Experimentally Determining the Relationship Between the Drag Force Experienced by Bodies Moving Through Water and Salinity

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ABSTRACT

This is an investigation into how the hydrodynamic drag force experienced by bodies moving through water is affected by the salinity (the amount of salt (NaCl) dissolved in water) of that water. This is achieved by experimentally determining how the product of the fluid density and coefficient of drag of a steel ball moving through water changes with salinity.

INTRODUCTION

Darg force is the resistive force experienced by bodies moving through any fluid, which arises due to the deflection of fluid particles that occurs during motion.

This investigation is about in the case of water, if and how the salinity of water can affect this force. In Principle, the only way in which Salinity could affect Drag force is through changing the fluid density, and coefficient of Drag of the Body. The Drag force experienced by a body is directly proportional to the product of these two quantities, thus determining how this 'combined coefficient' changes with salinity, can allow us to understand how the Drag force changes with salinity. This research project involved investigation how this quantity changes with salinity for the motion of a stainless steel ball moving through water.

The Experiment consisted of dropping a 7mm stainless steel ball into a 1200 ml measuring cylinder filled with water of different salinities and then measuring the time taken for the ball to fall. The specific slaitinites used were 0, 1, 2, 3, 4, and 5 M. Mathematical Calculations

RESULTS

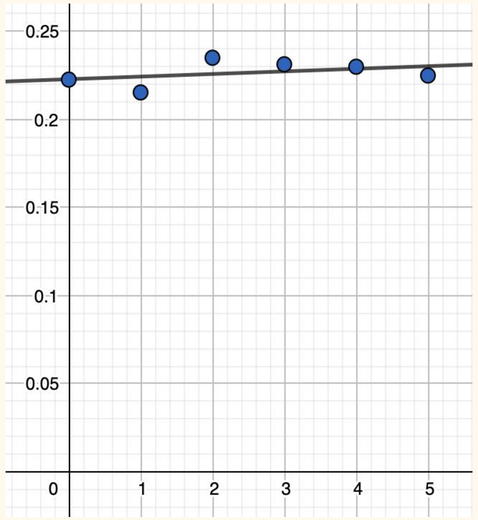

Fig 1. Coefficient of Drag Against Salinity (M)

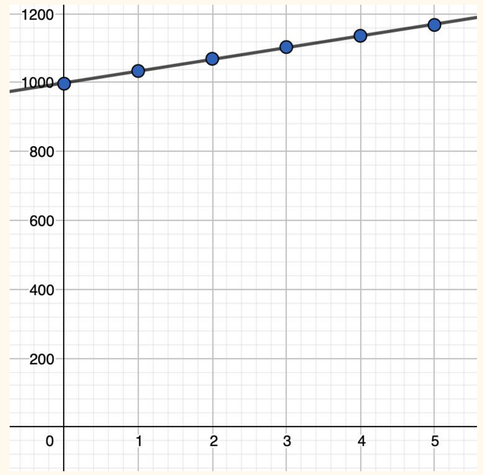

Fig 2. Fluid Density Against Salinity (M)

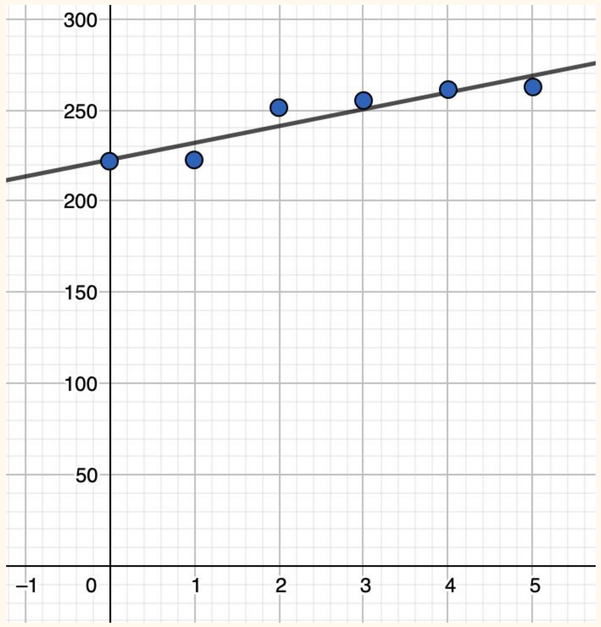

Fig 3. Combined Coefficient Against Salinity (M)

DISCUSSION

The coefficient of Drag displays no clear trend when plotted against salinity, with a Pearson Moment Correlation Coefficient of only 0.4. It does display a very slight positive trend, and has a very high variability, but both of these are likely due to the High error involved in the Experiment. The density on the other hand, as expected, has a very strong positive linear correlation, increasing by approximately 37 Kg/m^3 per unit salinity. Multiplying these two quantities together to obtain the combined coefficient, we can see that it displays a strong positive trend with Salinity,, with a pearson moment correlation coefficient value of 0.924, increasing on average by 9.22 per unit salinity.

This clear trend indicates that Salinity does indeed significantly affect Drag Force, and that the two are positively and approximately linearly related. The results show that Drag force would increase by almost 25% at maximum salinity. Moreover, the fact that coefficient of Drag only displays a slight trend as compared to density indicates that Drag force increases with Salinity primarily because saline water is denser than pure water, and that other minute effects caused by increases in Salinity have little to no impact on Drag Force.

CONCLUSIONS

The Drag Force Experienced by bodies moving through water is indeed affected by the salinity of that water. The two are strongly positively correlated, and tend to follow a general linear trend. This effect is predominantly due to the increase in fluid density caused by the adding of slat to water.

REFERENCES

https://www.youtube.com/watch?v=puKmkjhHN9c

https://www.khanacademy.org