

ABSTRACT

The Team partnered with Brightmark energy to create a product that will make the plants recycling more efficient. The problem that Brightmark is running into with the current process of using regular bolt cutters and manually remove the steel wires from plastic bales shown in Figure 1.



Figure 1: Plastic Bales

Thus, Brightmark Energy desires a tool from the Steel Wire Handling team to create a safer and efficient process that is two times more efficient than the original process. As team progressed some of the initial ideas the team came up with are pinching devices to attach on one of the sides of a bolt cutter head to grab the wire. Another idea was to create a latching device on the end of the bolt cutter to collect all the wires. Although, neither of these 3D printed prototyped ideas worked during testing. So, the teams last idea presented is creating a sharper, longer blade for a bolt cutter head. This solves one of the main issues Brightmark has with handling film bales that would be difficult to reach wires with a regular bolt cutter.

CUSTOMER NEEDS/SPECS

Brightmark's needs for a hand tool came from the challenge of removing steel wires from bales of plastic before processing takes place. The tool is to be a last resort option for when all other tools fail to cut open the film bales. Brightmark is focused on simple operation and maintenance. Seen in Table 1 & 2 are customer needs and specifications

Table 1: Customer Needs

CUSTOMER NEEDS
MUST BE A MOBILE HANDTOOL
NO BATTERIES OR MOTORS
EASY OPERATION
MUST CUT EMBEDDED WIRES
MUST BE DURABLE
COST EFFECTIVE SOLUTION

Table 2: Specifications

SPECIFICATIONS
MUST CUT 11GA WIRES
PROCESSED IN 3 MIN.
UNDER 20 POUNDS
UNDER 36" IN LENGTH

INITIAL DESIGNS

The initial designs created by the team were focused on the processing system plan that Brightmark had in place in fall 2020 (Figure 2). The system included having a raised platform where the wires are cut and pulled from the bales. In Figure 3, a saw guide assembly is shown to solve the cutting aspect. Figure 4 shows a clamping device used to demonstrate grabbing the cut wires by clamping the wires in and pushing the bales through the table.

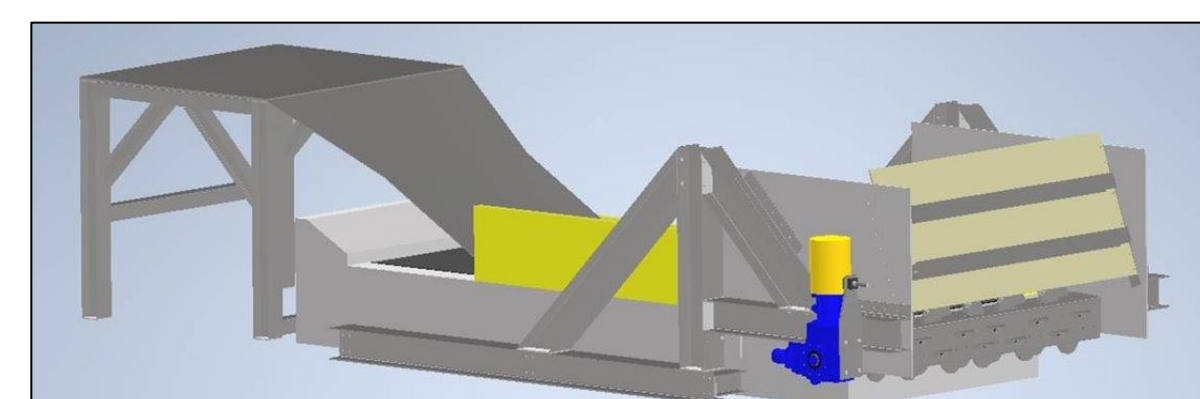


Figure 2: Bale Fall Process

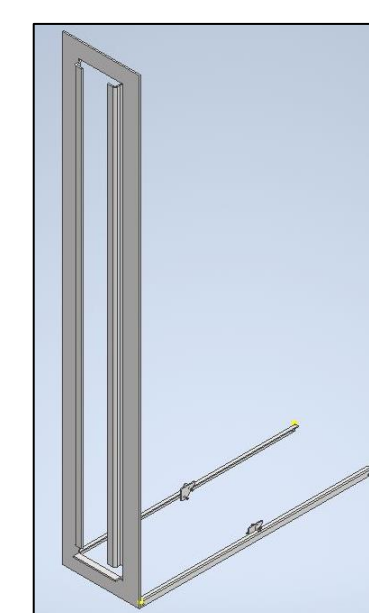


Figure 3: Saw Guide Assembly

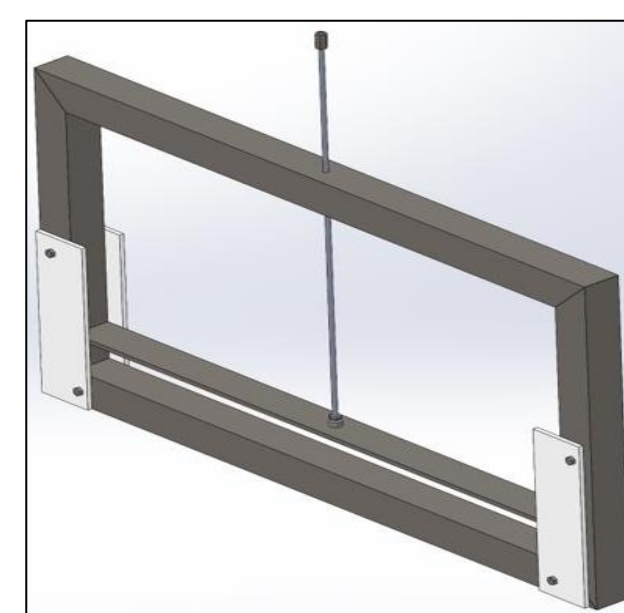


Figure 4: Cactus Jack Clamp

NEW DESIGN CONCEPTS

The team had several concepts that were approved in February by the sponsor. These concepts included that handle attachment, shield, and exterior jaws as seen in Figures 5-7. These concepts were to help improve safety as well as complete the task at hand. These concepts would keep the worker safe from whiplash as well as grab onto the wire. The handle attachment would then be used to gather the cut wires that would be removed from the bale.

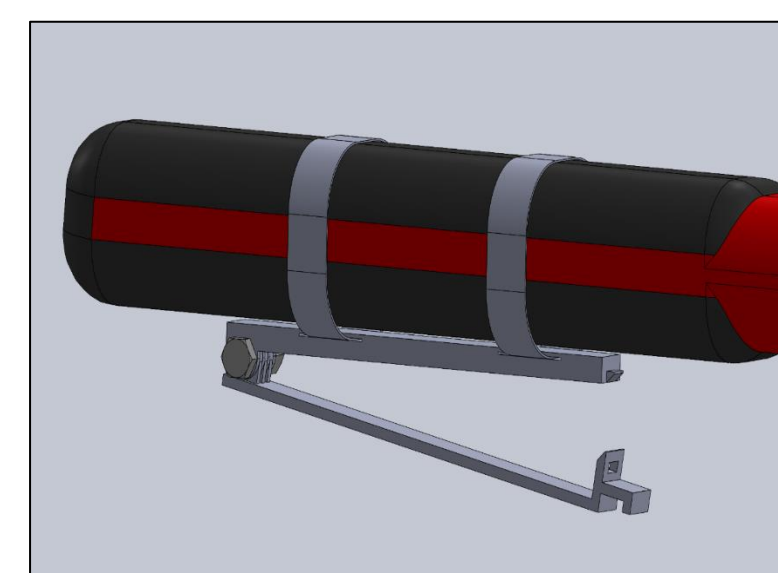


Figure 5: Handle Grabber

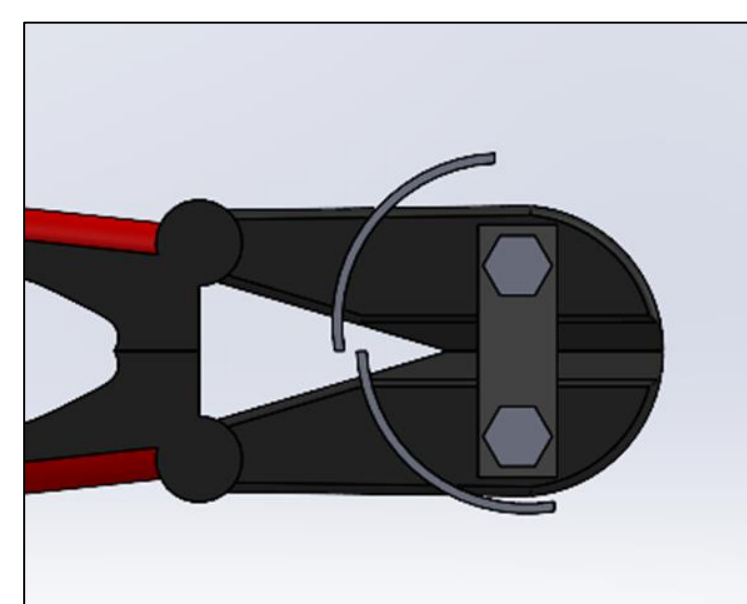


Figure 6: Shielding

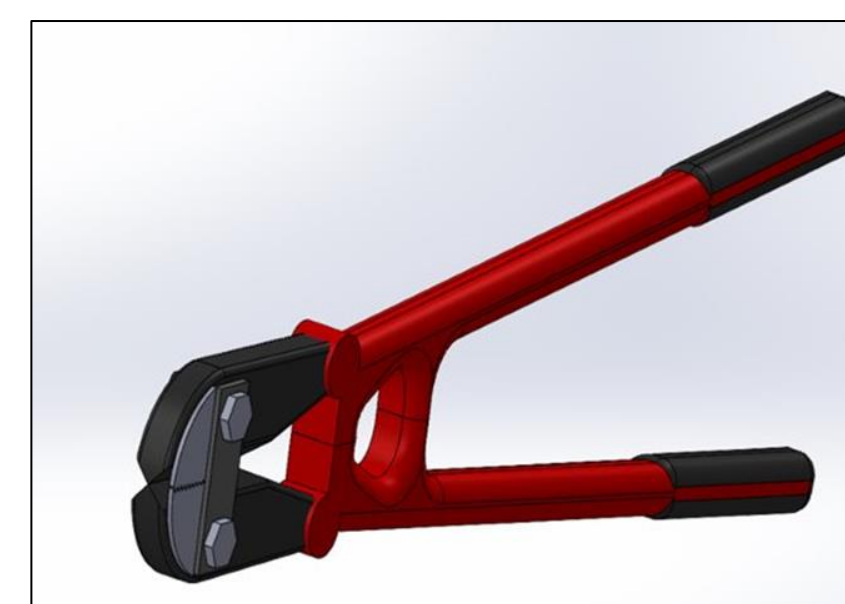


Figure 7: Jaw Grabber

TESTING RESULTS

The team conducted a hand tool evaluation for the steel wire project to determine which hand tool was best suited for the challenge presented to the team shown in Table 3.

Table 3: Tool Evaluation

Tool	Strap thickness	No. of Straps	Cutability	Bolt Cutter Test				Recommended Cutting Thickness	Cost	Add Mods	Comments
				Weight	Damage	Length	Style				
Fiskars	0.1180"	1	No	5.50lbs	Paint Removed	24"	Bolt	1/4"-3/8" Max	\$0	Yes	Could not cut
PITTSBURGH (Cable)	0.1172", 0.1179"	2	No	6.20lbs	Jaw damage	28"	Cable	3/8" Max	\$88.20	No	Could not cut
PITTSBURGH (Bolt)	0.1175", 0.1185", 0.1185", 0.1190", 0.1178, 0.0755"	10	Good, Cut with little pressure	5.20lbs	Paint Removed	28"	Cable	3/8" Max	\$21.99	Yes	Can cut 2-3 wires at once with little pressure Cuts plastic best, film bales does not cut well

The evaluations consisted of strap thickness, number of straps, overall cut, weight, visible damage, style, cost, comments, etc. After the conclusion of this evaluation the team chose the Pittsburgh Bolt Cutters as the appropriate choice for the project. Other testing that the team did was 3D printing. The team used 3D printing for prototyping and mockup on the bolt cutters as seen in Figure 8. The team also used handle attachment, shield, and jaw prototypes for testing. After the team tested these parts, the team quickly realized that none of the prototypes were going to work. The team made a mockup pair of heads using the plasma table as shown in Figure 9.



Figure 8: 3D Print prototype

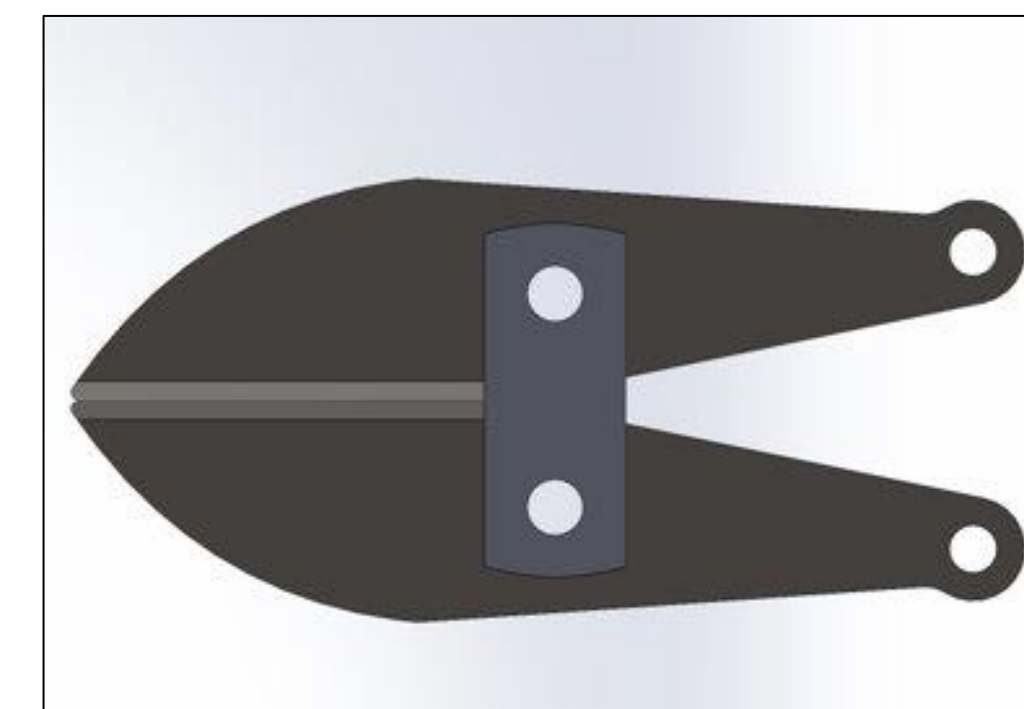


Figure 9: Plasma prototype

FINAL DESIGN

The final design in Figure 10 is an extended version of the original jaws which are cut from T2 tool steel. The larger cutting blade design will allow the operator to cut wires that are embedded in film bales. This design will reuse the old handles, side plate, and bolts. In addition to cutting open film bales this design can cut open ridged bales as well.

Figure 10: Extended Jaws



FINAL PRODUCT

This is the final product the steel wire handling team created (Figure 11). While there are still challenges with cutting film bales, these blades do a good job with the other bale types.

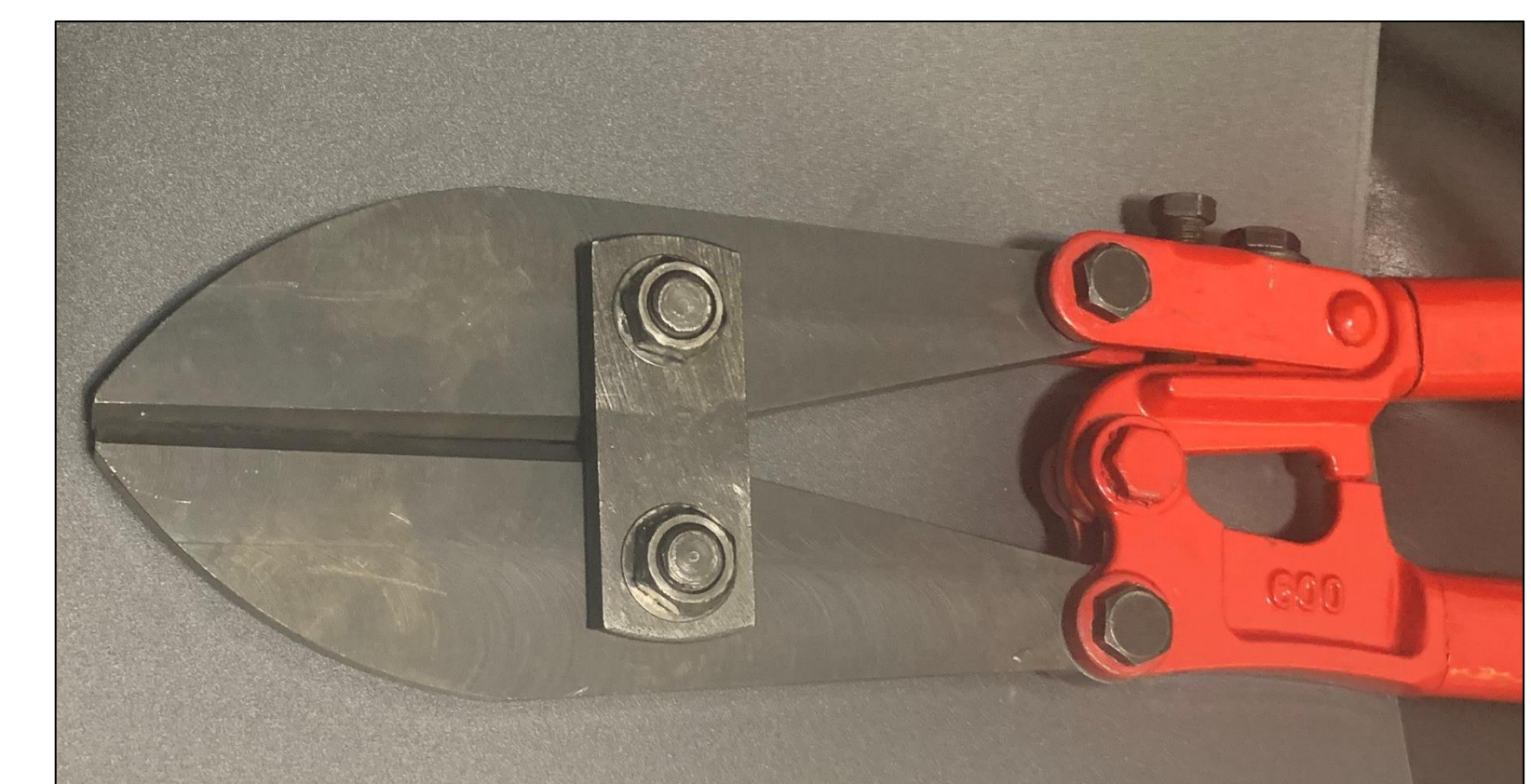


Figure 11: New Jaws attached to Handle

CONCLUSION

The team assembled a pair of bolt cutters with a new cutter head design and performed several test trials to determine utility. This new design is effective on ridged bales but has some performance issues with film bales. The team is still investigating a best procedure for the film bale types received at the plant that need the steel strapping removed.

LESSONS LEARNED

Throughout the project the team learned:

- How to quickly adapt to process change.
- The level of importance time management is.
- The ability to overcome design changes.
- Develop key communication skills within the team and with the sponsor.
- The challenges of including all details when speaking about the project.

ACKNOWLEDGMENTS

- Joe Thompson, III, Lab Manager/Instructor, Mechanical Engineering - has provided a table in the foundry for the team to use over the course of the project.
- Steve Moore, Lab Technician, Mechanical Engineering – Assisted in with Plasma cutter.
- Flare Precision LLC, Machining Company, Outsource company for bolt cutter heads.