Exhaust aftertreatment for inland waterway vessels

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Tehag Group

- Tehag Engineering AG founded in 1991 in Switzerland
- Since 1993 specialisation on exhaust aftertreatment for Diesel engines
- Starting with SCR for stationary applications
- Since 2005 production of the own DPF and SCR-Systems
- Ceritfied by Swiss VERT and German TÜV
- Since 2010 business unit for Muffler
Our markets

• Stationary Engines (Emergency, CHP)
• Buses
• Agriculture vehicles
• Construction vehicles
• Material Transportation
• Trucks
• Railway vehicles
• Ships
Why exhaust aftertreatment

- Mechanical Energy
- Heat
- Noise (dB/A)
- Exhaust (PM/HC/CO/CO₂/NOₓ)

Diesel
Air
Harmful Engine Emissions

- Muffler

- PM/PN/particles
  - Wall-Flow Filter

- Gaseous pollutant
  - Carbon monoxide (CO)  →  Oxidation catalyst
  - Hydrocarbons (HC)  →  Oxidation catalyst
  - Nitrogen oxide (NO/NO₂)  →  SCR-system
Harmfull Engine Emissions

• Composition of Diesel soot

Figure 2: Secondary electron image of a typical soot agglomerate.
DPF-Technology

- The wall-flow concept
Regeneration methods

• DPF with passive regeneration
  - CRT System

• DPF with active regeneration
  - fuel burner
  - HC-dosing
  - electric heating
  - fuel additive

• DPF with no regeneration
  - only for short time operation
passive regeneration

- CRT-concept
  - continuously regeneration technology
  - catalytic coating with platinum
  - oxidation of carbon to CO$_2$
  - side effect oxidation of HC and CO aswell to CO$_2$ ans H$_2$O
  - automatic regeneration starting at 250° C
  - Tehag product CWF-particlefilter
passive regeneration

• Requirements for a proper function:
  - app. 30% of the engine duty exhaust temperatures higher than 250°C
  - Fuel quality DIN EN 590, sulfur content max. 350 ppm
  - Use of lube oil with less ash
  - Maintenance of the engine
  - Slight oil consumption
  - Proper maintenance of the DPF
  - Permanent filter function control
active regeneration

- **Fuel burner**
  - Injection of Diesel in the Exhaust
  - Ignition by a glow plug
  - Increasing the exhaust temperature up to 650 °C
  - Burning process of the soot (Carbon)
active regeneration

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  - Maintenance of the engine
  - Slight oil consumption
  - Proper maintenance of the DPF
  - Permanent filter function control
  - Heat insulation
NOx-reduction

• SCR-technology
  - Selective catalytic reduction
  - Longterm proven solution to reduce NO & NO₂
  - Urea (Ad-blue) as reactant
  - Catalyst with special coating
  - Automatic control for the injection of Urea
  - Retrofit solution without connection to the engine control
  - Working temperature approx. 220° C
NOx-reduction

- Principal of operation:

$NO_x (g) + NH_3 (g) \rightarrow N_2 (g) + H_2O (g)$

$4 NH_3 + 4 NO + O_2 \rightarrow 4 N_2 + 6 H_2O$

$4 NO_2 + 8NH_3 \rightarrow 7N_2 + 12H_2O$
Examples

• MS Max Prüss

• Engines 2x MAN D2876 / 250 kW each

• Systems installed 2015
Examples

- MS Linz
- Engines 2x Scania DI 13 / 331 kW each
- Systems installed in 2012
- In total 6 boats were made
Examples

- LS Fritz
- Engine Scania DI 13  331 kW
- System installed 2016
1. Control Cabinet
2. Sootfilter for Auxilliary engines
3. Active Diesel Burn
4. Sootfilter for Main Engines
5. Exhaus Gas Piping Main Engines and Auxilliary engines
6. Compensator(s)
7. Silencer (planned)
8. Insulation

8. All exhaust gas pipes are insulated
conclusion

• Every engine produces harmful emissions
• There is long term proven aftertreatment technology available today to reduce soot, NOx, HC & CO very effective
• Selection of the technology depending on the operating conditions
• Proper function also depending on the maintenance of the engine
• Fuel and lube oil quality very important
Thanks a lot for your attention!

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