FLAME STABILITY: HYDROGEN ENRICHED NATURAL GAS

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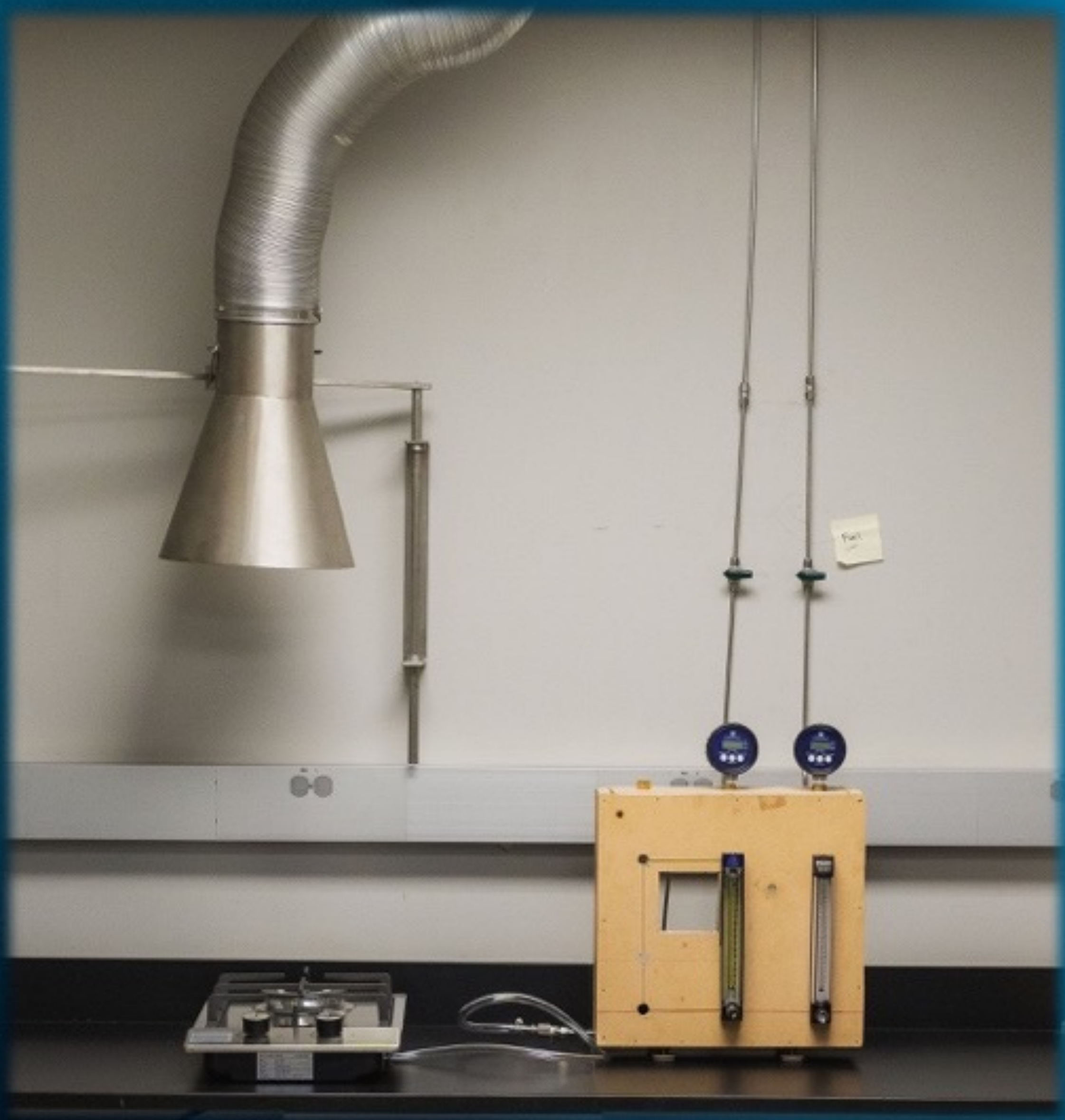
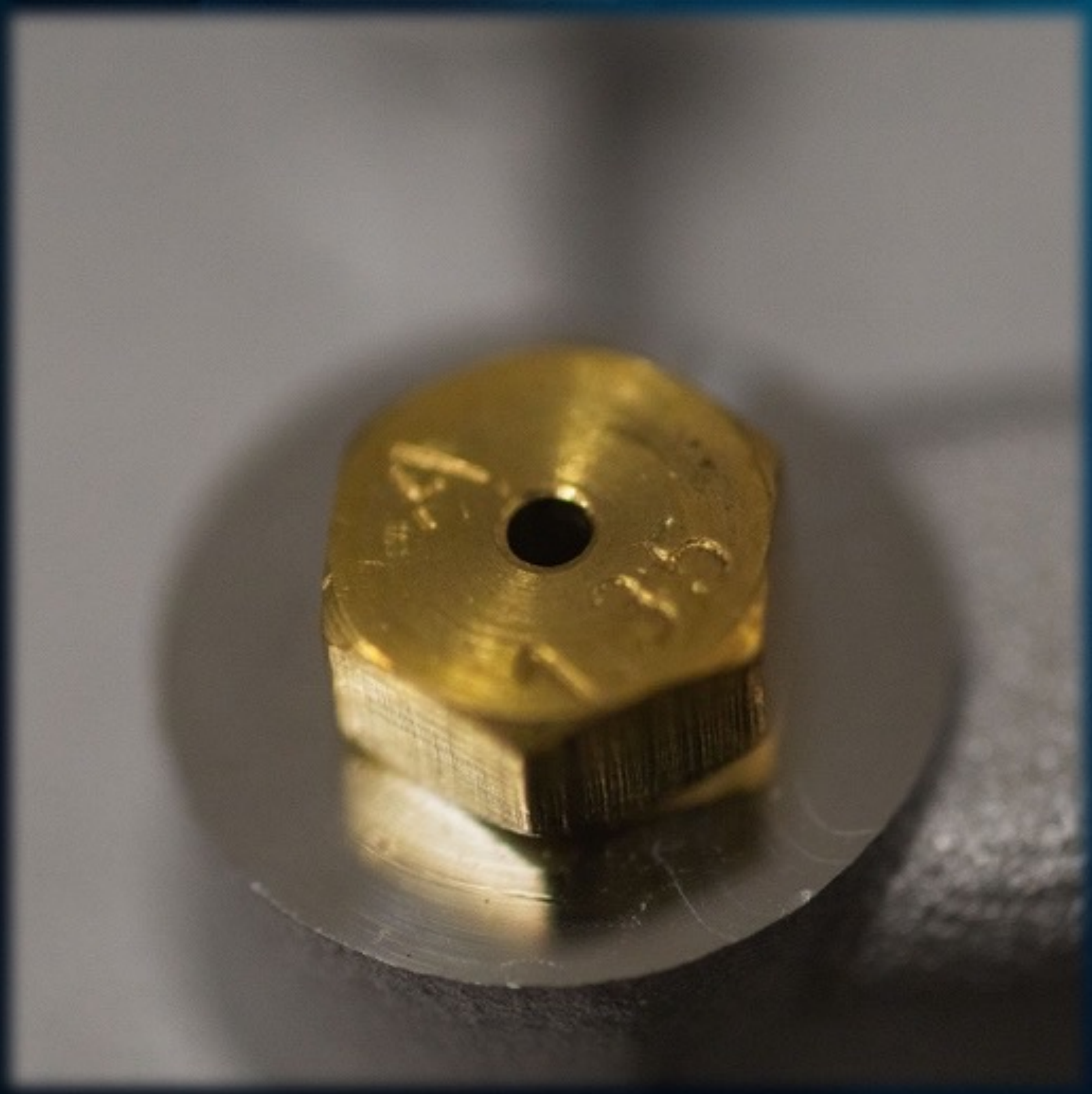
BACKGROUND

A hydrogen enriched natural gas (HENG) system is favored to replace traditional natural gas appliances in efforts to reduce harmful emissions and use fuels that are abundant. By modifying existing infrastructure, hydrogen can be introduced and mixed with natural gas to achieve a more sustainable and cost-effective fuel solution



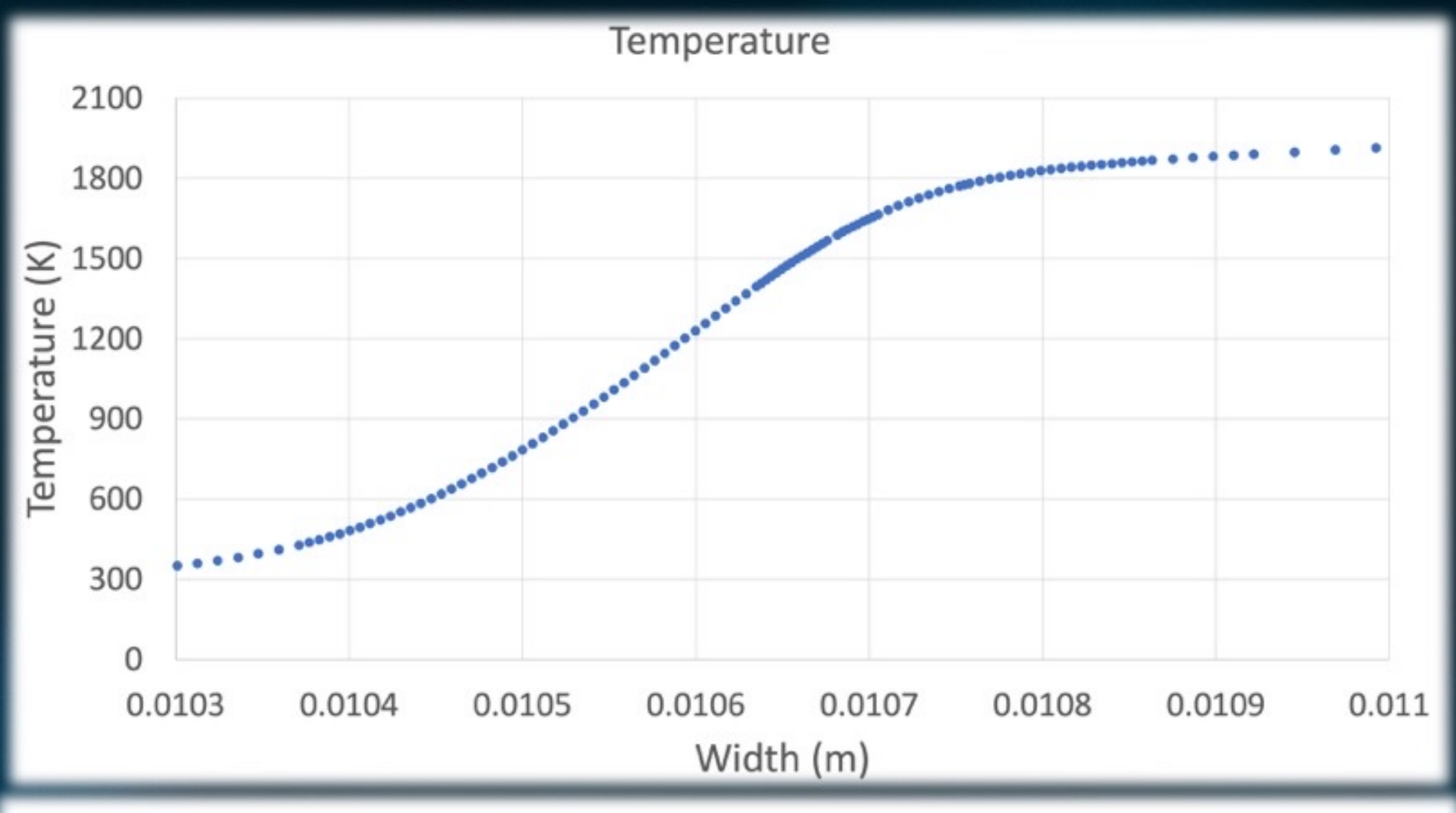
OBJECTIVE

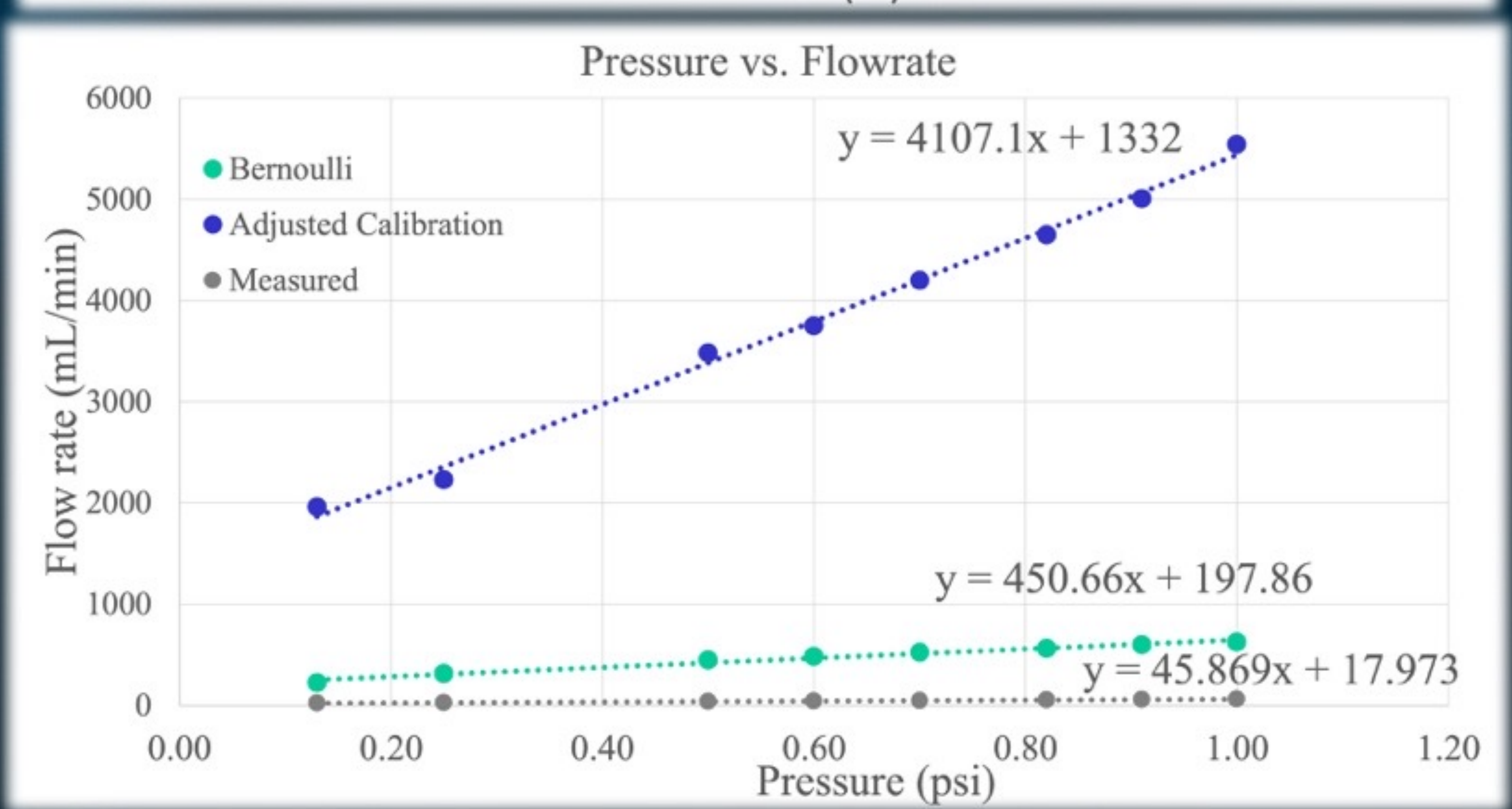
The objective is to achieve a stable flame for the combustion of a natural gas and hydrogen mixture. Flame stability will be characterized by flame temperature, flame speed, flame height, and energy release. The approach inlcudes chemical equilibrium calculations using Cantera, and experimental testing on a retrofitted stove burner.



THEORETICAL RESULTS

Using Cantera, flame temperature and flame speed analysis was performed for the HENG mixtures to determine optimal ratios. The adiabatic flame temperature for a 20% by volume hydrogen and 80% by volume methane was 2230 K with a flame speed of 0.44 m/s. This was verifed using a global combustion reaction with an adiabatic flame temperature with 2328 K resulting in a 4% difference between adiabatic flame temperatures. However, the calculated values do not agree with Bernoulli's theory becuase there is a differnce of 160%. Futher investigation is needed, but possible facotrs may include improper callibration or replacement of flowmeters.





CONCLUSION

This year's efforts were placed in setting up an entrained air system that would allow methane and hydrogen to combust. This system will allow for futher testing of different mixtures of methane and hydrogen, along with the ability to adjust volumentric flow, pressure, and oriface sizes.