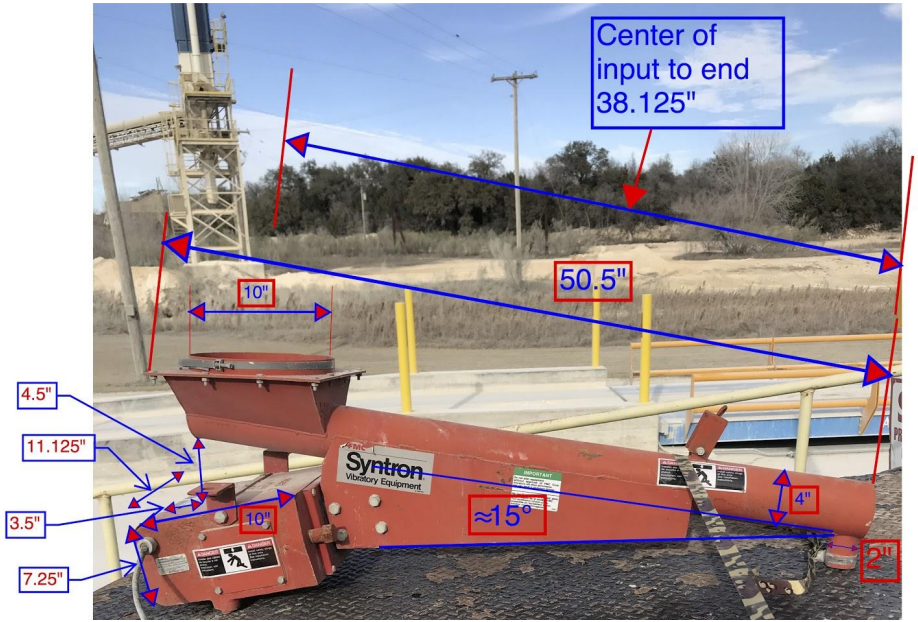
Hopper and Base

- Create hopper that has correct capacity (10ft^3)
- Size the hopper based upon the manufacturer's specifications
- FEA analysis on loads
- Support Feeder from structure





Feeder



- Client has this on site
- Will be configured to fit under the Hopper and fixed to the Hopper base