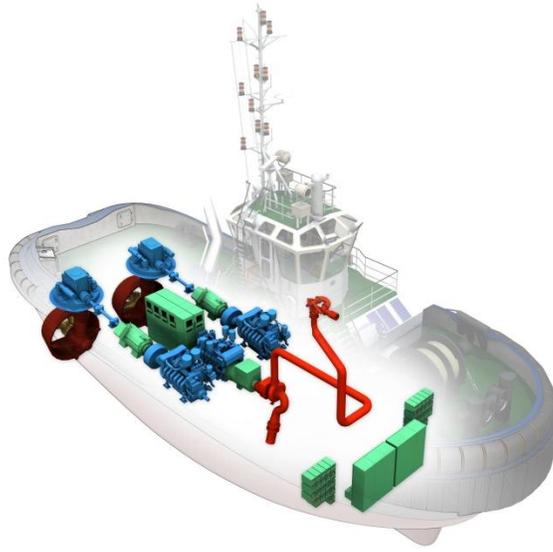


Damen ASD Tug 2810 Hybrid – INFO



RESULTS

Cutting fuel and emissions by at least 20%

Depending on the operating profile of a tug, the ASD 2810 Hybrid, which has a combination of diesel-direct and diesel-electric propulsion, facilitates average fuel savings of between 10% and 30% and cuts local emissions by 20 to 60%. The vessel has a bollard pull of 60 tonnes.

HISTORY

Extensive R&D – E3 Project

Already in 2009-2012 Damen and a number of partners ran a three-year E3-project (Environmentally friendly, Efficient in operation, Economically viable), whereby Damen and its partners monitored a conventional ASD Tug 2810 operating in the port of Rotterdam. The partners wanted to gather data on a typical harbour tug profile and see what was possible in terms of emissions and fuel cuts.

During the monitoring campaign the E3 team found that the average load profile showed that tugs are running inefficiently for most of the time. For up to 80% of the day they can be free sailing, station keeping, running idle essentially, and in turn, this makes them less environmentally friendly and leads to higher operational costs.

The diesel electric propulsion system in the ASD Tug 2810 Hybrid delivers enough power to prevent the main engines of the diesel direct propulsion system from running idle frequently or at low loads. During the E3 project Damen's Research Department made a computer simulation model to analyse various propulsion trains. Damen can use this simulation model to calculate the exact savings that are possible from the Hybrid in each individual case, based on the tug's operating profile and running hours.

Based on the findings and after looking at various battery, LNG, hydrogen and compressed natural gas solutions, the Hybrid emerged. NOx, HC, CO, SOx, CO2 and particles all decrease substantially, as does fuel consumption.

“Being green has to be commercially attractive”

Erik van Schaik, Design & Proposal Engineer, Damen Tugs says: “In the past many green solutions were simply too expensive for the tugboat market. We were very mindful that this vessel had to cut fuel and emissions, but at the same time it had to be positioned at an attractive price for the market. We wanted to make being green commercially attractive too.”

And indeed, he adds, fuel costs are not getting any cheaper, so the company is making considerable fuel savings as well. “The investment in the Hybrid version is higher but not excessively so. The Hybrid represents an extra investment of approximately 10% more than the regular ASD Tug 2810”, stresses Mr Van Schaik.

CHARACTERISTICS

Battery option

As an option, Damen is also offering a battery pack whereby it is possible to shut down all the engines during station keeping, manoeuvring and free sailing at low speeds, making the vessel even more environmentally friendly. Battery packs of 100 kWh each are likely to be provided, which allow the vessel to sail up to 5 knots. “Batteries make it much more comfortable for the crew because when they are asleep, energy is coming from the batteries so there is no noise or emissions”, says Mr Van Schaik.

Solar panels

Solar panels are added to the deckhouse on the Damen standard version and these are used to charge the 24V battery packs for starting the engines and emergency power for navigation lighting and radio equipment. Other green initiatives on the vessel include LED lighting, and a special paint coating, making the vessel more environmentally friendly and clean for at least five years.

Proven technology - propulsion

Damen wanted to use tried and tested technology for the ASD Tug 2810 Hybrid. One additional clutch has been added to the vessel and a 230 kW water-cooled electric propulsion engine between each main engine and the rudder propeller. One fire-fighting/generator set is installed to feed the electric propulsion engines or to drive the 1200 m³/hr fire-fighting pump. The generator/fire-fighting set engine is fitted with an exhaust gas after-treatment system consisting of a Selective Catalytic Reduction (SCR) system, a Diesel Oxidation Catalyst (DOC) and a half open, Diesel Particulate Filter (DPF).

The fire-fighting/generator set engine can deliver 695 kW at 1800 rpm and is fully compliant with the IMO Tier 3 regulations being introduced in 2016. Each main engine has a maximum power of 1840 kW at 1600 rpm and is IMO Tier 2 compliant.

OPERATING MODES

The captain can choose one of the following operating modes from the wheelhouse and then the Hybrid Control Unit manages everything automatically.

- **Stand-by mode** (only in combination with the optional battery pack)
All diesel engines will shut down and the battery pack feeds the normal electric system and the electric propulsion engines that are driving the rudder propellers. When the battery pack becomes empty the system will switch to free sailing mode automatically and the battery pack will be charged. The stand-by mode can be used for station keeping, manoeuvring and free sailing at speeds of up to 5 knots.
- **Free sailing mode**
The generator/fire-fighting set starts and feeds the electric propulsion engines that are driving the rudder propellers. The main engines are not running and the auxiliary generator set is feeding the normal electric system. The free sailing mode can be used for station keeping, manoeuvring and free sailing at speeds of up to 8 knots.
- **Towing mode**
Main engines start and drive the rudder propellers. The generator/fire-fighting set is not running and the auxiliary generator set is feeding the normal electric system. The towing mode has to be used during push/pull operations and free sailing of up to 13 knots.
- **Fire-fighting mode**
The fire-fighting mode has to be used during fire-fighting operations. Main engines start and drive the rudder propellers. Generator/fire-fighting set starts and drives the fire-fighting pump. The auxiliary generator set is feeding the normal electric system.

DAMEN ASD TUG 2810 HYBRID ® "REDUCED FUEL CONSUMPTION AND EMISSIONS"

Based on four years of intensive research in the E3 Tug project, a state of the art propulsion installation has been developed. The lessons learnt in this project are directly incorporated into the design. A method has been developed by the Damen Research department in cooperation with the Delft University of Technology to calculate the fuel consumption and emissions based on the operational profile of a vessel.

INNOVATIVE HYBRID DESIGN

The ASD Tug 2810 Hybrid can sail electric up to 8 knots, reducing the fuel consumption and emissions significantly. Electric motors on the main shafts are powered by batteries up to 4 knots and powered by an IMO Tier III compliant generator set up to 8 knots. The IMO Tier II compliant main engines are only running at higher speeds and during push/pull operations.

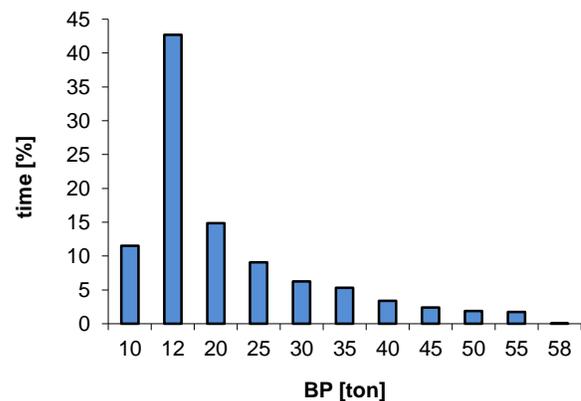
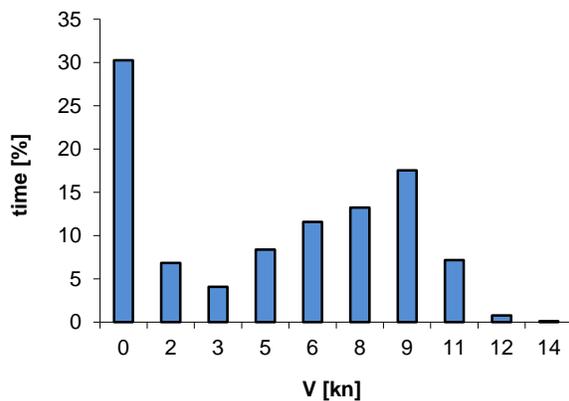
To determine the fuel consumption and the emissions of a tug, a calculation method is used which was developed by the Damen Research department in cooperation with the Delft University of Technology.

DETERMINING THE EQUILIBRIUM

A typical operational profile of a harbour tug was measured in the Port of Rotterdam on a standard Damen ASD Tug 2810. During the E3 Tug project measurements were performed to gain more insight on the true sailing profile of a tug.

It was found that a harbour tug almost never operates at high power or high speeds, i.e. 75% of the time below 8 knots and only 2% of the time maximum bollard pull.

The following operational profile was distilled from the measurements on an ASD Tug 2810 during 4 weeks and can be seen as a typical speed and bollard pull time distribution.



REDUCED FUEL CONSUMPTION AND EMISSION

Because the operational profile can change between customers, we are able to predict the reductions in an early stage. Up to **30%** reduction in fuel consumption was calculated with a true operational profile for the hybrid vessel, compared to the benchmark vessel (Standard ASD Tug 2810).

Up to **40%** reduction in emission of NO_x, HC, CO and up to **30%** reduction in emission of PM, CO₂, SO_x was calculated with a true operational profile for the hybrid vessel, compared to the benchmark vessel (Standard ASD Tug 2810). Therefore the ASD TUG 2810 HYBRID will have a lower environmental footprint.

Fuel and emissions compared to benchmark

