Automated Splicing and Cutting Machine

Project description

The scope of this project is to fabricate a splicing and cutting machine for company A. Their current system is unsafe for the operator and inefficient due to human error. Our design serves to automate this portion of company A's manufacturing process, removing the human error, reducing waste, and most of all, increasing safety.

Design Details

The design features a custom-built machine for splicing and cutting LDPE plastic film. It uses a Kanthal wire that is heated with a voltage regulator to cut the plastic. A roller and piston mechanism create a consistent splice using double-sided tape. The machine is controlled by a pneumatic valve and both cutting and splicing mechanisms actuate simultaneously at the press of a button.

Multidisciplinary Participation

- Electrical engineering
  - Focus on electrical elements
  - Heating element design
- Mechanical engineering
  - Focus on hardware and mechanical systems
  - Roller design
- Computer engineering
  - 3-D modeling
  - Virtual testing
- Industry expertise (sponsor)
  - Material expert
  - OSHA codes guidance
  - Industrial implementation
- Faculty expertise
  - Vast project experience
  - Electrical, mechanical, acoustical, and structural

Initial Design Matrix

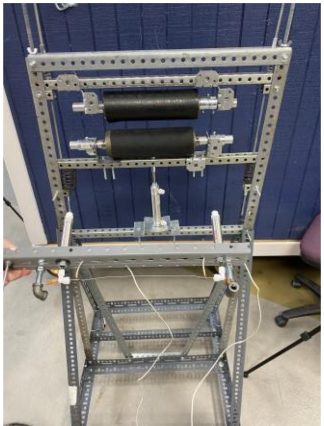
		Design			
		1	2	3	4
Criteria	Safety	1	1	2	1
	Operability	2	1	2	1
	Wastefulness	2	2	1	2
	Cost	3	3	1	1
	Installation	3	3	2	1
	Ease of manufacture	3	3	1	1
	Reliability	1	1	2	1
	Repairability	3	3	2	1
		18	17	13	9

Design Verification

Requirement/Metric	Verification Method	Results
Functional Requirement 1: Accurate Cutting and Splicing	Prototype testing, System-level testing, Acceptance testing	Pass
Functional Requirement 2: Continuous Operation	Prototype testing, User acceptance testing	Pass
Functional Requirement 3: Material Compatibility	Material testing, Acceptance testing	Pass
Functional Requirement 4: User Interface	User acceptance testing, Prototype testing	Pass
Functional Requirement 5: Successful Splice with no Disruption	System-level testing, Acceptance testing	Pass
Functional Requirement 6: Easily Mountable	System-level testing, User acceptance testing	Pass
Functional Requirement 7: Safety Features	Design review, Safety testing	Pass
Functional Requirement 8: Industry Compliance	Regulatory compliance testing	Pass
Design Metric 1: Cutting and Splicing Precision	Performance testing, User feedback	Meets Expectations
Design Metric 2: Operational Efficiency	System-level testing, User feedback	Meets Expectations

Final Design

- Adaptable
- Efficient
- Portable
- Safe to Operate
- Excellent proof of concept
- Easily Implemented



Knowledge and Skills Gained

- Understanding of mechanical and electrical hardware design principles
- Knowledge of material properties and their impact on design decisions
- Experience with project management and collaboration within a team
- Ability to troubleshoot and problem-solve technical issues
- Familiarity with patent research and academic literature review
- Understanding of the importance of communication in a multidisciplinary team

Health/Welfare of the Public

The health, safety, and welfare of the public were considered throughout this project. We conducted risk assessments and implemented safety features. For instance, we used a voltage regulator to regulate the heat generated by the Kanthal wire and prevent it from overheating, which could cause burns or start a fire. Additionally, we ensured that the machine was stable and that all its moving parts were adequately guarded to prevent injury.

References

- T. Takahiro, "Automatic Film Splicing Device of Filling and Packaging Machine," U. S. Patent 2,008,001,426, 1 Oct., 2008
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- D Briassoulis, A Aristopoulou, M Bonora, I Verlodt, "Degradation Characterisation of Agricultural Low-density Polyethylene Films." Biosystems Engineering, Volume 88, Issue 2, pp. 131-143, 2004