



REPORT: PETERSON x GULF





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Better fuel,
better performance.
Better combustion,
better emissions.
XBEE: naturally better.



Context



In February 2018, the Dutch fuel supplier FinCo Fuel introduces a new fuel called [ChangeXL powered by XBEE](#). The company offers fuels treated with **XBEE Enzyme Fuel Technology** in Benelux, and its affiliate Gulf Bunkering B.V. distributes [Gulf Marine ChangeXL](#) in several ports in the Netherlands.

In September 2021, a few months after acquiring the [exclusive distribution rights of XBEE in Benelux](#), the fuel company decides to commission the European consultancy firm [TAUW](#), which field of expertise consists in environmental and sustainable advice, to conduct an emission study of the exhaust gas emissions from the main engine of the [Island Empress](#), then chartered by Peterson Energy Logistics company in Rotterdam, the Netherlands.

Measurements have been carried out without and with **XBEE** respectively on September 23, 2021 and January 13, 2022. The ship is a platform supply vessel (PSV – DP II) equipped with Rolls Royce Bergen C25 diesel engines, developing 2,400 kW each. They run on DMA.

The project has been led by Henk-Jan Heres from TAUW. The consultancy firm was in charge of measuring all gas emissions and certifying the whole process, weighing the specific fuel oil consumption (SFOC) data according to the IMO E3 test cycle. TAUW is accredited by the Dutch Council of Accreditation (RVA) in accordance with standard NEN-EN-ISO/IEC 17025.

Said project has been supervised by Roy Gebbink from XBEE Europe who designed the SFOC continuous monitoring solution using Kral flowmeters and Datum Electronics torque and shaft power measurement devices.

Data

1 | IMO E3 test cycle

The International Maritime Organization has developed several test cycles to compare technologies. In the case of the *Island Empress*, TAUW selected the E3 test cycle and have carried out gas emissions measurements in compliance with the ISO 8178-01 standard.

This test cycle applies to propeller-law-operated main and auxiliary engines, and details a measurement program and weighing factor when analyzing the final results:

E3 Test cycle				
Speed	100%	91%	80%	63%
Power	100%	75%	50%	25%
Weighing factor	0.2	0.5	0.15	0.15

2 | Measured parameters

TAUW have measured an extensive list of parameters, besides entrusting the fuel analysis to the ASG Analytik-Service laboratory in Germany:

- Flue gas temperature (°C)
- Speed (rpm)
- Power (kW and %)
- O₂ (%)
- CO (g/kWh)
- CO₂ (g/kWh)

Monitoring by Peterson

3 | Monitored parameters

The ship's crew, upon request of Peterson, has installed and configured a highly accurate measuring system of flow meters and torque meters. Power output in kW and fuel consumption in litres per hour have been continuously monitored and validated by TAUW as being consistent with the CO₂ emissions measurements.

23-09-2021 - ENGINE 1 (PS) RUN1									
LOAD	START	END	FC @15°C (l/h)	TORQUE (Nm)	Power (kW)	ENGINE RPM	TURBO RPM	FC/Nm	FC/kW
100%	13:28:00	13:31:00	434,86	20234,97	1842,09	867	36130	0,0215	0,2361
75%	14:03:00	14:06:00	351,77	15456,51	1426,56	879	32380	0,0228	0,2466
50%	14:28:00	14:31:00	264,10	9798,67	910,54	885	26990	0,0270	0,2900
25%	14:52:00	14:55:00	149,46	5021,94	469,83	891	19000	0,0298	0,3181
23-09-2021 - ENGINE 1 (PS) RUN2									
LOAD	START	END	FC @15°C (l/h)	TORQUE (Nm)	Power (kW)	ENGINE RPM	TURBO RPM	FC/Nm	FC/kW
100%	15:38:00	15:41:00	412,06	20143,57	1835,88	868	36010	0,0205	0,2244
75%	16:00:00	16:03:00	348,64	15413,95	1422,63	879	33100	0,0226	0,2451
50%	16:20:00	16:23:00	265,62	10213,35	948,00	884	26810	0,0260	0,2802
25%	16:41:00	16:44:00	156,25	4900,69	458,48	891	19170	0,0319	0,3408
23-09-2021 - ENGINE 1 (PS) RUN3									
LOAD	START	END	FC @15°C (l/h)	TORQUE (Nm)	FC/kW	ENGINE RPM	TURBO RPM	FC/Nm	FC/kW
100%	17:04:00	17:07:00	410,33	20221,57	1834,50	864	36170	0,0203	0,2237
75%	17:26:00	17:29:00	367,85	15217,05	1401,26	877	32680	0,0242	0,2625
50%	17:51:00	17:54:00	261,07	10091,41	935,63	883	26870	0,0259	0,2790
25%	18:11:00	18:14:00	151,39	5272,39	493,26	891	19460	0,0287	0,3069

13-01-2022 - ENGINE 1 (PS) RUN1									
LOAD	START	END	FC @15°C (l/h)	TORQUE (Nm)	Power (kW)	ENGINE RPM	TURBO RPM	FC/Nm	FC/kW
100%	11:54:00	11:57:00	395,69	18789,93	1724,35	874	34150	0,0211	0,2295
75%	12:48:00	12:51:00	349,30	15650,07	1446,07	880	31310	0,0223	0,2416
50%	13:18:00	13:21:00	226,30	9750,21	903,99	883	24890	0,0232	0,2503
25%	13:40:00	13:43:00	146,07	5249,76	490,59	890	17910	0,0278	0,2977
13-01-2022 - ENGINE 1 (PS) RUN2									
LOAD	START	END	FC @15°C (l/h)	TORQUE (Nm)	Power (kW)	ENGINE RPM	TURBO RPM	FC/Nm	FC/kW
100%	14:54:00	14:57:00	406,34	19245,23	1770,18	876	33980	0,0211	0,2295
75%	15:13:00	15:16:00	352,25	15612,13	1442,56	880	30740	0,0226	0,2442
50%	15:36:00	15:39:00	225,97	10289,04	957,19	886	24970	0,0220	0,2361
25%	16:07:00	16:10:00	131,34	5241,06	489,78	890	17270	0,0251	0,2682
13-01-22 - ENGINE 1 (PS) RUN3									
LOAD	START	END	FC @15°C (l/h)	TORQUE (Nm)	Power (kW)	ENGINE RPM	TURBO RPM	FC/Nm	FC/kW
100%	16:34:00	16:37:00	404,48	19892,26	1829,69	876	34030	0,0203	0,2211
75%	16:51:00	16:54:00	324,57	14985,56	1384,67	880	29460	0,0217	0,2344
50%	17:18:00	17:21:00	228,84	9969,02	926,37	885	24650	0,0230	0,2470
25%	17:34:00	17:37:00	130,64	5349,60	499,36	889	17140	0,0244	0,2616

Data analyses

Given the results measured and weighed by TAUW, we can ascertain the fact that **ChangeXL powered by XBEE** helps reducing significantly carbon dioxide emissions in diesel engines:

CO ₂ (g/kWh weighted*)	Test 1	Test 2	Test 3	Average
Without XBEE	944	941	951	945
With XBEE	685	696	684	688
Difference	-27.4%	-26.0%	-28.1%	-27.2%

Moreover, based on the IMO E3 test cycle, an average **reduction of fuel consumption by 6.47% was demonstrated**. Whereas this E3 test cycle is based on weighed averages where a 75% part load has the heaviest weighing (50%), it is quite common for ships to operate at lower loads which would improve even more the reduction of fuel consumption.

Part load	% reduction	Weighing factor	% reduction according to E3 test cycle
100	-0.56%	20	-0.11%
75	-4.37%	50	-2.19%
50	-13.64%	15	-2.05%
25	-14.16%	15	-2.12%
Total	-8.18%	100	-6.47%

Conclusions

As stated by John van Rijn from TAUW:

"It is important to understand that fuel consumption and CO₂ emissions are directly linked. Percentage reductions in fuel consumption are therefore directly applicable to the same reductions in CO₂ emissions.

These results are confirmed by actual measurements of CO₂ emissions in the exhaust system. Measurements took place at exactly the same time as the other measurements. Even after reducing the measurement uncertainties, the measurements of exhaust gases still exceeded the measurements of the flow and torque meters.

Finally, Peterson's own measurement data also shows that they save an average of 14% fuel in partial load operation, thus also achieving this CO₂ reduction."

It is clear, once again, that **XBEE Enzyme Fuel Technology** quickly pays for itself and provides further significant savings to all fuel consumers. Therefore, it offers a free solution to reduce all gas emissions, including CO₂.

CO₂

-27%

E3 SFOC

-6.5%

Real SFOC

-14%

XBEE Enzyme Fuel Technology is global partner with Green Marine environmental program and allows shipowners to improve the performance of their ships on at least three key indicators!



Annex

GHG measuring equipment



Annex

SFOC measuring equipment

