Executive Summary

This month, I had two test with the new motorized ball valve. There was an explosion in the second test which resulted in a rebuild of the whole test article. The only pieces to survive were the ball valve and the check valve. I added a vent valve to the propellant tank. The vent valve makes it easier to load the HTP.

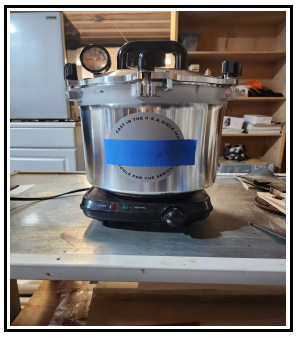
Also this month, I used a new 10.5 qt stainless steel pressure cooker to infuse fuel core segments. The new pressure cooker has three pressure settings which give me more control over the infusion process. Initial tests are encouraging.

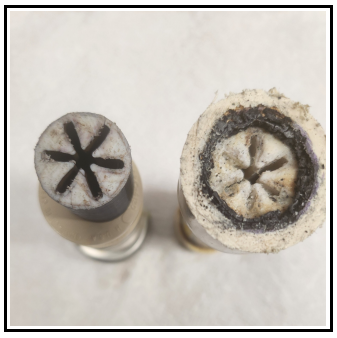
Technical Stuff

This month, I had two test with the new motorized ball valve. In the first test, I stopped the ball valve opening in 0.60 seconds. At a tank pressure of 140 psig with a 2.0 mm orifice, the initial flow rate is ~11 ml/sec. Ignition occurred in 0.49 sec and burn was for 2.9 sec. It was an explosive ignition with combustion oscillations. Unfortunately, I had a bleed through at the injector. Apparently, HTP splashed back onto the PLA adapter which melted a pathway through the adapter. Lesson learned, don't use a PLA adapter with the injector. I switched to the stock 1” to 0.5” CPVC adapter.

For the next test, I stopped the ball valve opening at 0.58 seconds. Ignition occurred in 0.6 seconds, burn was for ~ 0.7 seconds, and an explosion occurred shortly thereafter. Video analysis shows that the thrust was greater than 40 N. Using established parameters, this translates to a peak pressure of ~ 180 psi in the mixing chamber. The only test equipment to survive were the ball valve and the check valve. As such, I had to rebuild the whole test article.

The picture on the left is the new test article. I went to 1” CPVC adapters and couplings. I added a cross coupling which allowed me to insert a vent tube and valve. The vent valve prevents pressure build up in the oxidizer tank while fueling. This wasn't much of a problem when loading 50 ml of HTP. However, I did have to alternate between loading the HTP and releasing the pressure in the tank. I'll be loading around 150 to 200 ml of HTP in the near future. With the new fill tank, I just hold up the tank and let gravity do the work. As such, loading HTP is a lot easier.





Since I needed to go to a larger size anyway, I decided to invest in a 10.5 qt pressure cooker (center picture). This pressure cooker has three pressure settings; 5, 10, & 15 psig. As such, it gives me more control over the infusion process. Also, it is made of stainless steel and uses a steel to steel seal (i.e, no rubber seal). The shaker table can not support the pressure cooker as it is much heavier than the smaller pressure cooker. My first infusion without the shaker table is shown in the picture to the right.

I infused seven 6 cm fuel core segments at 5 psig with a $KMnO_4$ concentration of 50 gm/ml for 30 minutes. After infusion, I removed the fuel core segments and let them air dry overnight. The next day, I cut one of the fuel core segments into two pieces and compared it to a spent fuel core segment. It looks as though I have a good infusion. Next month, I plan to have rocket engine test with the new fuel core segments.

Also next month, I'll be experimenting more with the motorized ball valve. I've got to find the initial flow rate sweet spot. I'll eventually get to assemble a rocket motor using the 3 port fuel core.