Anaerobic Digester Feeding System

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Aim of the Project

The Aim of the project is to design and manufacture a Feeding System to breakdown and transfer organic materials into a previous project Anaerobic Digester.

Objectives

1. Research methods of feeding organic material into anaerobic digesters.
2. Complete a design study to determine the optimum design for the AD feeding system.
3. Create a complete 3D assembly of the design and complete working drawings.
4. Manufacture and source components to complete AD feeding system assembly.
5. Verify AD feeding system using two types of organic materials.

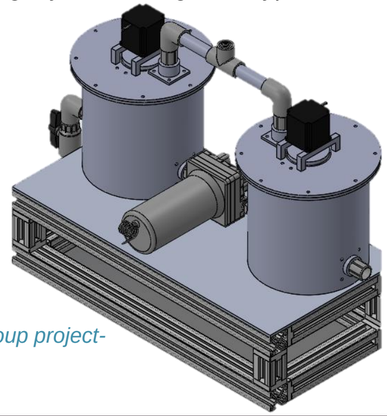


Photo of previous Group project- Anaerobic Digester

Background

- Anaerobic digestion is the process of breaking down organic waste and materials for the production of biogas.
- Microorganisms inside the Anaerobic digester tanks help to breakdown organic matter without the presence of oxygen.
- Materials such as Silage, Slurry, Straw, Grass, Muck, Maize and food waste can all be used in the production of biogas.
- To break up and transport these materials into an anaerobic digester a feeding system is used.
- Augers, Conveyers and sludge pumps such as Progressing cavity pumps, Centrifugal sludge pumps and Positive displacement pumps can all be used to transport the organic materials.

Design

For the design, the aim was to include a method of breaking down/chopping the organic materials as its being feed into the system and a method of transporting it into the anaerobic digester tank. By using sketches and SolidWorks this simple functional design was made.

The design has a removable cover to prevent any spillage. A cutter drum in the centre of the hopper will breakdown any organic matter as it passes through the system similar to a cutter drum in a silage harvester. After the organic materials will fall onto a moving auger which transports the organic materials towards the outlet. The auger and the cutter drum are both powered by two separate motors mounted on the back of the design, each controlled using two DPDT switches to allow for a change in rotation if any blockages occur. Connected to the outlet an elbow connection will run into a ball valve which prevents any organic materials flowing back through the system.

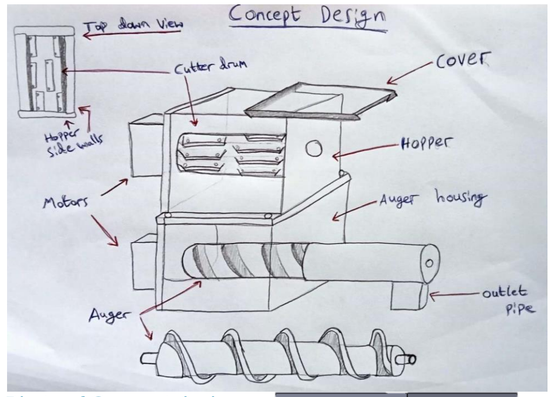


Photo of Concept design-

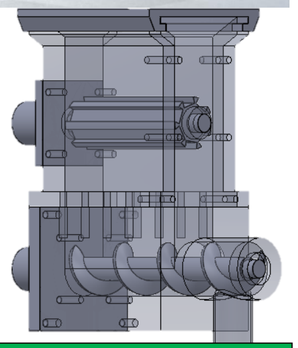
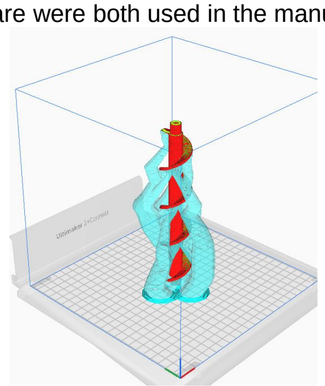


Photo of Final SolidWorks model-

Manufacture and Assembly

For the manufacturing process the decision was made to use 3D printers to print each part of the design as it greatly reduces the cost and manufacture time, it also allows for more complex parts such as the auger, cutter drum and housing to be made within the college. The UltiMaker 3D printers and Cura Software were both used in the manufacturing process.



Photos of the 3D UltiMaker Cura software used

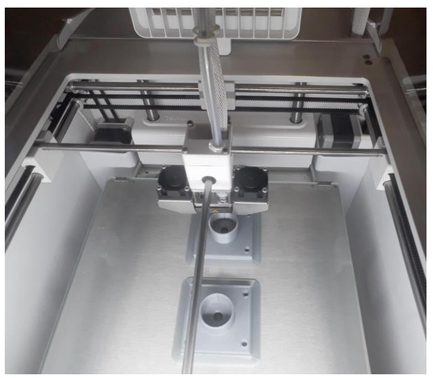


Photo of the 3D printer working

Once fully printed the 3D printed parts were coated in a water-resistant sealant to prevent any leakage and breakdown of the plastic PLA used in the printing process. For the assembly, simple M5 Allen key bolts were used to connect all the parts together. Bearings were then placed into position for the auger and cutter drum to prevent any wear over time.

Conclusion

- The aim of designing and manufacturing a feeding system for the previous group project Anaerobic Digester was accomplished.
- The design functions as intended.
- The 3D printed parts took a couple hours each to print but overall, the parts turned out well, connected together perfectly and were stronger than previously expected to be.
- Food waste works best with the design as the 3D printed roller is not sharp enough for harder materials such as silage or straw passing through the system.
- If a second version of the design was to be made, changing the main parts such as the hopper, cutter drum, auger and housing to aluminium or stainless steel would greatly increase the efficiency and lifespan of the system.

Photo of Final Assembly

Acknowledgements

I would like to thank my supervisor Dr. Emma Kelly and everyone involved for their continued help and guidance throughout the course of this project.