Name(s)	Project Number
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Project Title

Reducing Drag of Metal Objects through Water Using the Leidenfrost Effect

Abstract

Objectives/Goals

The purpose of this research project was to investigate whether the Leidenfrost effect can be used to reduce the drag on a metal object traveling through a liquid.

Methods/Materials

A steel ball, which had its temperature adjusted to 13 degrees, 67 degrees, and 330 degrees Fahrenheit, was dropped down a cylinder filled with room temperature water. The drop time was recorded to determine whether the Leidenfrost effect can reduce the drag of the metal ball traveling through water. It was hypothesized that if a metal ball is cooled/heated to various temperatures (below and above the boiling point of water) and dropped down a cylinder filled with room temperature water, then the ball heated to above the boiling point of water will travel through the cylinder significantly faster than at the other two temperatures.

Results

The steel ball experienced the shortest average drop time of 0.612 seconds at 330 degrees Fahrenheit, followed by 0.657 seconds at 67 degrees Fahrenheit, and 0.663 seconds at 13 degrees Fahrenheit.A one-tailed paired t-test was used to analyze whether the average drop time was statistically different for each of the three temperature-specific data groups. The obtained p-value was much smaller than the assigned alpha value of 0.05 showing that the steel ball at 330 degrees Fahrenheit traveled significantly faster than at the other two temperatures. This supports the research hypothesis and rejects the null hypothesis.

Conclusions/Discussion

The results of this research can be used for new drag reduction technologies to reduce energy costs for a broad range of applications, such as in nautical applications, pipeline transport, and microfluidic devices.

Summary Statement

This project investigates whether the Leidenfrost effect can be used to reduce hydrodynamic drag for the purpose of decreasing energy costs for a broad range of applications.

Help Received

My math teacher helped me with the data analysis and my dad helped me set up the Excel spreadsheet to perform the T-test.