10/3/22 - At this point we have a function that can solve for the pressure difference across the orifice plate assuming inviscid, incompressible, steady flow. Also note the assumption that the load is directly vertical (probably a safe assumption, but worth remembering). I’d like to wrap this in a class with all the parameters that define our damper that update as we simulate the motion.

10/10/22 - Currently the model only accounts for load rate (velocity), but I think after we test tomorrow we will find that our damper is dependent on the position as well. We should think about how to account for this positional dependency. It could have to do with the deformation of the bellows as they are elastically deforming as they are pushed down. Should this be an additional term we account for in the model? Probably.

10/17/22 - I’m gonna add a plotting function to the notebook.

10/18/22 - Not sure why but we aren’t getting similar results from the model as the physical testing. The damping force we are calculating with the model is so low compared to the spring force. The discharge coefficient is what is supposed to cause viscosity to play into the overall force, but even with toothpaste we are getting discharge coefficients larger than the usual range.

10/26/22 - Gonna implement Hagen-Poiseuille equation

10/31/22 - Josh and I looked over the equation and dimensions and it seems right, but our simulated results are just way bigger than what we got for the first toothpaste trial. Josh isn’t super confident in that data, though, so I think it is wise to wait until we get more test data to keep working on H-P. We should look at the viscosity of toothpaste and get a paper on it though to ensure we have the right number.

We need to simulate all of the test cases anyways, so I can do that ahead of time and put experimental data in retroactively. Setting up a better framework for plotting and stuff is important.

Gonna add a slide in the slideshow for the derivation of H-P from N-S and assumptions.

Also, I am going to add a function to calculate the area between our simulated curves and experimental data so that we have a quantification of simulation error.

I am also going to email an old TA of mine from a computational mechanics class to see if we can meet with him to discuss the model.

11/7/22

The data from prototypes 2 and 3 suggests that we are undercalculating the spring constant. I think this is because we are neglecting the fact that toothpaste is compressible and viscoelastic, so when we push on it, it will push back not only from damping but from elasticity. However, this assumption forces us to reconsider the flowrate we have calculated through the orifice, because if the toothpaste is compressing then we will have less volume flowing through the orifice. It seems wise that we tune the model for both the viscosity and the bulk modulus of the toothpaste. We can have a cost function that is the difference between the simulated results and the actual results at a given speed and displacement and optimize for viscosity and bulk modulus of the toothpaste.