Abstract

The purpose of this research paper is to investigate faraday's law of induction and eddy current braking via magnets falling down pipes of conductive and non-magnetic materials. Specifically, I investigated the effect of adding magnets on the time taken for them to fall down copper, aluminum and brass pipes. Additionally, a simplified mathematical model of the effect was developed and evaluated in relation to the actual results.

The magnets were placed in a 3D printed cylindrical capsule to keep the aerodynamic characteristics of each trial constant. The capsule was then dropped down one meter long pipes made of copper, aluminum and brass. Each trial was recorded with a camera and the time taken for the capsule to fall was measured using logger pro video analysis. Then the experiment was repeated with an additional magnet in the capsule until the last set of 9 magnets had been dropped. Each number of magnets was dropped 3 times down each pipe resulting in a total of 81 trials.

The results showed a nonlinear relationship, in which the time taken for the magnets to fall initially increased until a maximum at 3 and 4 magnets, followed by a decrease in time as more magnets were added. Although adding magnets caused a linear increase in mass, the resultant magnetic repulsion due induced eddy currents does not increase linearly with respect to the number of magnets. Hence, the non-linear relationship between the number of magnets and time taken for them to fall down the pipe is dictated by a combination of these two factors. Although the particular set up of the experiment showed a maximum time for 3 and 4 magnets, the mathematical model suggests this is highly dependent on particular the set up of the experiment, such as pipe material, radius and thickness. The results also supported the hypothesized proportionality between conductivity and eddy current braking effect, demonstrated by the copper pipe yielding the highest fall times for each number of magnets, followed by aluminum and then brass.