**The Inherent Safety of Hybrid Rockets**

By Kelsey Hudier

Working with rockets might be extremely gratifying and fun, but it’s also a dangerous task. Many things could go wrong, one of which being the rocket blowing up. This was an important factor to consider while deciding on a type of rocket to design, which is why a hybrid engine was chosen. Indeed, this type of rocket eliminates many risks which are due to the lack of control in solid motors and the added complexity of liquid engines.   
  
 The hybrid engine meshes the concept of solid motors and liquid engines. The solid fuel used for our rocket is paraffin, which is essentially candle wax. This material is inert, which makes it easy to handle. Our oxidizer is liquid nitrous oxide, which is safer than other oxidizers since it is non-toxic and stable at room temperature. It is also self-regulated, which means no secondary gas is needed to pressurize the oxidizer tank while it’s being used: reducing complexity of the system as well.

Additionally, no pumping is required with this type of engine. One of the main complications with liquid engines is that the propellant streams must be carefully pumped in the combustion chamber, or else there would be incomplete combustion or the rocket could explode. These additional components, while giving an edge to liquid engines in terms of performance and supreme controllability, also add potential points of failure.

To fully understand the inherent safety of a hybrid rocket engine, the following scenario could be considered. It is always a possibility that something goes wrong during the ignition sequence. The solid motor would not be able to abort the sequence. Rather it would shoot off, only to be controlled by the laws of nature. In the case of a liquid rocket engine, both the fuel and oxidizer would be present (before the flow was stopped) and leave the combustion chamber without combusting. This creates an area which is highly susceptible to explosions. With the hybrid engine, the flow of oxidizer could be cut off much like the liquid engine. And unlike the liquid engine, while some oxidizer would escape the chamber, not much fuel would be present for combustion making it slightly safer in this case. Of course this is not to say solid motors and liquid engines should not be developed. Comparisons such as these give an insight as to why the hybrid rocket engine is inherently safer than its counter parts.

It is interesting to note that nitrous oxide provides another layer of safety because it requires a certain amount of activation energy in order for the oxygen atoms to disassociate before it can be considered a potent oxidizer. Therefore, an intentional ignition source is required to start combustion. While it is possible that accidents occur with nitrous oxide, it is not likely if even the most basic of safety standards are upheld.

To conclude, although there is always a risk while dealing with rockets, hybrid engines are inherently safer than their competitors and ideal for the types of launches done by the uOttawa Student Team of Aeronautics and Rocketry.