

Methanol as Fuel for Passenger Ships

Research & Development
Daniel Sahren

ZES-Net Expert Workshop “Methanol”
April 29th 2020



Fuel properties

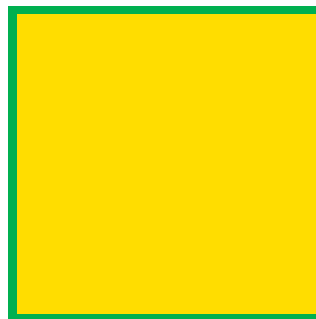
Property	Methanol	LNG	Diesel	Gasoline
Density [kg/m ³]	790	448	850	740
Heating value (volume-based) [MJ/l]	15,8	22,0	35,6	34,6
Heating value(mass-based) [MJ/kg]	20	49	42,8	46,7
Flash point [°C]	11	-188	52 - 96	-45
Self ignition temperature [°C]	455	540	250	280 - 460
Lower explosion limit [vol.-%]	5,5	4,6	0,5	1,4
Upper explosion limit [Vol.-%]	36	15	7,5	7,6
Heat release i. c. o. fire [kW/m ²]	450	4000	1400	2500
Boiling point (@ 1 bar) [°C]	65	-162	170 - 350	25 - 190
Enthalpy of evaporation [kJ/kg]	1160	511,7	250	375
Vapour pressure (bei 20°C) [bar]	0,13	gasförmig	0,004 (40°C)	0,25 - 0,45
Relative Vapour density (air=1)	1,1	0,55	6	3 - 4
Viscosity (@ 20°C) [cSt]	0,74	-	2,5 - 3,0	0,6
water solibility	100%	negligible	negligible	negligible

Space for energy storage

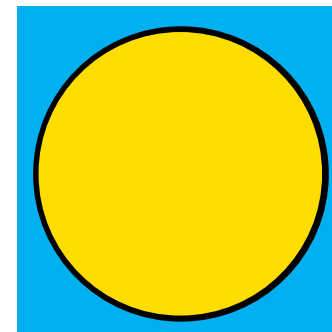
Equal amount of energy:



Diesel/
Heavy Fuel Oil



Methanol
incl. secondary barrier

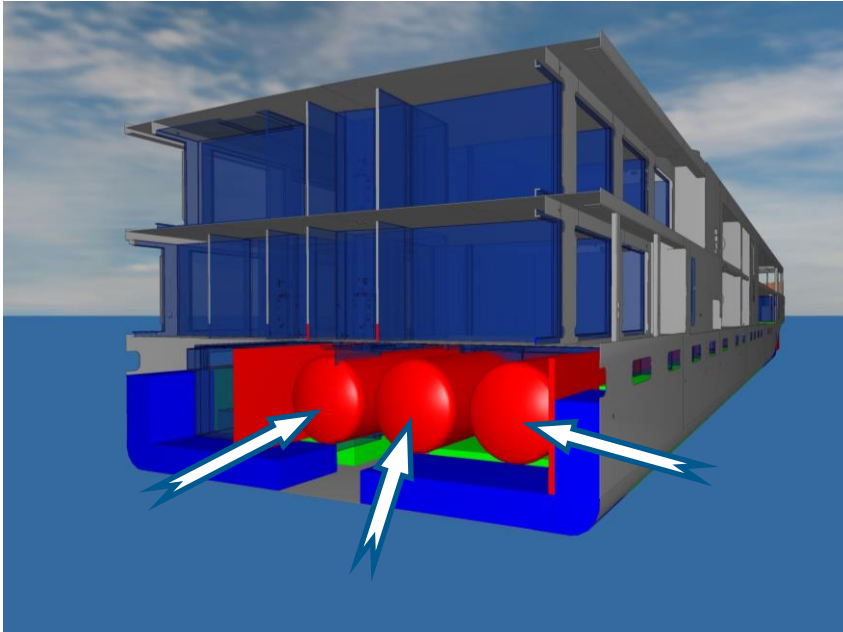


LNG (@-162°C)
incl. insulation and
tank holding space

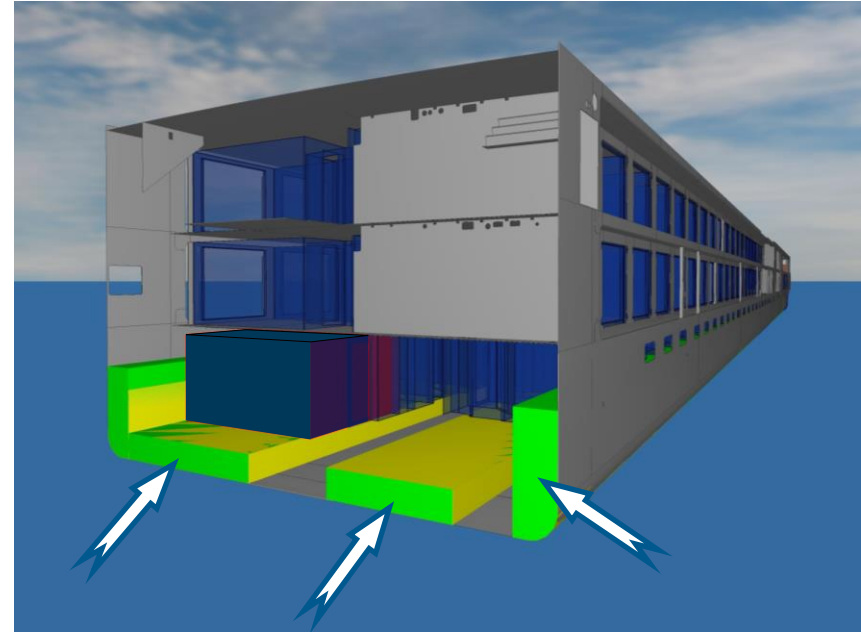
Space demand for the whole system needs to be looked at

Energy Storage on Board

Methane (LNG)



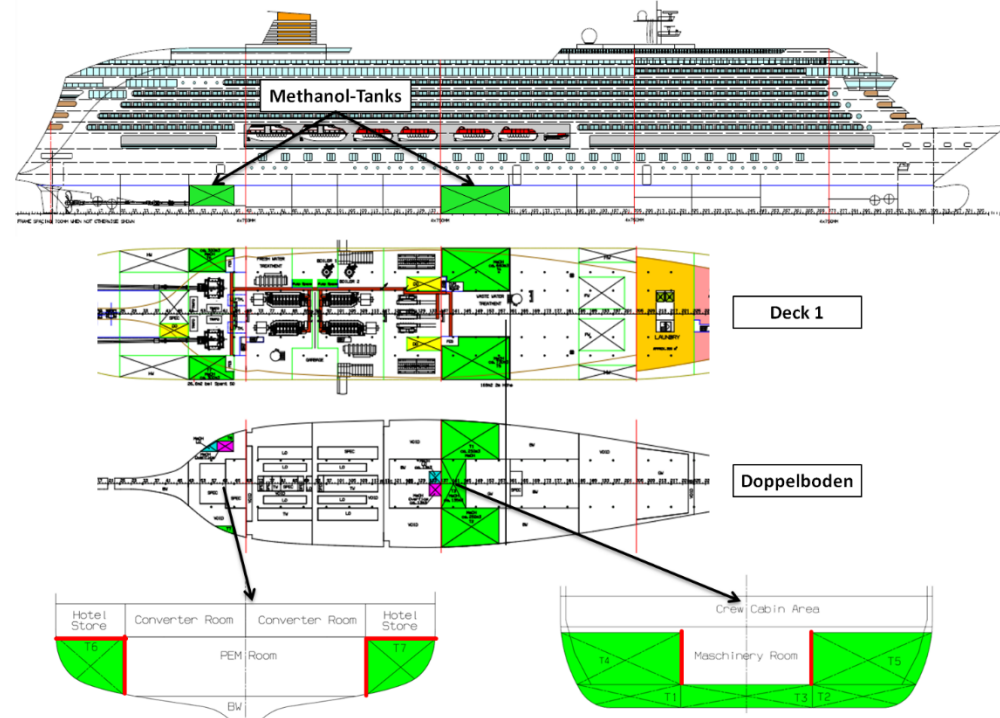
Methanol



Methanol allows nearly random tank arrangement

Methanol cruise ship

- Storage at ambient pressure & temperature, no pressure build-up
- Room saving, structural tanks
- Storage in hull & double bottom
- Common mild steel
- Relatively easy liquid fuel system



Methanol is very beneficial for the ship design

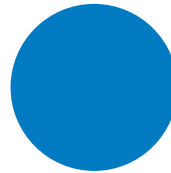
Lethal dose for fish

LC50, LC=Lethal Concentration:

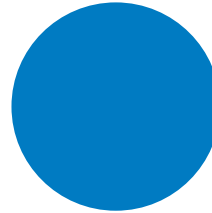
Concentration in water, at which half the population died within a specified test duration.

Methanol^[1]
15400 (mg/l)

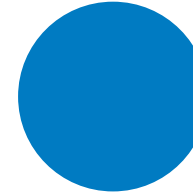
Methane^[5]
49,9 (mg/l)



Heavy Fuel Oil^[3]
79 (mg/l)



Diesel^[4]
65 (mg/l)



Gasoline^[2]
8,2 (mg/l)



[1] ECHA, European Chemicals Agency, registration dossier Methanol; [2] Petrobras/Statoil ASA, Safety Data Sheet, ECHA registration dossier Gasoline; [3] GKG/ A/S Dansk Shell, Safety Data Sheet; [4] ECHA, European Chemicals Agency, registration dossier Diesel; [5] ECHA, European Chemicals Agency, registration dossier Methane

Methanol better than

- Diesel by factor 240
- Gasoline by factor 1900

... Methanol properties

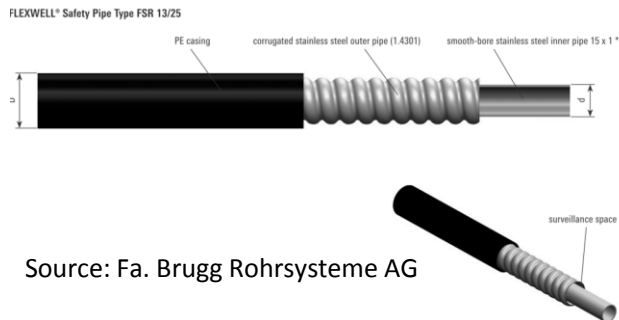
- For the environment **far less hazardous** than gasoline, diesel or heavy fuel oil
- Rapid mixing and dilution with water
- Aquatic plants and bacteria **biodegrade** Methanol **without residue**
- Methanol is **not more dangerous** than diesel, gasoline or LNG
- Poisoning reliably treatable **by simple means**. In particular, it is **not carcinogenic**
- Methanol itself has **no Global Warming Potential** (unlike Methane)

Methanol features unsuspected positive properties

Components & solutions

Use of standard Technology:

- couplings and tank equipment
- pumps, filters, valves
- double walled piping
- ATEX conformity
- inerting
- etc.



Source: Fa. Brugg Rohrsysteme AG



Methanol technology is onshore established since decades

New-build & Conversion

Methanol suited for all converters

- combustion engines
- gas turbines
- fuel cells



Engine availability

- ☒ Low speed (2-stroke)
- ☒ Medium speed
- ☒ High speed engines



Tank and fuel systems are easy

- Therefore new-build & conversion of existing ships are simple

MEYER WERFT GmbH & Co. KG

Industriegebiet Süd
26871 Papenburg
Tel. + 49 4961 81-7278

daniel.sahnen@meyerwerft.de
www.meyerwerft.de



Copyright MEYER WERFT GmbH & Co. KG, Papenburg, Germany. All rights reserved. This document is the sole intellectual property of MEYER WERFT GmbH & Co. KG and shall not be brought to the knowledge of any third parties neither in original nor by any reproduction and in each case neither as a whole nor in parts without the prior written consent of MEYER WERFT GmbH & Co. KG.