ADVANCES IN MAKING HIGH PURITY NITROGEN FOR SMALL SCALE AMMONIA GENERATION

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SYSTEM OVERVIEW

• We have installed on an Iowa farm the ability to generate demonstration amounts of Hydrogen, Nitrogen and Ammonia from Solar Power, Water and Air.

• The hydrogen and ammonia fuel a modified John Deere tractor.

• The ammonia can fertilize corn cropland.
SYSTEM DESCRIPTION

- Tractor is in storage building
- Low pressure 200 psi H2 storage tank
- H2 storage and fueling pumps hut
- Eight 3600 psi H2 composite storage tanks
- Tractor fueling dock
SYSTEM DESCRIPTION

- 8 Kw of solar arrays
- N2 stored in 1000 gallon tank at 235 psi max
- Ammonia generation building
- Inverters, controls and H2 and N2 generator in tractor storage building.
A modified Dual Bed, Pressure Swing Absorption (PSA) unit generates Nitrogen.

- 140 psi compressed air is routed through the PSA unit.
- The generator makes 2.7 lbs/hour.
- It takes 16.5 hours to make enough nitrogen to generate a 10 gallon ammonia batch.
NITROGEN PURIFICATION

• Residual oxygen in nitrogen gas contaminated the ammonia reactor.
• Installed a nitrogen purification unit containing a catalyst bed and desiccant container.
  – Small amounts of H2 are mixed with the purified N2 and the catalyst bed forms H2O water vapor that is removed by the desiccant.
NITROGEN PURITY SENSING

• Measure the purity of the nitrogen being generated by the Pressure Swing Absorber unit.
• When N2 Low Purity Sensor shows purity down to 300 ppm, stop venting from PSA.
• Add H2 and flow through purification unit until High N2 Purity Sensor shows level down to less than 5 ppm.
• Then flow nitrogen to the storage tank.
NITROGEN PURITY SENSING

NITROGEN PURIFICATION UNIT

PRESSURE SWING ABSORPTION UNIT

FLOW METER

LOW N₂ PURITY SENSOR

HIGH N₂ PURITY SENSOR

N₂ STORAGE TANK SAMPLE

PURGE BLEED

Sensing Flow Valve

TO PILOT OF ALL VALVES

HIGH PURITY NITROGEN

NITROGEN GENERATOR PURITY SENSING CIRCUIT

REGULATOR

AUTOMATED VALVE

MANUAL VARIABLE FLOW VALVE

SENSOR BLEED

C-FREE RENEW
CONCLUSION

• Have demonstrated that super pure nitrogen can be generated for use in intermittent batches for making ammonia.

• More at SolarHydrogenSystem.com