

Online-Workshop “Alternative Fuels”

July 08th 2021



Feasibility study:
Application of Ammonia as fuel in shipping

Organized by:



In cooperation with:



KONINKLIJKE
VERENIGING VAN
NEDERLANDSE
REDERS



Content and project team set-up

Work packages (extract):

A) Ship Design

- Rough concept design
(storage, exhaust gas after treatment, bunker station & safety areas)
- Defining main documents for an AiP
- Identifying the safety precautions



B) Fuel Properties

- Environmental impacts
- Costs depending on production pathways
(grey – green; NH_3 vs. conventional)



C) Infrastructural framework conditions and perspectives

- Most promising production path
- Evaluate competitiveness against alt. fuels

D) Mechanical application (working methods and raw emissions)

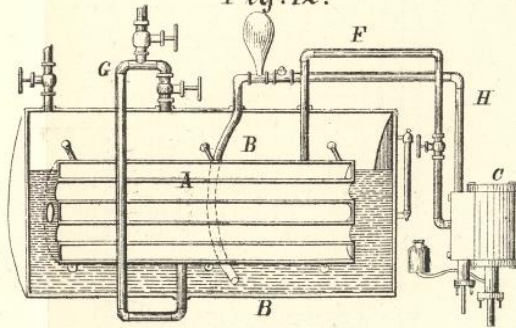
- Engine combustion selection of a suitable process
- Transferability on NH_3 / H_2 mixture to large engines
- Transferability of operations with diesel as ignition fuel
- Evaluation and optimization of nitrogen oxide
- Comparison of emissions from different converter technologies



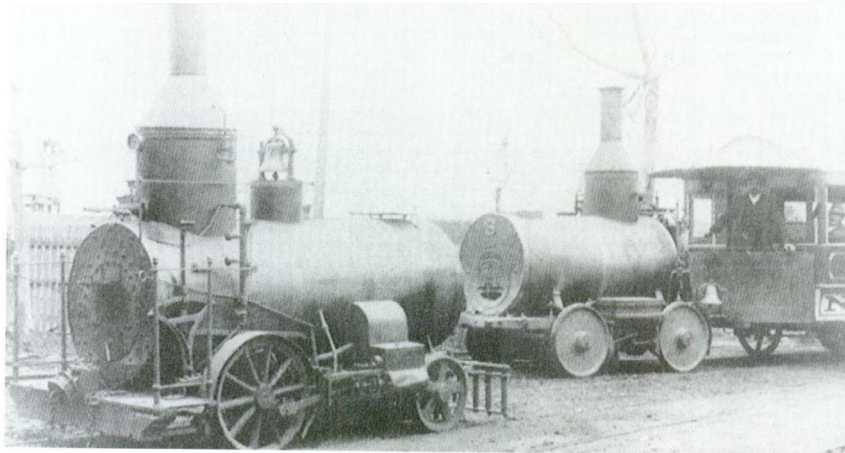
NH₃ Something new ?

Lamm's Ammoniak-Maschine. (Fig. 12.)

Fig. 12.

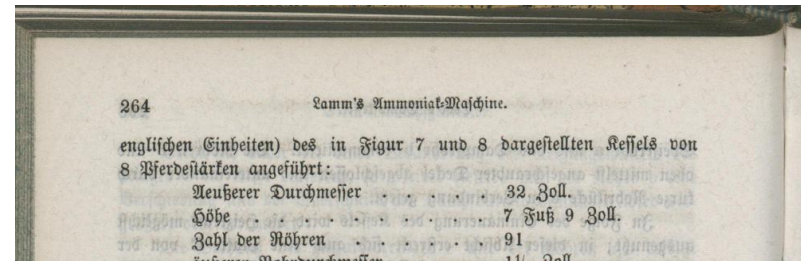


Dr. Emile Lamm patented two types of locomotive propulsion principles, the Ammonia system (July 19, 1870) and the Thermo-specific system (April 9, 1872).

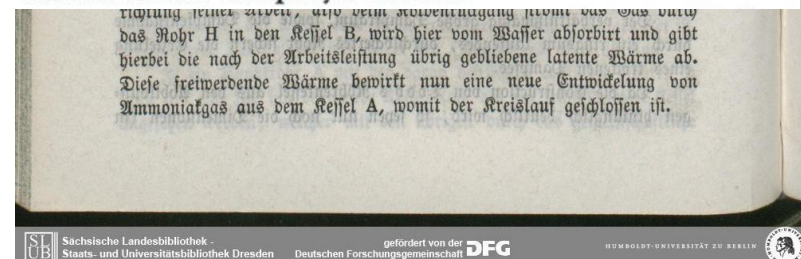


Lamm engines on New Orleans & Carrollton RR. Co., about 1875.

Louis C. Hennick Collection



The potential worth of these inventions were weighty enough to call fourth much capital and interest, especially on the part of the New Orleans & Carrollton RR. Co. and Gen. Beauregard. For instance, the N. O. & C. RR. Co. in 1872 conducted comparative trials to determine the ammonia locomotive's economies over animal propulsion. It was found that to operate the ammonia locomotive cost \$6.775 per day as compared to \$9.910 per car per day for animal traction. Expenses of animal upkeep and feed, also labor and track work (plank walkway), were cut out by Lamm's invention. May 27, 1872 saw the charter filed for The Ammonia & Thermo-Specific Propelling Co. of America. New Orleans' "social register" staffed the Board of Directors. Dr. Emile Lamm, Mr. Leon Godchaux, Mr. P. J. McMahon, Mr. W. C. Wilson, Mr. Jules Brudy, Gen. Beauregard, Mr. G. L. Laughland (elected President of the company), and Mr. H. C. Millaudon put their signatures to the company's charter.



NH₃ Something new ?

AMMONIA—A FUEL FOR MOTOR BUSES.

By EMERIC KROCH,* D.Sc. (Member).

THE first utilization of liquid anhydrous ammonia as a fuel for motor-buses took place in Belgium during the year 1943.

The first motor-bus was equipped and put into service in April 1943, and since then eight buses operating on three lines have covered several tens of thousands of miles, leaving and arriving on schedule, thus maintaining an important public service for the Belgian civilian population.

Before describing the principal features of this new development in alternative motor fuels and the results obtained during the first twelve months of exploitation, it appears opportune to give the reasons why this particular alternative motor fuel was chosen for the service described above.



Fig. 19. Gazamo system and ammonia-equipped motor bus, respectively [168]. Courtesy of the Energy Institute.

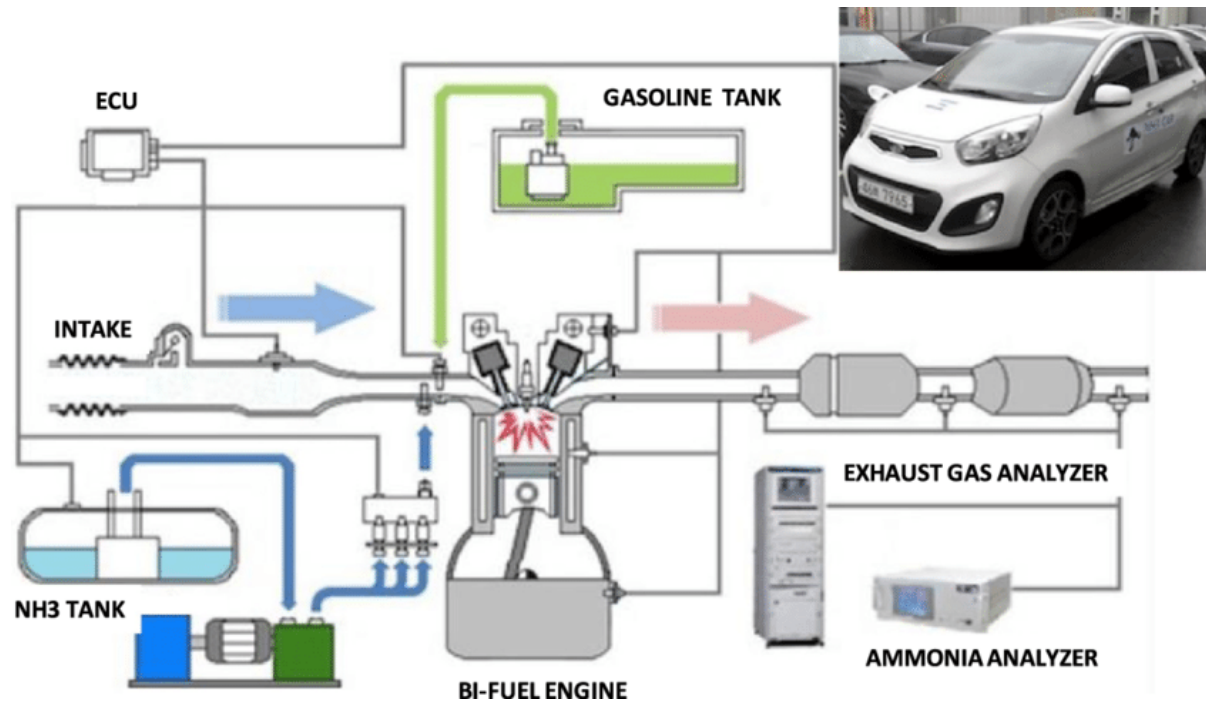


1960 The X-15 rocket plane set speed and altitude records in the 1960s, powered by NH₃.



2000 In the summer of 2007, this NH₃ vehicle drove across America, from Detroit to San Francisco, powered by a mix of ammonia and gasoline.

NH₃ Something new ?



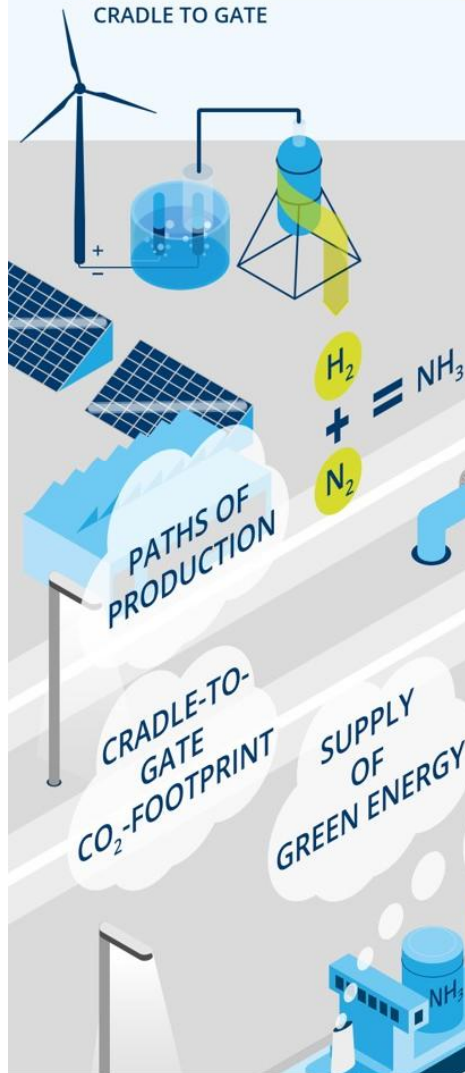
AmVeh car (top right). Ammonia based engine for transportation in South Korea

Courtesy of NH₃ Fuel Association.; KIER (Korean Institute of Energy Research)

AMMONIA AS A FUEL / QUESTIONS AND PROSPECTS

INFRASTRUCTURE

CRADLE TO GATE



PROPERTIES

STORING AND SAFETY



APPLICATION ON BOARD

COMBUSTION ENGINES AND FUEL CELLS

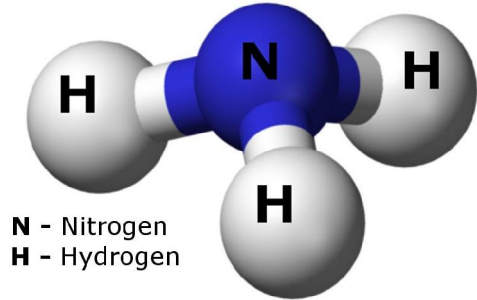


SHIP DESIGN

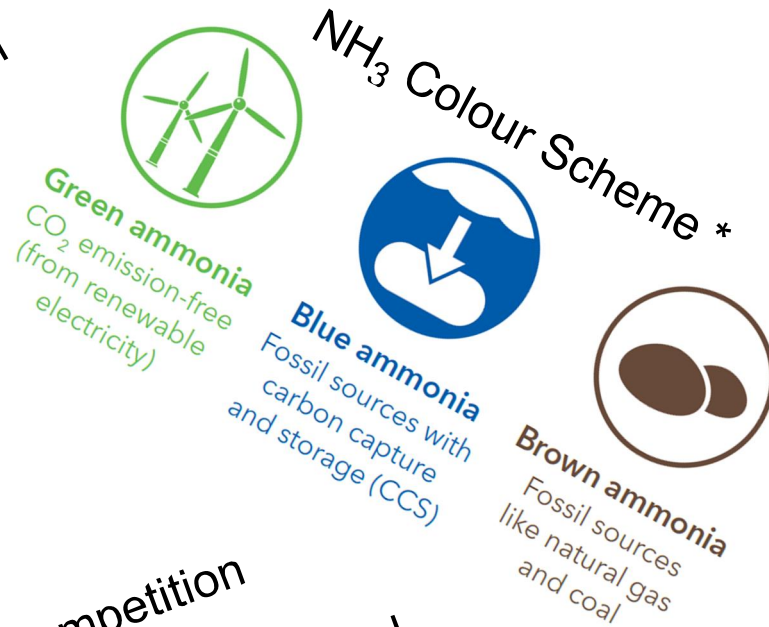
IMPLEMENTATION AND SAFETY MEASURES



NH₃ Challenges & Ideas



- Political Impact
- CO₂ reduction



- Infrastructure Production towards Use

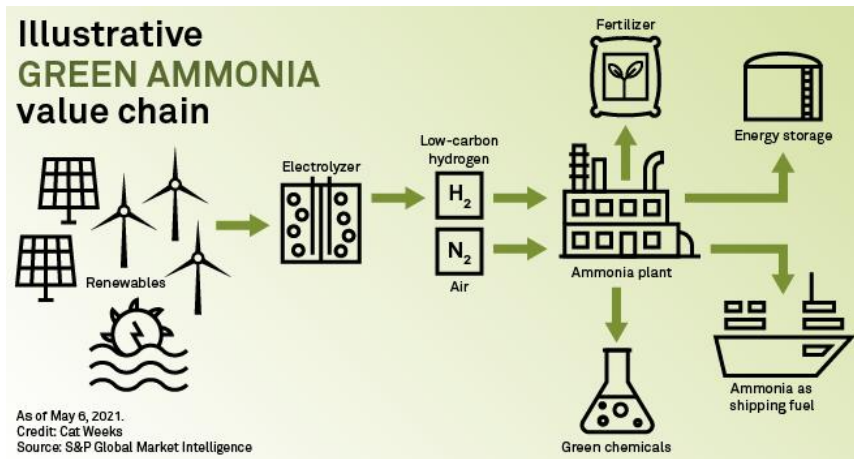
- Health & Safety Rules & Regulations



- Demand and Competition with other industries:
- *For 2012: 650 Mio t Ammonia-fuel demand (energy base) for all ships
 - 170 Mio t production in 2018

- Cradle-to-Grave
- OPEX – CAPEX
 - Energy
 - Emissions

Thanks for your patience !
Still time for a question ?



*An ammonia-fuelled ammonia gas carrier.
Photo courtesy of NYK Line*