Mick Zaatra
Item 2

Name and Citation of Article:

"MAGNETIC MANIPULATION OF PARTICLES AND CELLS IN FERROFLUID FLOW THROUGH STRAIGHT MICROCHANNELS USING TWO MAGNETS"

- Zeng, J. (2013, May). MAGNETIC MANIPULATION OF PARTICLES AND CELLS IN FERROFLUID FLOW THROUGH STRAIGHT MICROCHANNELS USING TWO MAGNETS. *All Theses.* Retrieved from https://tigerprints.clemson.edu/all_theses/1632/

Summary Sentence:

The article talks about manipulating diamagnetic particles and the cells that are in ferrofluids with magnetic fields using permanently placed magnets.

Summary & Analysis of Key Ideas/Information:

In the article it states that while microfluid devices, like ferrofluids, are being increasingly used the current knowledge of magnetic control of particle transport is lacking, more specifically in diamagnetic particles (ex. Ferrofluid). It talks about the manipulation of PDMS (Polydimethylsiloxane) with magnets and how different configurations control the speed and direction of fluid travel. PDMS is biocompatible and the study encourages the use of PDMS with hopeful further understanding of its control. The experiments carried out pertain to flowing ferrofluids though microchannels and demonstrating the use of this technique in possible future bodily infusion.

How this information will be used in my project:

I can use the methods of ferrofluid manipulations demonstrated to aid me in developing my own method of manipulation to better suit my needs.

Mick Zaatra
Item 2

Name and Citation of Article:

"Active surfaces: Ferrofluid-impregnated surfaces for active manipulation of droplets"

- Khalil, S., Mahmoudi, S., Abu-dheir, N., Varanasi, K. (2014, August 1). Active surfaces: Ferrofluid-impregnated surfaces for active manipulation of droplets. *American Institute of Physics (AIP).* Retrieved from https://aip.scitation.org/doi/10.1063/1.4891439

Summary Sentence:

The article talks about how instead of using gravity to allow droplets to passively move and fall, they use magnetic fields to drive and transport droplets of ferrofluids.

Summary & Analysis of Key Ideas/Information:

In the article they provide their methods of water droplet manipulation by dropping a small droplet of water onto an oil-based carrier fluid that is doped with magnetic particles and using magnets to move the magnetic particles thus moving the water droplet. The water droplet becomes misshaped when magnetic fields interact with the particles within it. The droplet seems to distort and tends to move towards the region of higher magnetic fields. They were also able to take to tainted water droplets and move them towards one another by vertically lowering a magnet directly between them. By using an oil-based surface, surface tension between the water droplets and the surface was at a minimum and by introducing ferrofluids, they were able to move the water droplets with less intense magnetic fields due to low surface friction.

How this information will be used in my project:

I can take the idea of using oils to cover the surfaces of where I'm going to introduce my ferrofluids, this will surely allow for better control of the ferrofluids and the use of less magnetic strength to achieve the same acceleration and fluid manipulation.

Mick Zaatra
Item 2

Name and Citation of Article:

"Spin-up flow of ferrofluids: Asymptotic theory and experimental measurements"

- Chaves, A., Zahn, M., Rinaldi, C. (2008, May 28). Spin-up flow of ferrofluids: Asymptotic theory and experimental measurements. *American Institute of Physics.* Retrieved from https://aip.scitation.org/doi/10.1063/1.2907221

Summary Sentence:

This article talks about further practice with spinning ferrofluids in bulk flow theories.

Summary & Analysis of Key Ideas/Information:

They took previous studies of ferrofluids that were introduced to cylindrical containers and were subjected to a rotating magnetic field and related the work with movement properties of bulk flow. They were able to use ultrasound velocity profile methods to measure the fluid and they also took torque measurements for water and kerosene based ferrofluids. They showed that the fluid corotating with the field in the cylindrical body was observed to counter rotate except near the air-fluid interface. They were expecting the counter-rotating fluid to drag the cylindrical container with it, but experiments showed that the container was corotating with the field instead, whereas the ferrofluid was in counter-rotation. They also provided theories of the analysis of flow and torques concerning with the counter rotation of the fluid.

How this information will be used in my project:

I'm able now to realize that a bulk amount of ferrofluid would actually change the behavior of how the fluid would rotate with respect to the magnetic field. A bulk amount of ferrofluid in a cylindrical magnetic-induced spinning system would cause a counter-rotation effect.

Mick Zaatra
Item 2

Name and Citation of Article:

"The effect of temperature on the anisotropy of ultrasound attenuation in a ferrofluid"

- Skumiel, A. (2004, October 28). The effect of temperature on the anisotropy of ultrasound attenuation in a ferrofluid. *Institute of Physics Publishing.* Retrieved from https://www.researchgate.net/profile/Andrzej_Skumiel2/publication/230967434_The_effect_of_temperature_on_the_anisotropy_of_ultrasound_attenuation_in_a_ferrofluid/links/5804bf0208ae0b2b3ef44097/The-effect-of-temperature-on-the-anisotropy-of-ultrasound-attenuation-in-a-ferrofluid.pdf

Summary Sentence:

This article talks about how sound attenuates in a magnetic fluid that is in an external magnetic field with varying temperatures.

Summary & Analysis of Key Ideas/Information:

Interestingly, ferrofluid undergoes a field induced anisotropy, the liquid is actually reconstructed and forms a chain-like cluster. When this happens, ultrasound wave absorption is enhanced because of the behaviors of the clusters that are formed. When a material presents a better attenuation of sound, it is usually due to its density. A denser material tends to attenuate sound better than a less dense material. The interesting part here is that while ferrofluid maintains its density throughout entering and exiting a magnetic field and varying temperatures, the sound attenuation is enhanced when in a magnetic field and when cooled.

How this information will be used in my project:

I can take the data of ferrofluid sound absorption at different temperatures recorded and ensure that my ferrofluid system can cope with vibrations; by manipulating temperatures.

Mick Zaatra
Item 2

Name and Citation of Article:

"A ferrofluid-based wireless pressure sensor"

- Chitnis, G., Ziaie, Babak. (2013, November 14). A ferrofluid-based wireless pressure sensor. *IOP Publishing.* Retrieved from http://stacks.iop.org/JMM/23/125031

Summary Sentence:

This article talks about how ferrofluid can be used to provide pressure data wirelessly.

Summary & Analysis of Key Ideas/Information:

Being able to sense pressure data is crucial for many applications. The limitations however include being able to take that data and transfer it without the use of wires. Wires are needed in pressure sensors because they carry a voltage across the sensor and the varying pressures that the sensor experiences also vary the resistance and thus sending back a comparative power consumption to determine the pressure. They were able to use ferrofluids to make this process wireless, they took a planar coil and observed its inductance change when magnetic fluid was displaced at a distance and experienced different pressure changes. Ferrofluid was enclosed in a membrane and moved through chambers when experiencing pressures thus changing the coil's inductance. The membrane acted as a wireless transponder and could be placed anywhere, while a transceiver coil placed near it can be ran through an Impedance Analyzer and phase dips can be recorded.

How this information will be used in my project:

Being able to measure system pressures is important especially in space environments, and being able to do so without the need of electrical connections. This allows for a wider variety of pressure sensing opportunities.