



“Heincke” sets new standard for Arctic going vessels

German research ship “Heincke” to be the first Arctic going vessel with diesel particulate filter and SCR catalyst

In early 2015 the German research ship “Heincke” left the ship yard “Motorenwerke Bremerhaven” after only two months with brand new, more efficient diesel engines, each equipped with a diesel particulate filter (DPF) and SCR catalyst. Thereby, it is the first seagoing ship worldwide which has its exhaust gases cleaned up by a combined system of DPFs and SCRs and runs completely on Marine Diesel Oil (MDO). This reduces its air pollutant emissions dramatically. The medium-sized Heincke mainly sails in the North- and Baltic Sea, the North Atlantic and in the Arctic.

Round about 50 per cent of Arctic going vessels are owned by or operated for public authorities

The unique eco system of the Arctic is under heavy threat not only because of green house gases heating the atmosphere in general but also because of the short lived climate pollutant Black Carbon (BC) which is the second main contributor to Arctic warming after CO₂. The black particles cover the white ice and snow surfaces where they reduce the ice shield’s reflection capacity (albedo) and increase its heat absorption – both effects accelerate the Arctic warming and melting of the ice. Black Carbon is a result of incomplete burning of fossil fuels or biomass and occurs for example from diesel engines, household heating or slash-and-burn farming. Due to global wind patterns most Black Carbon in the Arctic stems from North America and Europe.

Even more, vessels sailing through the Arctic contribute significantly to the deposition of Black Carbon as they emit the air pollutants immediately in the sensitive area where the substance causes serious damage. Interestingly, round about 50 per cent of the ships in the Arctic are owned by or operated on behalf of national governments (e.g. research or ice breaking vessels). It is quite a contradiction that ships that on the one hand often have the purpose of investigating climate change on the other hand contribute to global warming just by fulfilling their mission. Therefore, governments are responsible for those vessels’ emissions and have to tackle them by installing comprehensive and effective exhaust gas abatement technology on board. The most effective and efficient measure is the use of low sulfur fuel and the installation of comprehensive emission abatement techniques onboard. Currently a diesel particulate filter and an SCR catalyst are state of the art.



Contact

NABU German Headquarters

Dietmar Oeliger
Head of Transport Policy

Tel. +49 (0)30.284984-1613
Fax +49 (0)30.284984-3613
Dietmar.Oeliger@NABU.de

Daniel Rieger
Transport Policy Officer

Tel. +49 (0)30.284984-1927
Fax +49 (0)30.284984-3927
Daniel.Rieger@NABU.de



Foto: AWI

Alternatively the ship could switch to alternative fuels or drives (e.g. LNG, fuel cell). These measures are ready for use and can be undertaken immediately, while effective regulations and measures from the International Marine Organization (IMO) or the Polar Code are still awaited.

Germany as first mover proves feasibility

The German Ministry of Education and Research in cooperation with the Alfred Wegener Institute for Polar and Marine Research gave order to retrofit its 25 year old ship "Heincke" with three new MAN Diesel engines (532 kW each) plus a DPF by Hug Engineering and an SCR catalyst. The technology reduces Black Carbon emissions by 99,9 per cent, sulphur emissions by about 90 per cent and nitrogen oxides by 70 -80 per cent. In order to integrate the DPF and SCR on board, a complete reshape of the smoke stack had to be done. Additionally, an air compressor and a urea tank needed to be installed in order to supply the SCR catalyst. Next to the retrofit of the "Heincke" the federal ministry announced its willingness to install the same technology aboard the new ice-breaking research vessel "Polarstern", too. Currently, other federal ministries also investigate the possibilities to equip their ships with exhaust gas abatement systems. In general, all German research ships sail on Marine Diesel Oil.

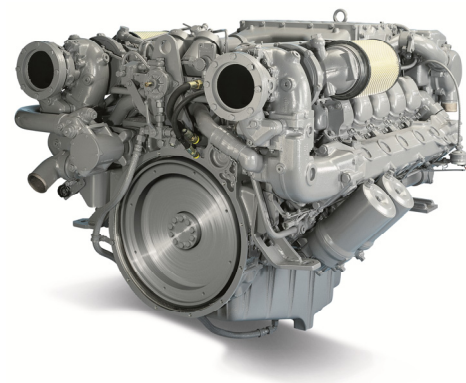


Foto: MAN Engines

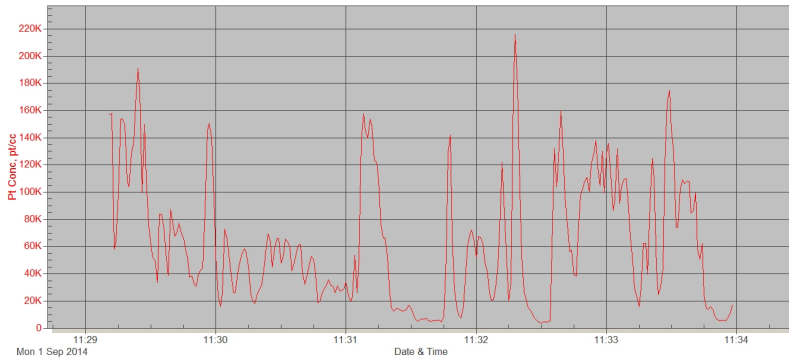
Environmental NGO pushed for filter solutions

Since 2011 Germany's biggest environmental NGO NABU (Nature and Biodiversity Conservation Union) is engaged in reducing air pollutants from ships. Besides its campaigns addressing cruise and container ships, NABU demands the (retro-)fitting of all 700 ships owned by the German authorities with a DPF and an SCR. In 2014, the environmentalists made public measurement campaigns supported by internationally recognised senior expert on transport and air pollution, Dr. Axel Friedrich. They found high numbers of particles next to the "Heincke" while the ship was at berth in the Norwegian port city and world heritage site Bergen. Since the ship was not equipped with the above named emission abatement techniques at that time, the measured concentration of particles was expectably high. The documentation of these findings was sent to the minister of education and research together with the demand to take exhaust gas abatement technology into account for all ships in her ministry's behalf. The minister – besides the retrofitting of the "Heincke" – committed herself to consider the request for upcoming overhauling and tenders for new ships. NABU intends to make measurements aboard or next to the "Heincke" in order to control and verify the system's proper operation respectively its emission reduction rates.

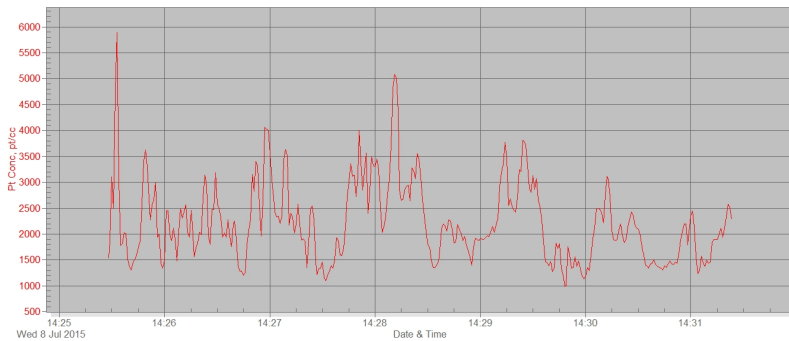
Measurements

In September 2014 NABU conducted measurements of ship emissions in the port of Bergen, Norway. The measurements were done by utilization of particle counter TSI P-Trak 8525 which shows concentration of ultra fine particles per cubic centimetre (pt/ccm) of air also referred to as particle number (PN). Compared to the measurement of particulate mass (PM_{2,5}; PM₁₀) the particle number (PN) refers to the amount of numerous but almost weightless and respirable ultra fine particles which are a more accurate indicator for health risks. Referring to PN hinders the overestimation of the bigger but less harmful particles which dominate the measurement of PM by mass. Ultra fine particle concentration has a high correlation with direct health issues like heart attacks.

One of the most polluting ships in the port of Bergen on the 1st of September 2014 was the German science ship Heincke. Measurements showed peak concentrations of 220,000 pt/ccm while concentration altered around 60,000 to 80,000 pt/ccm (see graph 1). The background concentration in the city of Bergen on that days was below 2000 pt/ccm. Even next to big roads with dense traffic the concentration is mostly below 10,000 pt/ccm. The PN concentration at the berthing ships were alarmingly high and entail an immense health risk for inhabitants and guests of the city.



Graph 1: UFP concentration 09/01/2015 Heincke, Bergen

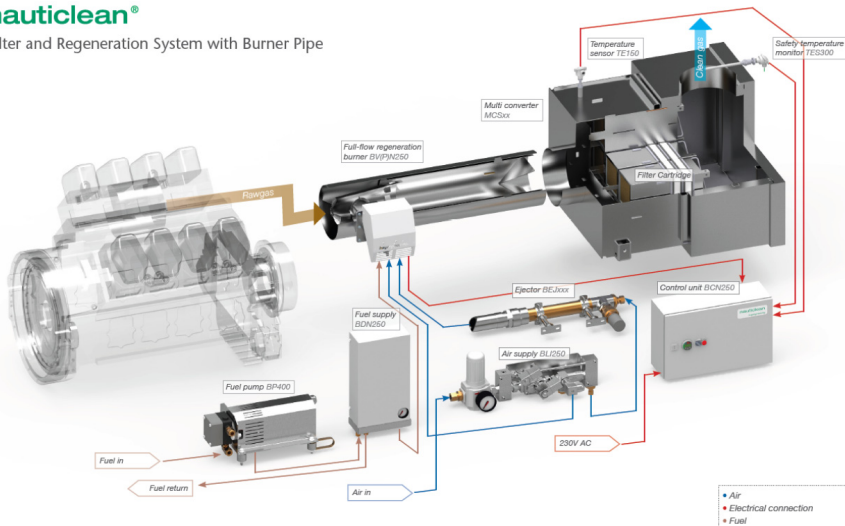


Graph 2: UFP concentration 08/07/2015 Heincke, Bremerhaven

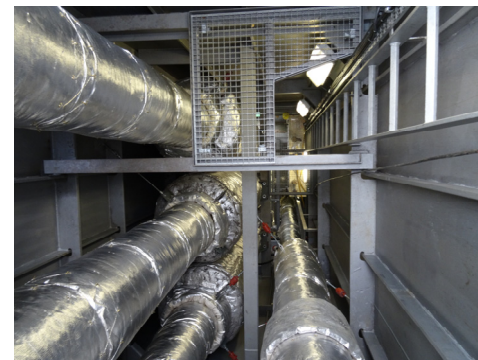
In Juli 2015 NABU conducted control measurements on board of the retrofitted "Heincke", this time in Bremerhaven, Germany. The results show very low concentrations of particulates in the direct surrounding of the ship. Next to the stack the measurements showed a concentration below 3000 pt/ccm which is at the same level as the local background concentration in the harbour (see picture). The findings confirmed that the DPF is working very well and are a verification for its feasibility to reduce Black Carbon emissions to almost zero.

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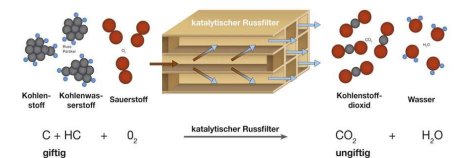
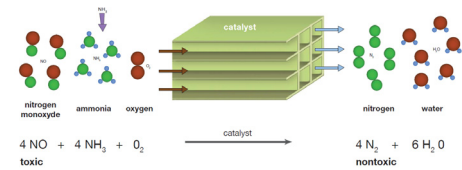


Particulate counter shows very low UFP concentration directly next to the smoke stack. Foto:NABU/Diesener



Inside smoke stack particulate filter Foto:NABU/Diesener

Selective Catalytic NOx Reduction SCR



SCR (above) and DPF. Scheme by HugEngineering

For more information go to: www.NABU.de/ships

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Text: Daniel Rieger, Sönke Diesener
Photos: Roland Krone/Alfred-Wegener-Institut, MAN Engines, Sönke Diesener