Torque and Axial Measurement Device for Soil Abrasion Testing

Overview
The Penn State Department of Energy and Mineral Engineering needed a device capable of measuring both torque and axial load to be implemented into the existing instrument they are using to develop a soil abrasion index. While our team’s initially proposed concept met all of the customer’s needs, it was extremely expensive to implement and the sponsor was unable to accommodate the cost. Our biggest challenge was the time constraint of the project, since we were forced to completely re-design with five weeks left. This left minimal time for machining, assembly, testing, and analysis.

Objectives
Design, manufacture, and install a device capable of measuring the torque and axial load exerted by a rotating shaft on an instrument used to run tests on various types of soil. The device must be able to withstand adverse environments, durable, give accurate and repeatable measurements, and fall within the allotted budget.

Approach
• Customer needed gathered through e-mails and frequent site visits to CATO Park.
• Frequent visits to CATO Park to gather measurements and examine instrument.
• Team was certified in safety and was allowed to enter the area unsupervised.
• Formulated concept generation including commercial torque transducers.
• Vast variety of torque transducer patents was examined.
• Later determined through more specific customer needs that a portable device is not ideal.
• Also through measurements of the existing machine multiple products were not considered.
• With suggestions from sponsor preloaded bolts were researched.
• Also, with suggestion from sponsor a bras ring was machined.
• Strain gauges were purchased and attached to the brass ring.
• CAD models for the initial system level design and final design were done.

Outcomes
• One step closer to forming the desired abrasivity index
• The sponsor will now effectively compare torque values
• The bolts are reliable and measure force with low tolerances
• One step closer to transforming the instrument into a rheometer
• Easy installation and removal process
• Low cost in comparison to commercial transducers
• Verified sponsors research on existing products in market