Compostation Prototype

**Statement of Problem:**
Design a solar-powered composting system capable of degrading food waste, paper waste, and pet waste into a nutrient-dense humus for local land application.

**Objectives:**
- Decrease organic material transported to landfills.
- Source system energy from renewable sources.
- Increase public awareness of the benefits of composting.
- Produce Class A biosolids for agricultural uses.

**Motivation:**
- Population increases have lead to strains on landfills and waste treatment facilities.
- Growing public concern of greenhouse gas emissions and environmental impacts.
- Availability of waste streams which can be converted to high-value products.

**Market Share**
- Niche markets already predisposed to energy conservation technologies.
- Populations where grants are available to provide funding for the development of environmentally friendly processes.
- Targeted customers include: apartment complexes, college campuses, and public parks.

**Societal and Global Impacts**

**Positive Impacts**
- Mitigation of greenhouse gas emissions due to reduction in waste transport.
- Inputs otherwise treated as waste are utilized to generate a value-added product.
- Educational benefits provided to the community at large.
- Reduced capacity requirements for local landfills.

**Potential Design Drawbacks**
- Net increase in emissions if the system installation is not accompanied by a reduction in garbage collection.

**Process Goals:**
- Production of Class A biosolids
- High substrate conversion
- Cost effective

**Alternatives Considered:**
- Shredding
  - Cascaded shredders
  - Industrial biaxis shredder
  - Multipurpose blender
- Thermophilic Decomposition
  - Screw conveyor
  - Belt conveyor
  - Aerated fermenter
  - Plug flow reactor
  - Screw conveyor
- Air Filter
  - Carbon Filter
  - Biofiber filter
  - Combined water and air filter
- Mesophilic Decomposition
  - Dual fermentation tanks
  - Batch fermentation tank

**Design Constraints and Challenges**
- EPA Class A biosolids design standards require that compost be maintained at an operating temperature of 40 degrees Celsius for a minimum of five days, and exceed 55 degrees Celsius for at least four hours.
- Availability of solar energy due to weather fluctuations.
- Addition of non-biodegradable substrates to the feed stream.

**Economic Analysis:**
- The gross earnings of the installed pilot system has been evaluated.
- Annual Sales and Savings Income: $2,685.61

**Direct Costs:**
- Purchased Equipment: $3,250
- Installation: $812.50
- Instrumentation and Controls: $325.00
- Total: $4,387.50

**Indirect Costs:**
- Consultation and Design Costs: $1,316.25
- Total: $5,703.75

**Fixed-Capital Investment (P):**
- $5,703.75

**Fixed-Capital Investment (A):**
- $1,597.48

**Direct Production Costs:**
- Maintenance and Repairs: $1,140.75
- Depreciation: $570.375
- Total Product Cost (A): $1,140.75
- Annual Cash Flow: $71.99

**Moving Forward**
- Obtain experimental data for the proposed prototype to measure the final quality of the finished compost.
- Analyze finished compost to confirm there are no measurable quantities of pathogenic bacteria to comply with EPA Class A biosolids guidelines.
- Design a visual model highlighting the aesthetic features of the system for marketing purposes.
- Develop a functioning prototype.