



**CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY**

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Project Title
A Study Using Different Concentrations of a Ferrofluid to Model the Effectiveness of E-Ink in Electronic Paper

Abstract

Objectives/Goals
The purpose of this experiment is to determine the ratio between the oil and the electrically charged particles in electronic paper.

Methods/Materials
The ferrofluid dilution with greatest amount of ferrofluid and the least amount of added oil was expected to attract the greatest amount of iron particles to the magnet.
The amount of ferrofluid attracted to a magnet will be used to determine how concentrated the electrically charged particles should be in e-paper.
A magnet was rolled under each glass ball, filled with an oil/ferrofluid mixture. When the ferrofluid had stopped settling, the magnetic liquid at the bottom of the ball and some of the surrounding water were extracted. Because the two liquids are immiscible, the total amount of ferrofluid in the graduated cylinder was recorded as the approximate amount of magnetic liquid attracted to the magnets.

Results
The results indicated that the hypothesis was basically correct. The amount of ferrofluid attracted to the bottom of the balls by magnets was negatively proportional to its dilution. The balls of the first set were filled with 0.80 ml water, 1.00 ml ferrofluid and no oil. The average amount of ferrofluid attracted was 0.99 ml.
2nd Set (0.80 ml ferrofluid and 0.20 ml oil): 0.99 ml
3rd Set (0.50 ml ferrofluid and 0.50 ml oil): 0.37 ml
4th Set (0.20 ml ferrofluid and 0.80 ml oil): 0.20 ml

Conclusions/Discussion
These results may have occurred because the concentration of iron filaments in the fluid is greater without added oil. However, the ferrofluid/oil mixture had a tendency to bubble, giving the appearance of a greater volume than ferrofluid alone. Lessening the concentration of electronically polarized ink or particles, relative to magnetic fluids in this experiment, would be beneficial to E-paper's design. Without significantly losing visual quality, a small dilution of the ink would be more cost efficient.

Summary Statement
The purpose of this experiment is to determine the concentration of the electrically charged particles in electronic paper using ferrofluid as a model.

Help Received
Parents financed the experiment; Mother helped clean beakers after each trial; Ms. Susan Hinton sent sample of Gyricon SmartPaper.