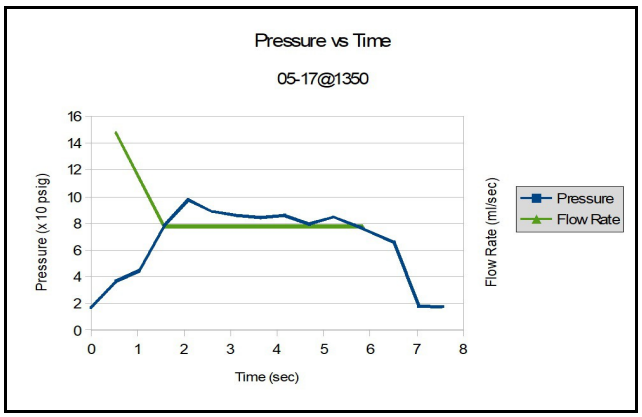
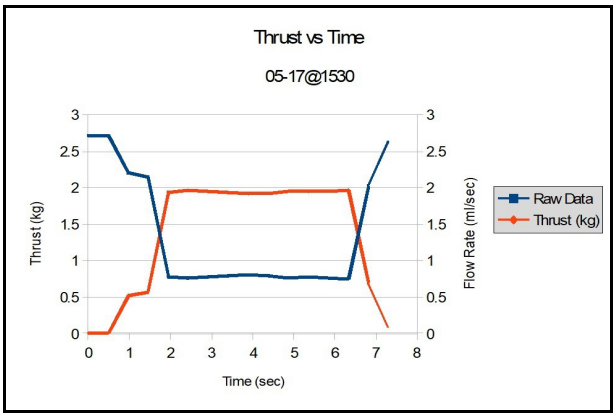
Executive Summary

This month I measured the thrust at 19.1 N and it looked pretty steady. I increased the thrust by increasing the throat diameter to 6 mm which resulted in a slight increase in mass flow rate. The characteristic velocity was calculated to be ~1662 m/sec with an efficiency of 104% . Also, I've been working on the flight system. I have rearranged the mass some with the purpose of moving the CM more in line with the thrust vector. Next month, I plan to launch the Mark I Viper.

Technical Stuff

This month I increased the diameter of the throat to 6 mm. In a previous test, I measured a ~20 N thrust at the end of the test run. Post test analysis showed that the throat eroded to ~6 mm. Since I needed to increase the thrust, I ran a test with a 5.5 mm diameter throat and a test with a 6 mm throat. The test results for the 6 mm diameter throat are shown below.





Ignition occurred in ~1.0 sec and burn time was about 5.4 sec (video). I measured the thrust at 19.1 N and it looked pretty steady. The throat diameter eroded from 6.0 mm to 6.7 mm with an average throat area of 0.32 cm^2. This tracks with the decrease in chamber pressure as the throat area increases. It follows then that the thrust would be relatively steady. The average pressure was ~102 psia (7 Bar).

I used 50 ml of HTP plus 2 ml of ethanol for an O/F ratio of 25. The volume flow rate of HTPE was about 7.74 ml/sec resulting in an average HTP mass flow rate of 10.34 gm/sec and an ethanol mass flow rate of 0.24 gm/sec. The post test mass loss of PLA/$KMnO_4$ was 15.95 gm resulting in a mass flow rate of 2.95 gm/sec. The total mass flow rate was 13.53 gm/sec and the HTP/PLA ratio was 3.2 (a good oxygen rich mixture).

The characteristic velocity was calculated to be ~1662 m/sec with an efficiency of 104% (theory is ~1593 m/sec). Hard to believe, but I ran the calculations several times and I even averaged the pressure over a larger sampling. Also, with the increase in throat diameter, the characteristic length changed from 33" to 23". Of course, this is one test with the throat diameter at 6 mm. There will be more testing next month.

With the thrust and the total mass flow rate, the specific impulse is ~1412 m/sec and the coefficient of thrust is ~0.85. Less than one but keep in mind, I'm testing at ground level and the nozzle expansion ratio is optimized for a higher altitude.

Finally, this month I've been working on the flight system. I have rearrange the mass some with the purpose of moving the CM more in line with the thrust vector. If you viewed the video of the last test, you will notice a little off axis torque on the engine. I've got to fix that or not only will the Mark I Viper pitch forward it will also yaw to port, not good. I increased the size of my fins to increase aerodynamic control.

Next month, I will run consistency and reliability testing using the 6 mm diameter throat and 12.5 cm fuel grain. Note that all previous testing was done with highly stabilized HTP. The next series of test will be using unstabilized HTP at higher concentration. Also, come hell or high water, I will launch the Mark I Viper.