

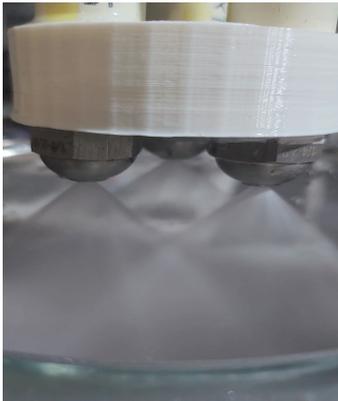
Executive Summary

This month, I worked on increasing the flow rate and thrust of the class II rocket motor. I increased the HTP ignition flow rate to ~ 71 ml/sec using three stainless steel 1/4" spray nozzles. Using the single port PLA fuel core design as a basis, I designed a new three port PLA fuel core segment. With this fuel core, I should get ~ 75 N (~ 17 lb) of thrust. During combustion, I plan to throttle up to ~ 100 N (~ 22 lb).

Technical Stuff

This month, I worked on increasing the flow rate and thrust of the class II rocket motor. I'm focusing on two different HTP flow rates, ignition flow rate and burn flow rate. HTP ignition flow rate is the flow rate at the opening of the ball valve when the initial pressure inside the engine is atmospheric. The HTP burn flow rate is the flow rate during combustion. From ball valve opening to combustion, the pressure increases inside the motor while the flow rate decreases. I surmise that the HTP flow rate decrease is linear based on the observed pressure increase being linear.

The picture on the left shows the opening of the ball valve with three stainless steel 1/4" spray nozzle with a 2.0 mm diameter orifice. For this test, the three nozzles have an H₂O ignition flow rate of ~ 71 ml/sec (~ 24 ml/sec/nozzle) at 140 psi propellant tank pressure. It takes ~ 3.2 seconds for the ball valve to completely open. I stopped the ball valve opening at 1.0 sec. I used a 12V DC lithium polymer battery and a delay timer. Please note, I use water for all indoor flow testing. This is one of the many advantages of using room temperature HTP as an oxidizer.



The H₂O ignition flow rate for a single nozzle at 140 psi and a 1.0 sec stop was ~ 28 ml/sec. The H₂O ignition flow rate for a single port PLA/KMnO₄ fuel core is ~ 21 ml/sec. As such, I'm in the ballpark.

The picture on the right is a preliminary design of a three port, six centimeter PLA fuel core. Each port has the same parameters as the original PLA/KMnO₄ design. The HTP (not H₂O) flow rate during combustion for a single port fuel core is ~ 10 ml/sec. I estimate that with a three port 12 cm fuel core and an O/F ratio of 2.5, I should get ~ 75 N of thrust at ignition. It is my intention to throttle up to ~ 100 N after ignition by fully opening the ball valve.

Next month, I plan to run the instrumented testing using the Class I rocket motor and a motorized ball valve. This test was scheduled for this month but delayed by six inches of snow and ice. Also, I will continue with the design of the class II fuel core and further characterize the flow rate of the three spray nozzle design.