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Chem 125 Project Proposal - 6c Ferrofluids

Purpose Statement:

A ferrofluid is a liquid of suspended nanoparticles that will align themselves along magnetic field lines when exposed to a magnetic force. When exposed to a magnet directly, the ferrofluid will align with the poles under the magnet to lift it up due to a magnetic pressure. An equilibrium is found when the magnets weight is balanced by the magnetic pressure and the hydrostatic pressure.[1] This property of the ferrofluid of lifting up the magnet yields a structure property relationship where the magnet is suspended in a low friction environment, and is able to absorb vibrations and spin freely. The strength of the ferrofluids' ability to absorb shock should be related to how strong of a magnetic field it is generating.

These observations lead to questions we are interested in investigating, including: 'What is the strength of magnets (in the magnetic force of a ferrofluid lifting a magnet) measured as the force?', 'Does the strength of the magnetic field effect the friction between the bottom surface of the container and the suspended system of ferrofluid and the magnet?' and 'Does the volume amount of ferrofluid affect the system's ability to absorb mechanical force?'. These questions will investigate the property of strength of magnetic fields and their relationship to structural changes observed in the ferrofluid. Measurements will be taken using a mechanical force gauge measuring compression force, a stopwatch, and a balance. Data collected will include force measurements, time system spinning, strength of magnetic field, weight of magnets, and volume of ferrofluid.

Laboratory Procedures:

1. Acquire ferrofluid 60 ml of ferrofluid and 6 N52 1.26 x ⅛" neodymium magnets from Amazon
2. Measure 20 ml of ferrofluid in volumetric pipet and place in a petri dish
3. Weigh magnet and place in petri dish
4. Manipulate ferrofluid until is uniformly covering the magnet
5. Measure the compression force required to push the magnet until it touches the bottom of the petri dish.
6. Repeat measurement three times
7. Repeat procedure, changing the magnet used and volume of ferrofluid used

[1] Scherer, C., & Figueiredo Neto, A. M.. (2005). Ferrofluids: properties and applications. *Brazilian Journal of Physics*, 35(3a), 718-727. https://dx.doi.org/10.1590/S0103-97332005000400018

1. Measure volume of ferrofluid in volumetric pipet and place in a petri dish
2. Weigh magnet and place in petri dish
3. Manipulate ferrofluid until is uniformly covering the magnet
4. Set up apparatus to spin the magnet by applying a consistent rotational force
    a. Attach small iron rod to top of magnet
    b. Spin small string onto rod
    c. Hold top of rod and pull string to set magnet spinning
5. Measure time the system spins
6. Repeat measurement three times
7. Repeat procedure, changing the magnet used and volume of ferrofluid used

Safety Concerns: touching to skin or spilling the ferrofluid

Safety Measures: wear lab coats/aprons, long-sleeved shirts, goggles, and latex gloves. Handel ferrofluid carefully and dispose of according to TA.

Equipment and Supplies List

- Force gauge
- Balance
- Timer
- Petri dish
- Volumetric pipet
- 60 ml of ferrofluid
- 6 neodymium magnets
- 6 ceramic magnets
- Lab coats/aprons
- Goggles
- Latex gloves

Timeline:

- Day 1: Play with ferrofluid and magnets and test procedure for issues (Lab)
- Day 2&3: Conduct Procedure (Lab)
- Day 4: Analyse data and conduct any follow up experiments
- Day 5&6: Write up report and presentation board
- Day 7: Practice presentation