USE OF AMMONIA-FOSSIL FUEL EMULSIONS IN A DIESEL ENGINE

Ammonia as a Hydrogen Carrier

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Previous Work by Dr. Agosta

- Patent on emulsions of non-miscible liquids and slurries
- Patent on hydrodynamic characteristics of venturis
- Model of diffuse dispersion of ignition kernels
- Model of combustion of 2-Phase system
- Army Depot Project - 1962

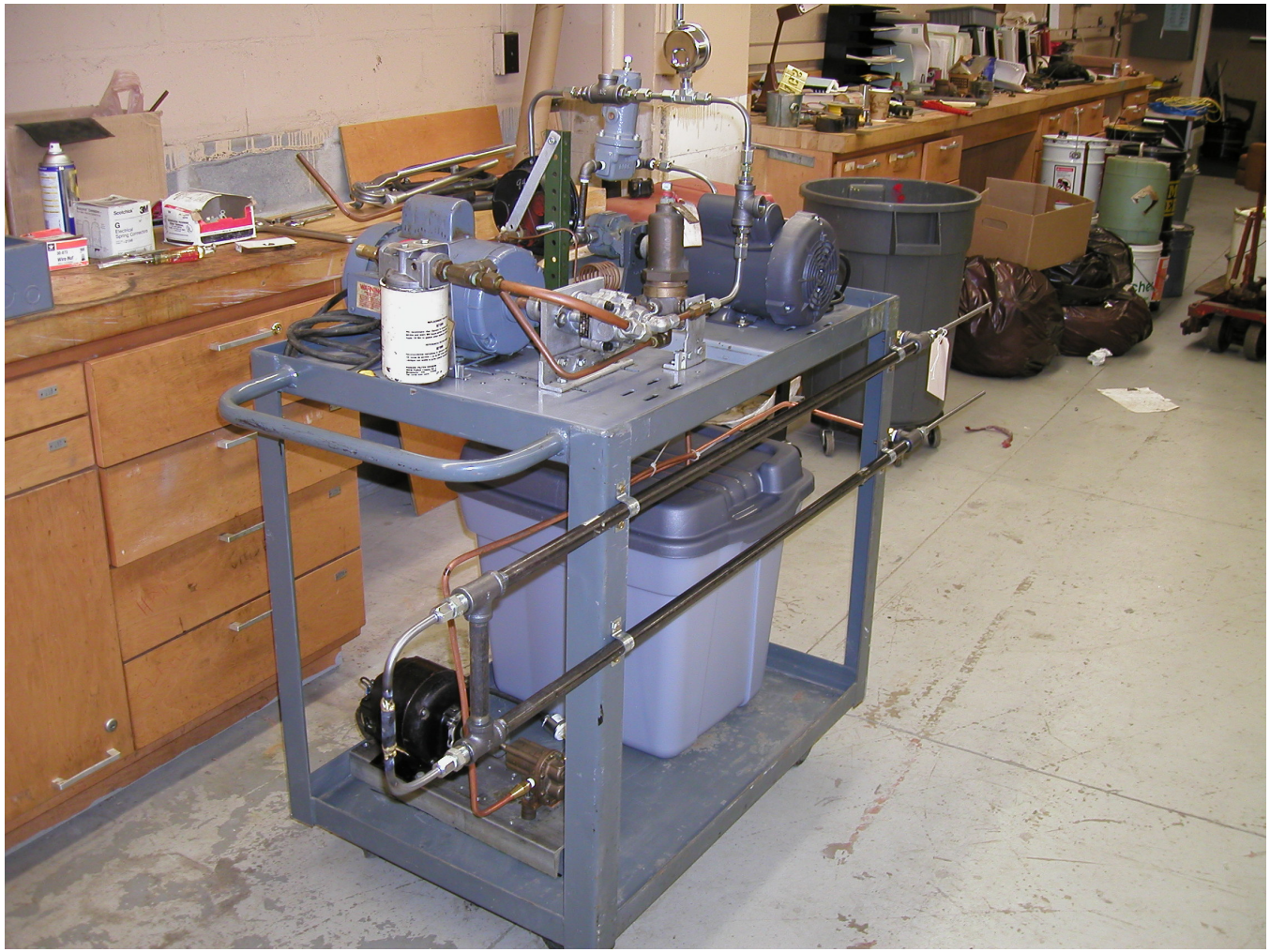
Use of Ammonia as a Fuel

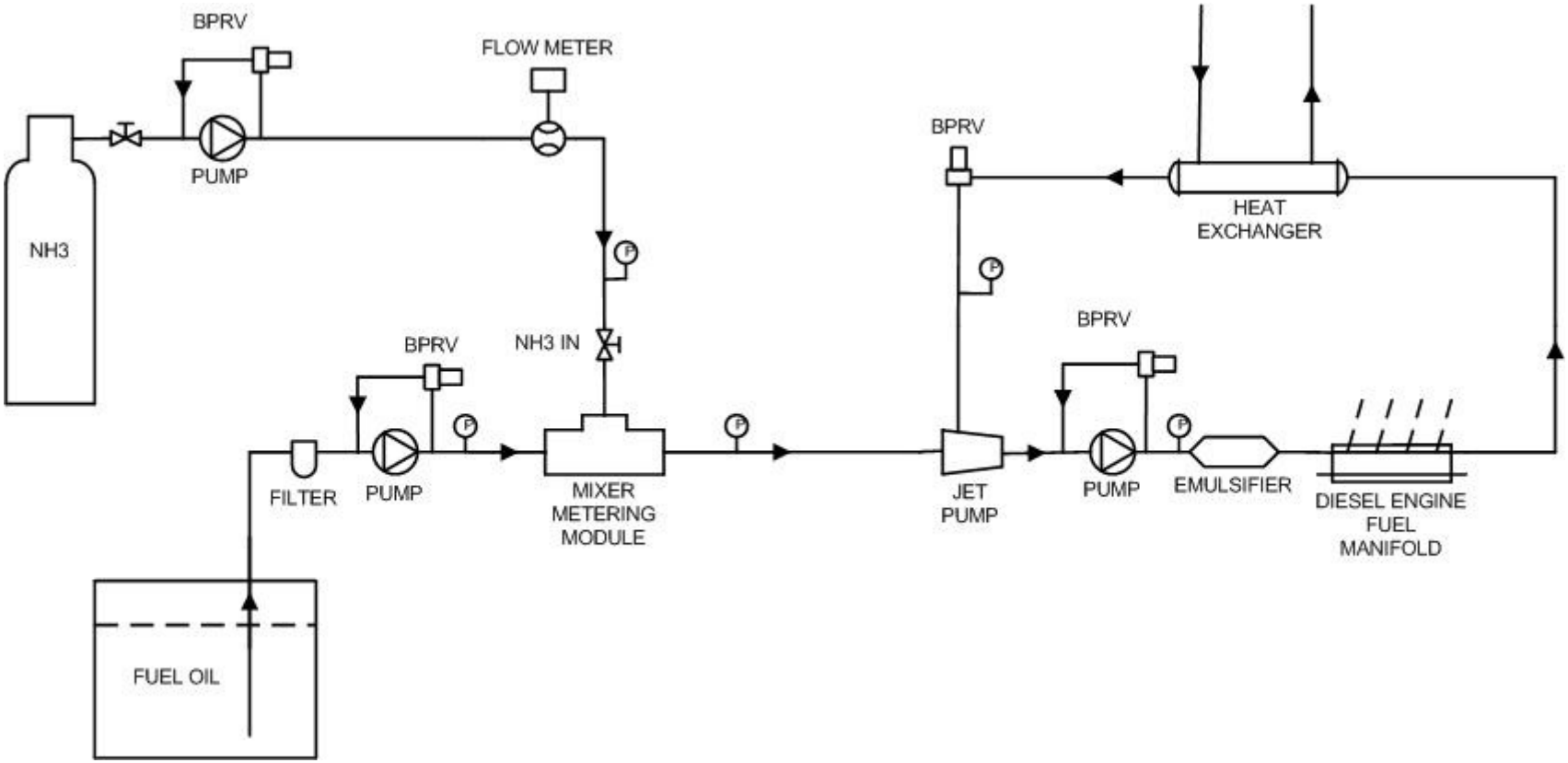
- Lessens dependence on foreign oil imports
- Decreases CO_2 footprint
- Product of combustion of NH_3 is water – same as hydrogen
- Decreases particulates
- 200 years of experience with storage and handling NH_3 – only 50 years with hydrogen
- NH_3 is used to reduce NOX emissions
- NH_3 can be used in future fuel cells

Objectives of Current Project

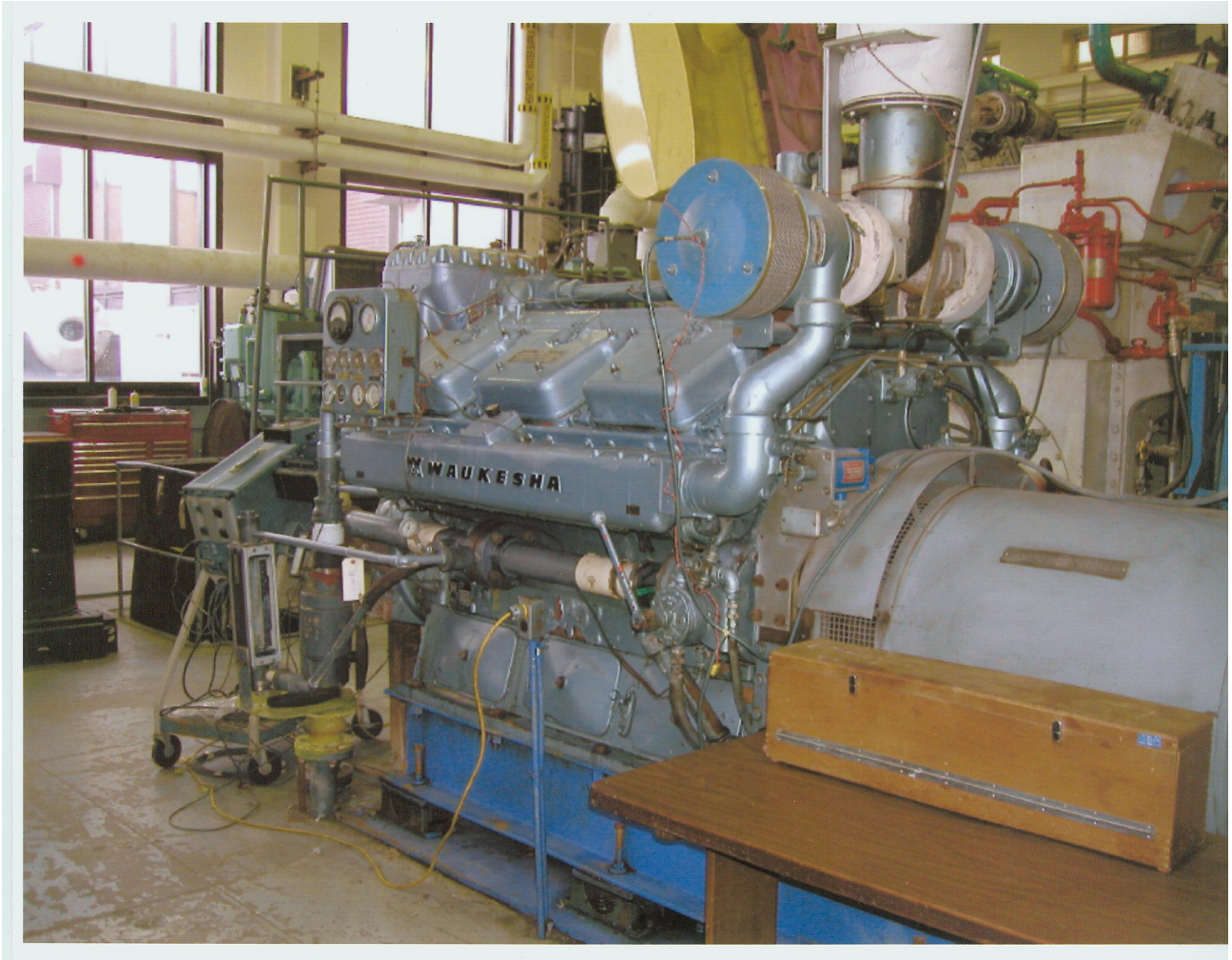
- Design and construct a prototype fuel system for producing an emulsion of diesel oil and ammonia
- Demonstrate feasibility of combustion of diesel oil/ammonia emulsions in an existing unmodified diesel engine
- Determine qualitatively the maximum amount of ammonia that can be utilized in the diesel engine

Prototype Fuel Emulsion System




BPRV
FLOW METER
PUMP
NH3
BPRV
NH3 IN
FILTER
PUMP
MIXER
METERING
MODULE
BPRV
HEAT
EXCHANGER
JET
PUMP
BPRV
PUMP
EMULSIFIER
DIESEL ENGINE
FUEL
MANIFOLD
FUEL OIL

Waukesha Diesel Generator
USMMA I.C. Engines Laboratory



Initial Test Results
April and July 2008

- Engine operated successfully on emulsions of fuel oil and ammonia.
- Failure of ammonia pump required modification to test operating procedures. Measured flows were 1%, 6% and 19% ammonia by mass. Revised system operation may have affected accuracy of ammonia flow measurements.
- Engine ran normally with no apparent change in operating parameters.
- Video taken during April tests follows.

Proposed Future Work

- Run series of tests at various ammonia percentages and engine powers
- Install instrumentation for measurement of cylinder pressures
- Perform statistical analysis of data
- Establish quantitatively a database for future commercial designs

Potential Markets

- Electric Power Generation – Small Towns, Farms in US and in Developing Countries
- Transportation – Marine Diesel Generators
- Transportation – Railroad Yards
- Airports, Hospitals, etc.

Conclusion

Acknowledgement

This work on the use of ammonia-fossil fuel emulsions in a diesel engine has been performed by Dr. Vito Agosta and Prof. James Harbach. The project has been funded by Hydrogen Engine Center Inc., the U.S. Merchant Marine Academy, and Propulsion Sciences Co.