Department of
MECHANICAL ENGINEERING
THE UNIVERSITY OF UTAH

Cell Tarp Roller Drive

Team: Braden Mulvey, Jared Timmons, Dustin Snedeger, Taylor Ward
Advisor: Dr. Shad Roundy

INTRODUCTION:

Rio Tinto is one of the largest mining companies in the United States. One of their exports is copper from the Bingham Canyon Mines in near SLC. During the refining process, impure plates are placed in electrolytic cells. These cells are covered with a tarp using the system shown in Figure 1 to help retain heat. Unfortunately, the current system fails every 3-4 days which is undesirable.

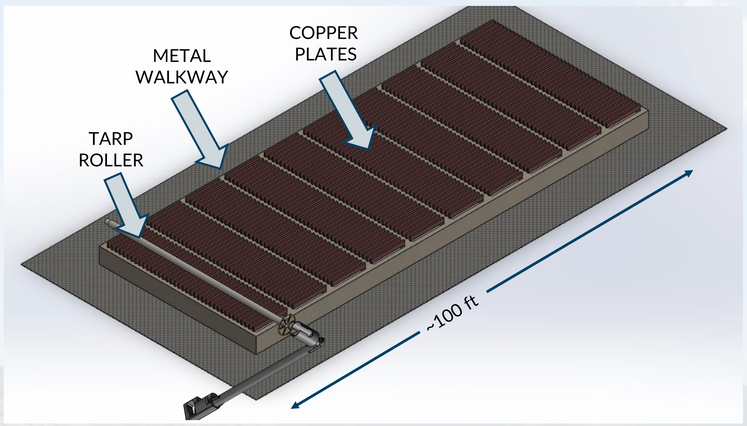

Figure 1: Mockup Drawing of electrolytic vats with submerged copper plates & the tarp roller.

PROBLEM STATEMENT:

Our task was to analyze their current system, improve the lifespan and reliability of the current design, while also ensuring that any new design would be available "off-the-shelf" and be easy to assemble.

KEY PROBLEMS:

- Shaft and Sleeve Separation
  - Inner drive shaft and outer aluminum sleeve may separate during use.
- Socket Failure
  - Inner drive shaft socket frequently cracks during normal use.
- Weight of the System
  - Users complain about the weight of device.

PROBLEM - SHAFT & SLEEVE SEPARATION:

- Created two alternative designs to test.
  - One using a pipe clamp and wire to prevent slipping and the other using a machined u-bolt style clamp.
- Analytical and physical separations tests were performed to verify two alternative clamping solutions.
- Both prototypes are able to withstand 45 kg of weight without failure.

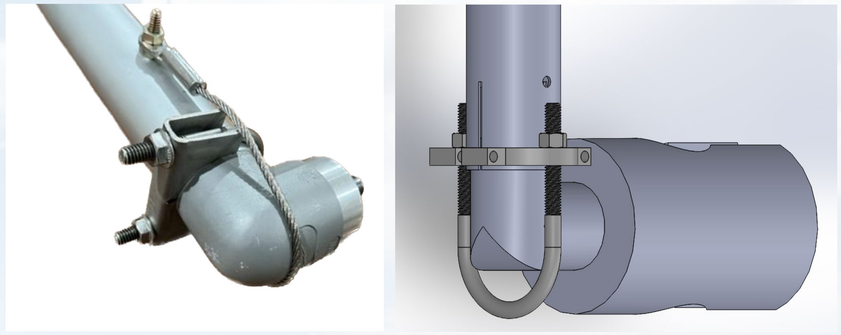

Figure 2: (Left) Image of Cell Tarp Roller Drive Prototype V3 and (right) V4. Both are focused on the 90-degree adapter junction and the changes made to prevent separation at this point.

PHYSICAL TESTING:

- Hung both drills by the handles and suspended increasing weight from the end where failure is most likely to occur.
- Ideally needed to sustain at least 15 kg to be viable.
- Both designs successfully held 45kg without separation.

Figure 3: V3 Prototype (left) and V4 Prototype (right) are shown undergoing testing. Both prototypes are holding 45kg using bailing wire.

PROBLEM - SOCKET FAILURE:

- Using Finite Element Analysis (FEA), we determined that the internal socket experienced high stress concentrations when the socket begins to separate from the nut. At full engagement the current socket should be able to withstand the current load.

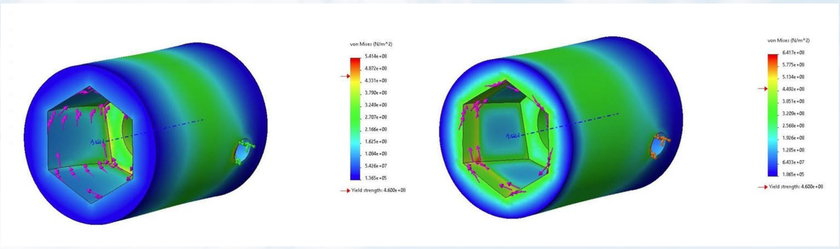

Figure 4: Socket simulation at 122 Nm of Torque on the inner surfaces. The left image has 20 mm of engagement and the right image has 5 mm of engagement. The sockets are constrained at the circular pin holes at the back.

PROBLEM - WEIGHT OF THE SYSTEM:

- Wheeled roller can be added to either design to reduce the weight that the user will experience during use.
- The tire is puncture-proof and allows the tarp roller to connect without the user bending over.
- Physical testing with wheel mechanism was also performed to assess the usability and practicality of the device.

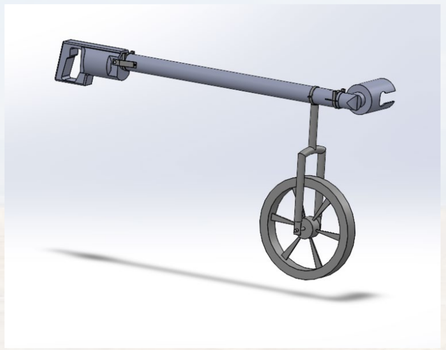

Figure 5: Cell Tarp Roller Drive prototype with wheeled mechanism installed.

CONCLUSION:

The two prototypes give Rio Tinto options on how the company wants to move forward. The V3 design is simpler, but does require drilling holes in the outer sleeve. On the other hand, the V4 prototype requires no modifications but is more expensive. Our team is confident in the reliability of both designs. They are an improvement from the original, have been validated by both analytical and physical testing, and will prevent Rio Tinto from replacing the drills as frequently.