CSL CASE STUDY

BIODIESEL AS AN EFFECTIVE DECARBONIZATION TRANSITION SOLUTION FOR EXISTING SHIPS

To achieve decarbonization in the maritime industry at the scale and speed required to meet the goals of the Paris Agreement, readily available solutions are needed to reduce greenhouse gas (GHG) emissions for existing shipping fleets.

As part of its quest to precipitate the decarbonization of its ships, The CSL Group ("CSL") launched its biodiesel demonstration program in 2019 with tests on the auxiliary engine of one vessel in its Great Lakes fleet.

In 2020, the program progressed to testing on the main and auxiliary engines of two vessels, and in 2021, trials were conducted on eight CSL Lakers.

CSL's pilot project was successful in demonstrating the technical viability of biodiesel for existing marine engines and its efficacy as a transition fuel towards the decarbonization of the marine transportation sector.

Photo: Jason Desjardins

WHY TEST BIODIESEL ON SHIPS?

Biodiesel is a drop-in fuel option for vessels that does not require retrofitting or major modifications to ships or infrastructure. The fuel can be delivered through existing supply and bunkering facilities and, depending on the source of feedstock, can reduce well-to-wake greenhouse gas emissions by over 80%.

TESTING AND ANALYSIS

Over the duration of CSL's trials, various grades of biofuels were tested on bulk carriers and self-unloading bulkers on a range of engine loads and configurations. The fuel's NOx emissions were measured in accordance with EPA 7E, while sulphur content was measured in accordance with ISO 8754.

Emissions testing and fuel analysis was conducted at different bio-content concentrations to measure environmental compliance. In 2019, B50 fuel, a blend of 50% biodiesel and 50% marine diesel oil (MDO) was initially tested and increased to B80 fuel, a mix of 80% biodiesel and 20% MDO.

In 2020, the ships trials commenced with a B50 fuel, progressed to B80 and reached B100, which is pure biodiesel made of 100% bio-content second-generation biofuel. In 2021, eight CSL vessels used B100 continuously for a duration of five to eight months.

During each test, engine emissions were measured at 25%, 50%, 75% and 100% load according to their technical file, as well as at their normal operating loads to demonstrate a typical operation.

BIODIESEL SOURCE

Sourced in North America and supplied by Canada Clean Fuels, the biodiesel used during CSL's tests was produced entirely from waste plant material, specifically refuse soybean oil. The biodiesel is a FAME type, which stands for fatty acid methyl esters, and is produced by transesterification of the soybean oil. Production of biofuel did not affect food production or supply chains.

The carbon intensity of the selected biofuel was 1.8 gCO2eq/MJ, as measured through the Canadian GHGenius life-cycle emission inventory tool.

DUE DILIGENCE

Prior to commencing the biofuel trials and receiving approvals from the flag state and port state control, DNV was engaged to conduct a risk assessment. Mitigating actions were developed for the following identified risks:

- increase in NOx emissions
- waxing at cold temperatures
- spontaneous combustion of soaked rags
- low viscosity of the fuel
- degradation of the piping system
- loss of fuel conditioning module
- clogging of filters
- fuel degradation in storage tanks
- inadequate fuel treatment
- lube oil contamination.

FUEL PROPERTIES AND MEASUREMENTS

A biofuel standard for marine fuel does not currently exist at the concentrations used in CSL's trials.

The fuel was evaluated against ISO 8217:2017 with the exception of bio content, which was measured in accordance with EN 14103, a European standard for measuring high concentrations of biofuel.

All grades of biofuel and their properties were analysed, confirming their compliance with the values specified in ISO 8217:2017. As expected, FAME was measured at higher concentrations than the 7% allowed by the marine fuel standard. Additionally, while the standard allows for a pour point at -6°C, CSL's testing conditions were at temperatures that did not go below 0°C. During the trial, bunker tanks were not heated and tank temperature remained around 13°C.

RESULTS

CSL's tests successfully demonstrated that biodiesel is a technically viable and practical fuel option for existing ships to reduce well-to-wake GHG emissions and reduce SOx and NOx emissions below regulatory limits.

Among the findings:

- Total NOx emissions remained within Tier II limits for all grades of trialed biofuels.
- During B50 and B80 trials, NOx emissions were less than indicated in the technical file, suggesting that biofuels may be effective in reducing NOx emissions.
- The sulphur measured in all grades of trialed biofuels was below North America Emissions Control Area limits.
- SOx emissions were lower than the minimum measurable value of the vessel equipment.
- The carbon factor assessment demonstrated that even before a life cycle analysis is performed, biofuels can provide an immediate CO2 reduction of 11.7%.

CONCLUSION

Biofuels represent a viable means to reduce airborne emissions from shipping without a large capital investment from shipowners. The lack of technical issues associated with their use on vessels also make them a low risk option for shipowners and for the marine industry in general.

The CSL Group is a leading provider of marine dry bulk cargo handling and delivery services and the world's largest owner and operator of self-unloading vessels. Headquartered in Montreal with regional operations throughout the Americas, Australia, Europe and Asia, CSL delivers millions of tonnes of cargo annually for customers in the construction, steel, energy and agricultural sector.

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