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Danube Business Talks 2024

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Green Vessels – Concepts for Inland Navigation

- Short Introduction of „Kanzlei Anzböck“
- Current developments in new ship design/technology
- Current developments in retro-fitting design /technology
- Presentation of project-related highlights
- Outlook on further development

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1. Short introduction of „Kanzlei Anzböck“

Kanzlei Anzböck was founded in 1980. The office has 7 employees, 3 of whom are civil engineers, 2 for marine engineering and one for mechanical engineering

The office specialises

- in the design of ships and floating structures,
- project design for floating structures
- supervision of new buildings and conversions
- expertises concerning the approval of ships, floating devices, small vessels and recreational craft,
- inspection of tankers in accordance with ADN regulations,
- Cooperation with the European bodies for the technical regulations for inland waterway vessels
- training of ADN experts

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2. Current developments in new ship design/technology

a) Current development of hydrodynamic optimization

aa) Optimization of hull forms: Parameters

- Breadth of locks and channels: Europa IIb: 11,45 m; breadth can be increased → no possibility in locks with convoys, passage through the Rhein-Main-Donau-Kanal not possible (limit: 11,45 m)
- Length limited by longitudinal strength because of relatively low height of inland waterway vessels and by lock dimensions
- Draught limited by the operation area
- Optimization of forebody lines → reduction of loading capacity
- Optimization of aft body lines → less displacement in the aft body → pronounced stern trim in ballast condition
- Conclusion: high block coefficient for high loading capacity → high resistance

ab) Optimization of propulsors

- Propeller diameters limited by light ship draught and water depth → tunnels
- Free running propellers: limited thrust
- propellers in nozzles → higher propeller thrust, lower propeller diameter, increased resistance due to nozzles at speeds exceeding approximately 11 km/h
- Chance for improved propulsive efficiency → paddle wheels (side wheels, stern wheels)

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ac) General remark on efficiencies:

Efficienc losses because of a bow thruster: between 3,5 and 5%
Efficiency losses in a gear box: between 2 and 3,5%
Efficiency loss in a shaft bearing: 0,5%
Efficiency loss in a mechanical Z-Drive: between 8 and 10%
Effinciency loss by use of a Diesel engine: 56% (abt. 44% efficiency)
Efficiency loss by use of a propeller: between 40 and 55% (propeller efficiencies between 60% and 45%
Propulsive efficiencies (propeller-, hull- and relative rotative efficiency together: between 35 and 45 %

Example:
single screw motor vessel:
Engine: 44%
shafting and gear box 5% of 44% = 2,2%:
Propulsive efficiency: 40% of 41,8% = 16,72%

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ac). Use of alternative materials

- High tensile steel:
  Advantages: # less weight, higher loading capacity
- Aluminium:
  Advantages: # less weight, higher loading capacity
  Disadvantage: # higher production costs

b) Current development in new ship powering technology

- Diesel engines: no attempts to improve the efficiency of ship Diesel engines noticed (reason: stage 5 engines optimized according to current state of the art).
- Gas-Engines: see item 4

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3. Current developments in retro fitting design/technology

a) Current development of hydrodynamic optimization

aa). Hydrodynamic developments:

- not really possible because of 2a,aa)
- Proposals:
  - Anchors not in the water: closure of anchor niches required: reduction of power consumption: up to 5%
  - careful composition of convoys, i.e. barges configuration : stern by stern; barges with lower draught upstream of barges with higher draught: power savings up to 10%

b) Current development in retro fitting ship powering technology

Alternative fuels:

Gas Engins

Dual Fuel Engins

Fuel Cells

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4. Development in technology:

Challenges for the use of alternative fuels on river-going ships
Alternative fuels:

a) LNG:

most widespread in ocean shipping, for four stroke gas engines following the OTTO principle and 4-stroke DF motors;, only minor use in inland waterway shipping

Advantages: # up to 25% less CO_2 emission

Disadvantages: # high NO_x emissions
possible high Methan emission depending on Methan slip of engines and quality of exhaust aftertreatment
required tank capacity 1, 8 to 2,5 times the tank capacity of Diesel
engines have slightly lower efficiency than powered with Diesel (approx. 3%)
conversion of existing engines problematic (NRMM, Stage V required)

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full compliance with ES-TRIN Art 30, e.g.

- Second independent propulsion system for maneuvering and 6,5 km ahead speed
- LNG containment system separated from the engine room
- Tank positions under deck: >1,0 m from ship side walls,
  Tanks with double wall and double bottom >0,6 m
  Tanks on open decks: > B/5 from the side walls
- Boundaries of LNG fuel tank rooms A60
- Engine room: Gas safe, explosion safe or ESD-protected

high costs
no bunker stations (infrastructure) along the Danube
Crew qualification necessary

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b) Hydrogen:

for Hydrogen combustion engines, Gas turbines, or fuel cells with electric motors,

minor use in ocean shipping, extremely low usage in inland waterway shipping

Advantages; # no CO_2 emissions

Disadvantages:
energy content of compressed Hydrogen (700 bar):1/7 of Diesel storage capacity of hydrogen 7 x larger than Diesel
energy content of cryogenic Hydrogen (-252,9°C):1/4 of Diesel
storage capacity of cryogenic hydrogen 4 x larger than Diesel
hazards to structural integrity of the vessel in case of spillage
crew qualification necessary
extremely high costs
no bunker stations (infrastructure) along the Danube

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c) Methanol: for combustion engines or fuel cells with electric motor

Remark: only e-Methanol is carbon-neutral fuel

Advantages: # between 20% and 25% less CO_2 emission

Disadvantages:
toxic
Energy content of Methanol: 1,6 to 1,97 times less than Diesel
storage capacity of Methanol 1,6 to 1,97 times larger than Diesel
high Methan, NO_x and SOx emission depending on the quality of the used aftertreatment system; values comparable to IMO TIER II can be achieved
high costs
no bunker stations (infrastructure) along the Danube

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d) HVO 100: for use in conventional Diesel engines

Advantages:
up to 90% reduction of CO_2
fully compatible with conventional Diesel fuel
immediate use possible
no engine conversion necessary
no conversion of fuel oil bunkers necessary

Disadvantages:
slightly more expensive than Diesel fuel
low availability

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5. Presentation of project-related highlights

LNG
„Star Princess

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LNG
„Icon of the Sea“

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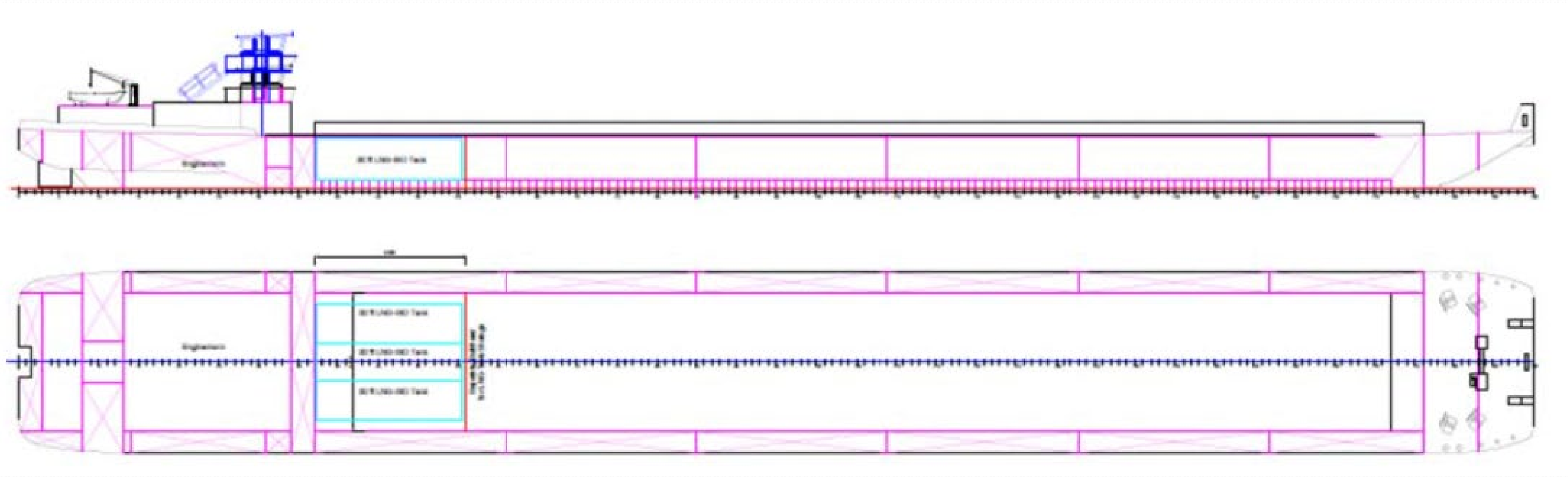
LNG
Storage of 30‘ tank containers on a river-going motor vessel; example



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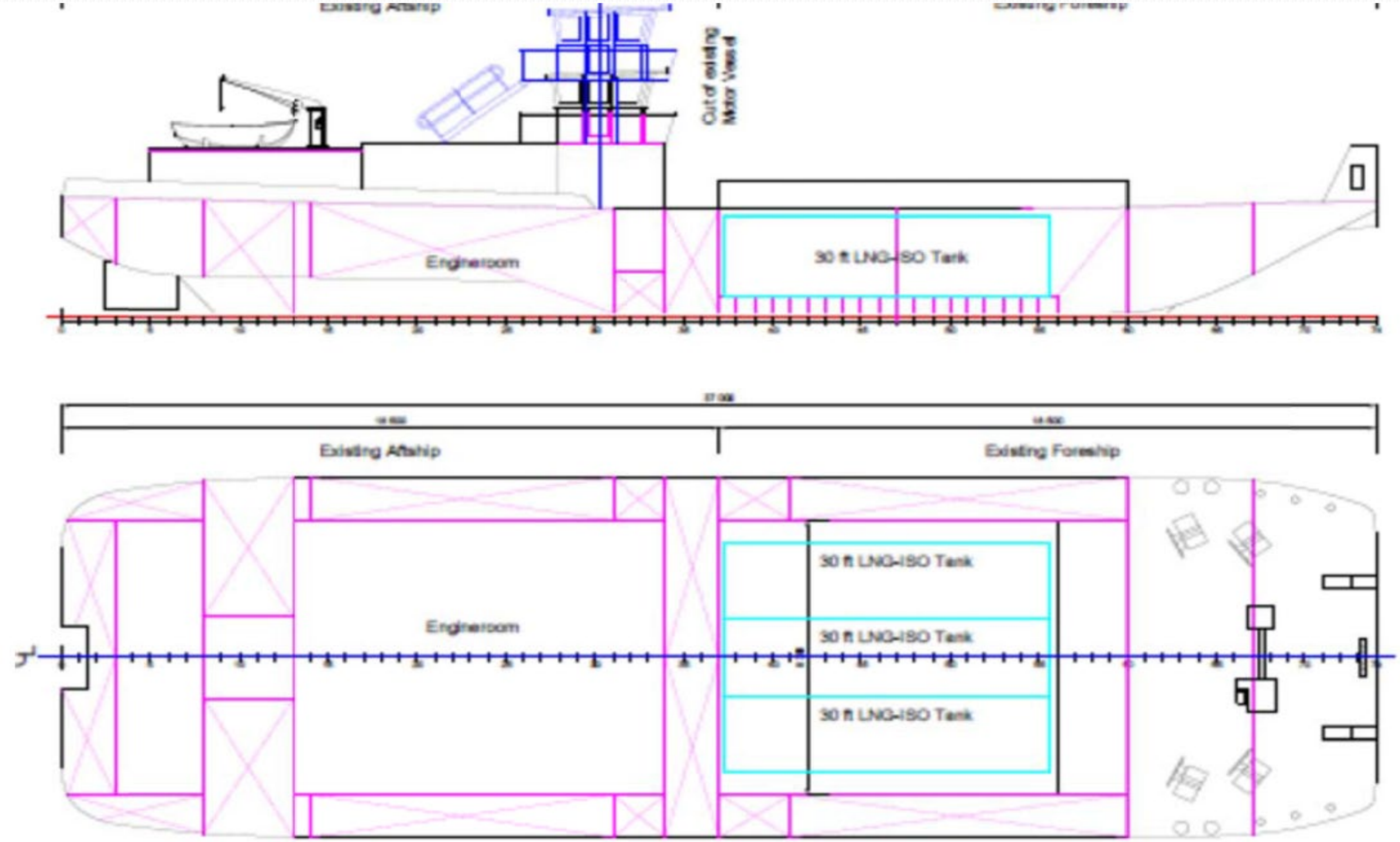
LNG
Example for the storace of 30‘ tank containers on pushers



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Hydrogen
H2-Barge 1

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Hydrogen –Internal Combustion Engine

Development of power and energy management systems for fuel cells and hydrogen powered ships

Methanol – Internal Combustion Engine

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Thank you for your attention