Biodigester and Methane-Fueled Heat

Overview
Penergy Solutions is developing a compartmentalized anaerobic biodigester, manure-processing unit for applications on small/organic farms and green waste disposal. A 40-ft long drainpipe, the reactor body, was compartmentalized by way of rubber-sealed plywood plates connected to 55-gallon, waste-holding barrels, which slide through the digester body on their sides.

Objectives
To produce a working, research-ready prototype by: sealing the reaction chamber from oxygen; redesigning the plate-separated compartments; upgrading the sulphur gas scrubbing system; building a solar-thermal panel for heat supplementary heat; and creating a new gas storage system, with which Penergy can continue their research into compartmentalized anaerobic digestion

Approach
- Analysis on the problem and research on current methods and designs of digesters
- Talked with our sponsor to determine a specific set of product requirements. Combining their knowledge of the product market and our research from existing patents we created a customer needs assessment.
- Came up with several different designs that would be feasible solutions to segment the digester
  - There were three options: plates, barrels, and a plate-barrel combination.
- Picked the best design based on cost, ease of manufacturing, and simplicity. This was the plate-barrel combination
  - After selecting the design, models were created using SolidWorks to get have visuals as to what the product would look like for ourselves as well as our sponsor
- Built the prototype in the shop in the Agricultural Engineering building
- Tested the prototype onsite at the Penergy farm. Because it takes several weeks for manure digestion to complete it was not determined whether the yield from the manure was as plentiful and clean as hoped
- Updated the design and prototype based on the results from the testing

Outcomes
- The manure digester redesign resulted in a new compartmentalization which fixed the instability of the original plates
- New biogas bag is capable of storing the methane and does not deteriorate under environmental conditions
- Built a new solar panel that supplies supplemental energy to the greenhouse
- Redesigned the gas scrubber system to remove impurities from the methane gas