THE HYDROGEN ECONOMY AND THE CHEMICAL INDUSTRY

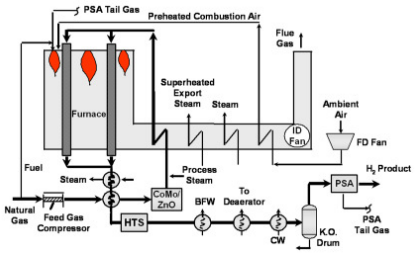
DR. JENS SCHMIDT / DOW

International Hydrogen Symposium, Hamburg Oct. 2019

Production of Hydrogen

Steam Methane Reforming (SMR)

- 90% of H2 produced in Steam Methane Reforming (using nat. gas)



Steam-methane reforming reaction

$CH_4 + H_2O$ (+ heat) $\rightarrow CO + 3H_2$

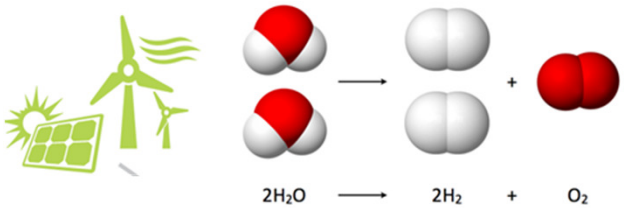
Water-gas shift reaction

$CO + H_2O \rightarrow CO_2 + H_2$ (+ small amount of heat)

- Emissions of roughly 10t CO2 / 1 t of H2 (25 t / 1MM scfd)
- Costs are mostly depending on Nat.Gas price
  - ~ $2-3/kg H2

Water Electrolysis

- Water Electrolysis
- Developed 1888
- Theoretical Energy 142 MJ/kg H2 -> 39.4kWh
- 1 MWh -> 25.4kg Hydrogen
- Modern electrolyzer ~19kg = 75% Efficiency
- 53MWh electricity per 1 ton of H2
- Main cost is power (76 to 171 Eur/MWh) -> 4-12 Eur/kg
- Capital costs ~ 1-1.5MM Eur/MW installed
- Low to zero CO2 emissions (depends on power source)



INDUSTRIAL USE OF HYDROGEN

What do we use Hydrogen for

- Industrial
  - Ammonia, Fertilizers
  - Hydrochloric Acid
  - Methanol
  - Aniline
  - Fat hardening, etc.

- Fuel
  - Fuel Cells
  - Combustion Engines

- Basis for use in Carbon Conversion
  - Long chain hydrocarbons via Fischer Tropsch (jet fuel, etc.)
  - Methanol synthesis from CO2 or Syngas
  - Green methane/natural gas from CO2

CO2 neutral H2 !

TRANSPORT & LOGISTICS

Hydrogen Logistics

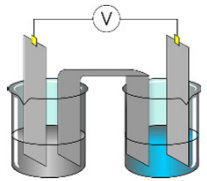
- Hydrogen is difficult to transport
  - Gaseous at 200 – 700 bar (1 kg H2 per 100kg container weight)
  - Liquid at -253 °C (10 kg H2 per 100kg container but 20 % energy loss)

- Storage in Caverns
  - ca. 60 – 80 bar pressure
  - Density ~ 0.09 kg/Nm3 at normal pressure
  - @70 bar ~ 300t in 50.000m3 cavern

WATER-ELECTROLYSIS AT DOW IN STADE

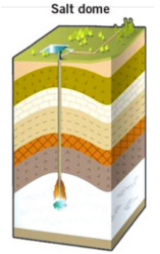
Production and Storage capacity at World Scale

- Dow produces ~ 50.000 t/a Hydrogen with salt water electrolysis
  - Total Power Consumption City of Stade 46.000 people (excl. industry) ~ 2600 t/a



- Equivalent to electrolysis-capacity of ~ 230MW
  - ~ 3-400 MM Euro Capital Invest equivalent
  - ~ 100 MM Eur/a power costs at 8000 h/a and 60 Eur/MWh
- Direct access on site to northern German wind power

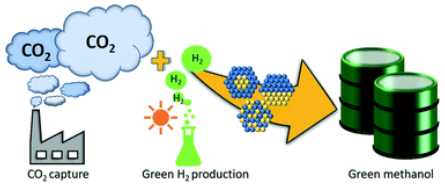
- DOW operates several salt caverns
  - Generating 1MM m3/a cavern capacity
  - Experience in storing propylene and ethylene in salt domes already
  - Can generate hydrogen storage cavern faster than anyone else



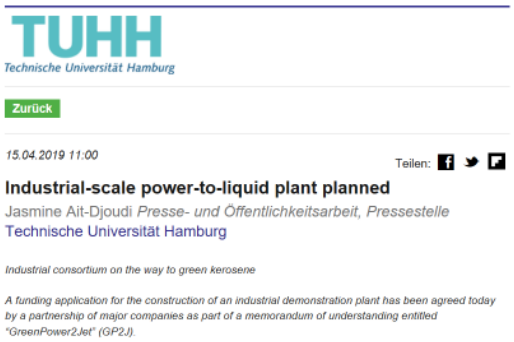
OUTLOOK

Current & Future Projects

- Utilization of Hydrogen and CO2 from DOW owned Nat.Gas. Power plant
  - 42 kta “Green Methanol”
  - 10 kta “Power 2 Jet – Green Jet Fuel”



- Storage of Excess Power
  - We operate 5 TWh of electrolysis today
  - Cavern storage available
  - Access to renewable power in GW scale
  - Modification of gas turbines to use H2 up to 50% vol. under investigation



TUHH
Technische Universität Hamburg

Zurück

15.04.2019 11:00

Teilen:

Industrial-scale power-to-liquid plant planned

Jasmine Ait-Djoudi *Presse- und Öffentlichkeitsarbeit, Pressestelle*
Technische Universität Hamburg

Industrial consortium on the way to green kerosene

A funding application for the construction of an industrial demonstration plant has been agreed today by a partnership of major companies as part of a memorandum of understanding entitled "GreenPower2Jet" (GP2J).

TAKEAWAYS

- Dow Stade has huge quantities of electrolysis H2 available (50.000 mt/a)
- Dow Stade can offer storage of H2 in salt caverns
- Dow Stade has access to huge quantities of renewable power

- Traditional transportation of H2 is difficult/inefficient
- Invest costs for Water electrolysis are high
- Production costs of “green” H2 are significantly higher than fossil based

DOW Stade
Enabler for Hydrogen Economy
on World Scale in Lower Saxony

Seek

Together™