CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
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Project Number
S0315

Project Title
The Role of Reynolds Number in Liquid-Liquid Drop Experiments

Abstract

Objectives/Goals
The purpose of this experiment is to determine the most favorable conditions for forming very thin liquid columns, with drops of polyethylene oxide, in order to make very thin fibers.

Methods/Materials
Drops of polyethylene oxide were ejected from a pressure regulated syringe into a bath of water. As the drop fell, it disrupted a laser trigger which began a video recording at 1000 frames per second. A computer code was used to analyze the images. The code determined the drop diameter, as well as the impact velocity. The viscosity was determined using an existential rheometer. Varying drop regimes were observed subjectively. 32 trials were collected.

Results
Three ranges of drop regimes were explored: a ballistic range with no bubbles, a breakthrough range with bubbles, and a catch range with no bubbles. Drops were found to transition between five unique regimes. From highest Reynolds Number to lowest Reynolds Number regimes transitioned as follows: Inverted Torroid, Flat Bottom Pendant Drop, Break Through with Bubble, Torroid, Catch. A phase diagram of Froude Number vs. Reynolds Number was created to show the transition between the three ranges of drop regimes.

Conclusions/Discussion
Drops with Reynolds number in the catch range would be most favorable to create very thin fibers. The break through range formed liquid columns using bubbles which could be another useful method of creating liquid columns and fibers.

Summary Statement
This project investigates the Reynolds number of a drop and the formation of liquid columns in order to produce very thin fibers.

Help Received
Used lab equipment at Stanford University under the supervision of Travis Walker; mentor wrote my drop analysis code; mentor assisted in designing apparatus