MAGNETIC HYDRODYNAMIC PROPULSION OF BLOOD

BACKGROUND

Left Ventricular Assist Device issues
- Axial Fan
- Many moving parts
- Imposes unnatural behavior to the flow of the blood
- Stagnation points
- Impingement regions
- Can induce Thrombosis

DEFINITIONS

- Thrombosis: Local coagulation or clotting in the blood in a part of the circulatory system.
- Electromagnetic flowmeter principle: Faraday’s law of electromagnetic induction
- When a conductive medium passes through a magnetic field B, a voltage E is generated which is proportional to the velocity v of the medium.
- Magneto-hydrodynamic drive principle: Lorentz force
- The force experienced by an enclosed charge q moving with a velocity v under an applied electric field E that is orthogonal to the magnetic field B is given by: \[ F = q(E + v \times B) \]
- Inside the MHD VAD, the blood will act as the conductive fluid needed to flow through the device.

INTRODUCTION

An electromagnetic flow meter and a Magneto-Hydrodynamic Drive have similar operation principals. Thanks to this, it is possible to first construct an experimental electromagnetic flow meter and then convert that flow meter into an MHD system.

Step 1: Create and calibrate the electromagnetic flow meter
Step 2: Design an ideal model of a Magneto-Hydrodynamic drive
Step 3: Create a Magnetohydrodynamic Drive
Step 4: Create case specific designs of Magneto-Hydrodynamic Drives

DESIGNS

- Magnetic Flow Meter
- Ideal Model of Magneto-Hydrodynamic drive
- Magneto-Hydrodynamic Drive

RESULTS

The following results show previous electromagnetic flow meter test done with salt. The total flow range was 2 to 6 L/min. The resulting graphs show a slight variation in the induced EMF as the flow rate increased or decreased. After analyzing the data, it is apparent that our prototype can sense the changes in the induced EMF that originate from changes in the flow rate.

GRAPHS

These graphs show induced EMF vs. time compared to the change in flow rate vs. time.

CONCLUSIONS

- The electromagnetic flow meter shows a trend in the EMF data
- The data also shows error and a need for a new model
- A new model has been created
- The new model is currently being tested with the new revisions

REFERENCES


