CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY

Name(s)
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Project Number
S0109

Project Title
The Robins-Magnus Effect and the Effect of Traversing Different Fluid Media on the Velocity of a Rotating Solid Sphere

Abstract

Objectives/Goals
The goal of this experiment was to determine how traversing different immiscible fluid media affects a rotating solid sphere's position at different points in its fall (i.e. its direction) and speed, as caused by the Robins-Magnus effect.

Methods/Materials
A 30 liter aquarium was filled with water, and a ball with radius 3 cm was dropped vertically into the aquarium from a ramp structure that caused the ball to spin. A digital camera with a slow shutter speed as well as a video camera recorded the fall. This was repeated five times. Then 10 liters of water were removed, 10 liters of vegetable oil were added, and the trials were repeated. Water was replaced with oil in these amounts two more times so that the final test condition was all oil, with five trials for each test condition. After experimentation, each photograph was digitally enhanced with superimposed rulers to measure the deflection of the ball from a vertical line at three points in its fall. The video replay was converted into a digital file and used to determine the elapsed time of the ball's fall.

Results
The time of fall ranged from 0.166 seconds, +/- 3 % for all water, to 0.195, +/-5% for all oil. The largest total average deflection was 0.4 cm, in the test condition with 2/3 oil and 1/3 water. In all test conditions except for the condition with all oil, the ball curved to the right in the second half of its fall.

Conclusions/Discussion
As hypothesized, the ball fell more slowly as more oil was added. In all test conditions, the ball was deflected to the right at some point in its fall. Generally, this deflection was more pronounced as more oil was added, again supporting the hypothesis. This increased deflection likely stems from the higher viscosity and associated lower settling rate of the ball in the oil. The data also support that the Robins-Magnus induced deflection of the ball was amplified by passing through the oil-water interface.

Summary Statement
This project investigates how the behavior of a rotating solid sphere varies while transitioning between different fluid media, as influenced by the Robins-Magnus effect.

Help Received
Father activated digital camera during experimentation