The Injera Project: Team Injeneering

Overview
Injera is an Ethiopian flatbread and main dietary staple of the people of Ethiopia. Injera is made from Teff flour, handmade everyday and cooked over a wood fired stove. Injera production as well as other factors has caused Ethiopia to suffer issues regarding deforestation, hunger, human health concerns, and poor living conditions. A venture led by the African Climate Exchange aims to solve these issues with The Injera Factory, a sustainable system of injera production. Team Injeneering has been asked to further develop a device to deposit and form injera batter onto a moving conveyer belt, to be used in an assembly line in Ethiopia.

Objectives
The purpose was to further the development of an injera dispensing machine that could easily be fabricated, assembled, operated, and maintained in Ethiopia. The team was to design a simple machine to handle and control a low viscosity batter and dispense it onto a continuously operating conveyor belt. The design must also be adaptable to changes in batter density and viscosity, as well as changes to injera size. The machine must produce a minimum of 5400 injera per hour with each injera being 50-55 cm in diameter and 5 mm in thickness.

Approach
- Analysis of previous Injera Factory designs
  - Issues included contamination due to grinding, leaking, and pressure control
- Industry research and patent search
- Brainstorming and concept generation aimed at solving issues
- Concept selection via multiple concept weighting formulas
- Selected two designs and developed system level designs
- Developed detail designs for both designs
- Consulted professionals from Reading Bakery Systems
- Chose to prototype the Waterwheel concept over the Sliding Plate’s design
  - A rotating cylinder that decouples tank and conveyor
  - Dispenses a volumetric amount of injera, independent of pressure
- Fabricated a successful scaled alpha prototype of the machine

Outcomes
- Design can produce 43,200 injera per workday
- Due to the volumetric flow regime, the device can handle changes in viscosity and batter height
- NPV analysis shows The Injera Factory can show profits up to $2 million in ten years

Recommendations for further development:
- Build a scaled-up prototype.
- Design for upstream and downstream processes
- Improve shape consistency and eliminate dripping