Uni-axial Automated Tensile System Experimental Results

Mazin Chater, Youssef Jalwaj Soubai, Jaden Pharoah

Activity Report

1 Research Question

A uni-axial tensile tester is a widely used system for gathering ultimate tensile strength and Young's Modulus of a given material. Generally, these systems can be expensive and sophisticated yet their value as an educational tool for chemistry students is significant. As such, a cheaper, student-friendly design is highly desirable. Provided a minimally functional base model with issues ranging from largely inaccurate and imprecise results, obscure functionality, and generally an unpleasant and non-intuitive user interface, a targeted solution must aim to re-envision and harmonize the old structure into a more refined prototype. An effective solution is ideally considered when a low-budget, accurate and reliable system is readily accessible.

2 Experimental Results

What follows is an experimental analysis of results gathered from the implementation of a friction-less, automated uni-axial system. Two distinct materials, namely nitrile and latex, were used to conduct a number of trials. Pictured in Figure 1 is a stress-strain curve from an arbitrary trial testing a latex sample. Of special consideration is the general uniformity of each plot. In the base model and in all other manual systems more generally, achieving a "smooth" plot is extremely difficult due to the necessary application of a constant increase in strain. The use of an automated linear actuator to fulfill this requirement eliminates human error associated with non-uniform data collection.

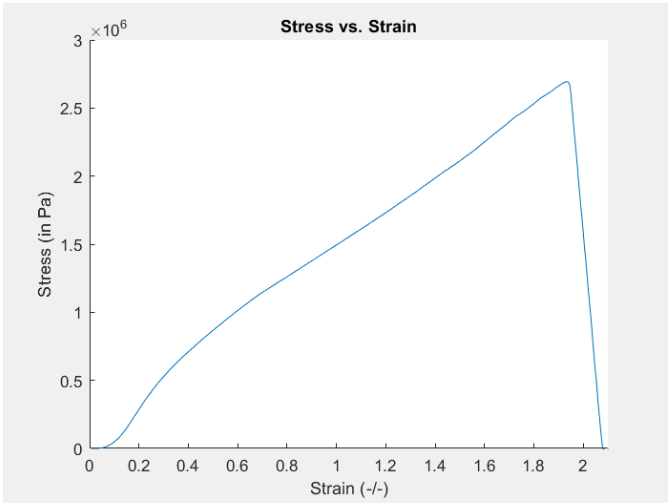

Figure 1. Stress-strain curve derived from our system for latex glove sample

3 Data Analysis

Table 1 summarizes experimental results from five trials conducted on nitrile and latex glove samples. Error is presented in terms of percent difference from known values. It is worth noting that the slight error arising from the latex samples is likely due to differences in glove thickness. The latex glove thickness used in

- *Mazin Chater,*
  E-mail: mchater3@albany.edu,
- *Youssef Jalwaj Soubai,*
  E-mail: yjalwaj-soubai@albany.edu,
- *Jaden Pharoah,*
  E-mail: jpharoah@albany.edu
  Electrical & Computer Engineering, University at Albany.

PP-2017 V2.1

Metric	Sample	# Trials	Our System	Known Value	Error
Young's Modulus	Latex Glove	5	770 ± 30 kPa	740 ± 10 kPa	± 4
..	Nitrile Glove	5	2.4 ± 0.2 MPa	2.4 ± 0.2 MPa	± 0
Ultimate Tensile Strength	Latex Glove	5	2.7 ± 0.3 MPa	3.3 ± 0.1 MPa	± 18
..	Nitrile Glove	5	4.4 ± 0.4 MPa	4.4 ± 0.1 MPa	± 0

Table 1
Summary of experimental results from multiple trials

gathering the Table 1 results was 127 microns while the known values were achieved using a thickness of 110 microns. When accounting for this difference, there is only a marginal discrepancy in the referenced metrics. Another potential source of error is variability in material strength throughout the glove. A more rigorous assessment of the accuracy of the system should be performed with uniform materials with minimized variability. Despite these slight nuances, the general form of the stress-strain curves are nearly identical to those obtained by commercial machines, adding validity to the system in a broader sense.