CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
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Project Number
J1310

Project Title
How Is the Buoyancy of an Object Affected by Different Liquids?

Abstract

Objectives/Goals
My objective was to determine the effect of a liquid's density on the buoyancy of an object. I believed that the liquid with the highest density would result in the most buoyancy force on an object.

Methods/Materials
I used three hollow plastic objects (cube, sphere, and triangular prism) in four different liquids (distilled water, salt brine, kerosene, and isopropyl alcohol). The test objects, being hollow, floated in the liquids. I constructed a test set-up using a plastic container with a pair of pulleys at the bottom and a spring scale suspended over it. Using a thread attached to my test objects, then placed through the two pulleys and hooked to the spring scale above, I measured the apparent mass of each object while submerged in each test liquid. I did ten measurements (trials) of each object in each liquid. To get the experimental value of buoyancy for each test I added the actual mass of each object to the experimental value of apparent mass.

Results
The liquid with the highest density resulted in the largest buoyancy force for each of the three objects as compared to the other liquids. The lowest density liquid yielded the lowest buoyancy for each object as well. Also the largest (by volume) object, the cube, caused the most buoyancy force and the smallest object, the triangular prism, had the least buoyancy in each liquid case.

Conclusions/Discussion
From my research I found Archimedes' Principle: The upward buoyancy force is equal to the mass of the liquid displaced. Using this principle, I calculated the expected buoyancy of each object in each liquid using the object's calculated volume and a reference value of density for each liquid. I then compared my expected values to the measured values to get percent error. For the 12 cases (three objects times four liquids) all but one of my percent error results were about eight percent or better. Finally, I plotted the measured buoyancy with calculated volume for my three objects in each liquid, and using the slope of the line, I determined an experimental value of density for each of my liquids. I then compared this density value to my reference value to determine percent error. This analysis showed less than five percent error for each of the four liquids' densities. My conclusion is that higher density liquids do cause more buoyancy force and that my data analysis using percent error confirms that Archimedes' Principle is correct.

Summary Statement
My project measured the buoyancy force on three objects in four different liquids to determine the effect of a liquid's density on the buoyancy of an object.

Help Received
My dad helped me get the materials and construct my test set-up. He also helped me understand the math and reviewed my work. My mom helped me with my board and proofread my work.