Foam Splitter Machine

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INTRODUCTION

Sekisui Chemical is an $11 billion organization that is operating in more than twenty different countries. Sekisui Voltek is one of the larger facilities the company owns and manufactures a variety of foams for several different marketplaces such as automotive and aviation. Sekisui Voltek brought a problem to Trine University's DET department to be solved. The sponsor, Keigo Shimura, is a senior R&D engineer for Sekisui. As the inventor of the foam, Keigo introduced the current technique used to split the piece of foam. This original method is labor intensive and involved two people and several manual steps to complete. Sekisui wanted the team to create a more automated method of splitting the foam to allow for testing different foam sizes and should lead to a new market opportunity for Sekisui to grow and expand.

PROBLEM STATEMENT

Sekisui Voltek has created a new foam product that can be split in half with minimal effort. While the market for this product is being developed, the only way to test the splitting affect is by manual operation using two people. The student design team was tasked to create a machine that can split the various foam thicknesses and provide testing for the foam product. The goal if to create a proof of concept machine to be used in Sekisui's testing lab to split a single roll of foam into two rolls of foam. The machine needed to be able to split thicknesses between .5mm-1mm.

CUSTOMER NEEDS

- Split the Foam
- Accessibility
- Efficiency
- Durable
- Adjustable

SPECIFICATIONS

- Cutting blade of less than 30 degrees
- Rollers with diameters less than 12"
- Safety doors that open at a minimum of 100 degrees
- Operated with 2 people
- Foam can be removed in under 2 minutes
- Split the foam in under 5 minutes
- Steel construction
- At least 4 wheels
- Adjustable rollers (3 Settings)
- Speed is adjustable for 3 peel strengths

INITIAL DESIGN

The team created a sketch after the initial meeting with the sponsor. Figure 1 shows the original design concept created after the meeting.

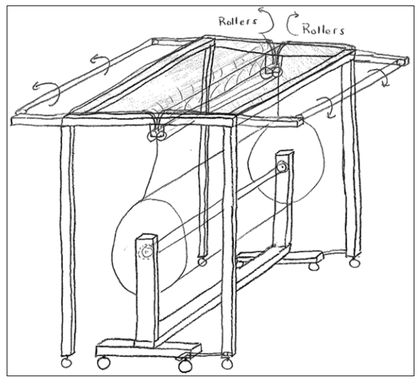

Figure 1: Original Design Sketch

SYSTEM-LEVEL DESIGN

The Foam Splitting Machine is comprised of four individual systems that enable functioning. The four functional systems include the power (Figure 2), alignment (Figure 3), cutting (Figure 4), and receiving (Figure 5). Each system was analyzed to give the machine the ability to split the foam effectively and efficiently.

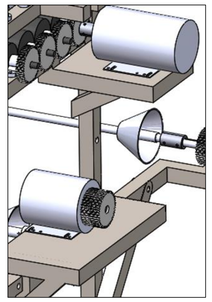

Figure 2: AC Motors

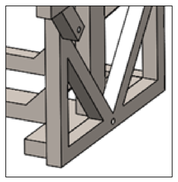

Figure 3: Lower Pin Alignment

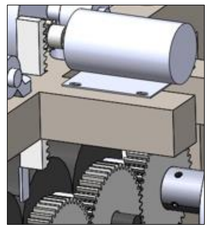

Figure 4: Moveable Hotwire

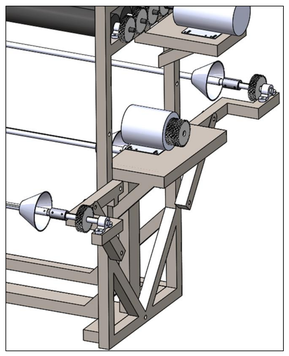

Figure 5: Receiving Arms

DESIGN CONCEPTS

The team used a voting matrix to choose a final design concept, after devising multiple designs. Figures 7 and 8 are SolidWorks concepts for the team's Foam Splitter.

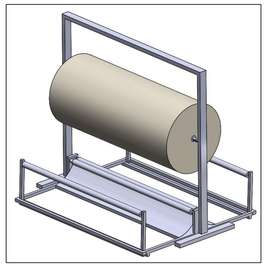

Figure 7: Vertical Design

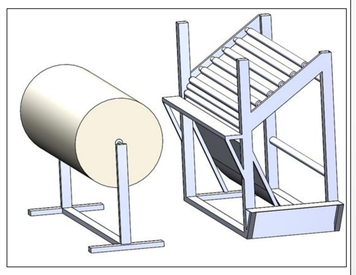

Figure 8: Horizontal Design

TEST RESULTS

The team ran Finite Element Analysis (FEA) on the final design of the frame. Shown in Figure 9 is an FEA test. Applied is a 4,000-pound force achieving a factor of safety of just over 1.

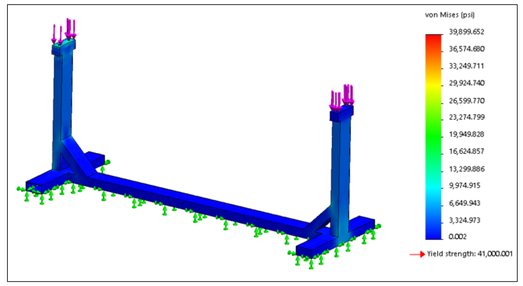

Figure 9: 4,000 lb. Applied Force

FINAL DESIGN

Figure 10 illustrates the final prototype that was developed by the team to be manufactured for Sekisui Voltek.

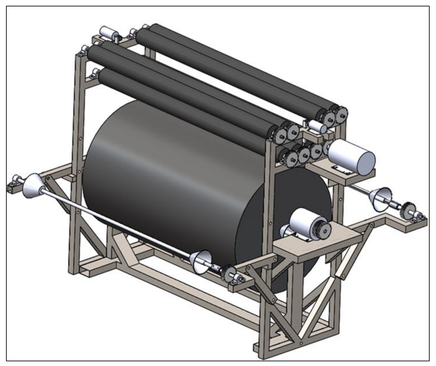

Figure 10: Final Design in Working Position

FUTURE WORK

The team still needs to order all raw materials to build the foam splitting machine as well as test the final product once the machine is built. Lastly, the team needs to powder coat the machine to ensure the machine looks presentable as well as demonstrate to the sponsor how to run the machine.

CONCLUSION

The team worked together to create a product that met all the customer needs and will open new avenues for Sekisui Voltek. The design has versatility and functionality that will allow for successful use in different splitting operations. Through design iteration, brainstorming, and problem solving, the team succeeded in creating an innovative, robust, easy to use, and ergonomic Foam Splitting Machine for the Sekisui Voltek.

LESSONS LEARNED

- The team learned how to communicate with an outside entity to effectively complete the project.
- Experienced the difficulties of the design processes and overcoming those difficulties.
- Learned how to adapt to change throughout the design process. Learned that design iteration is the key to design success.
- Learned how to communicate internally about initial ideas for the project and issues that arose. The team learned how to work around schedules and be flexible with meetings.
- Learned that time management, organization and communication are three of the most important aspects for success of a project.

ACKNOWLEDGMENTS

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