



REPORT: NAVIGASA





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



Context



The shipping company Naviera de Galicia S.A. operates three cargo vessels: the *M/V Mandeo* and the sisterships *M/V Finita R* and *M/V Manuela E*, all powered on intermediate fuel oil 180.

After having used a classic chemical additive during four years, the company decided to evaluate the **XBEE Enzyme Fuel Technology** on board the cargo ship *M/V Finita R*. The vessel is equipped with a Wärtsilä W6L32 main engine of 2,760 kW.

In order to ensure a precise and reliable monitoring of the evaluation, the following program has been carried out by the accredited laboratory Dekra:

- On September 20, 2011 gas emissions of the ship's main engine have been measured before the first fuel treatment with **XBEE**.
- On February 28, 2013 the engine emissions have been measured again after 1,680 running hours on **XBEE** IFO 180.
- In November 2013, the ship has been overhauled after a total of 21,268 running hours of the main engine.

Finally, on November 18, 2015 the laboratory Coterena embarked onboard the *M/V Finita R* to measure both gas emissions of the main engine for the third time after 27,992 running hours, and the specific fuel consumption.

This data has then been compared to Wärtsilä's own protocol data.



Data by Dekra

1 | Engine load

Although specific engine loads have not been recorded by Dekra engineers, the regular sailing load of the ship has been maintained for both the baseline and the comparative measuring campaign at around 65%.

2 | Measured parameters

Dekra engineer Agustín González supervised the monitoring and reporting of an extensive list of parameters:

- Flue gas speed (m/s)
- Humidity (%)
- Flue gas temperature (°C)
- Average gas flow (m³/h)
- O₂ (%)
- CO (ppm; mg/m³; kg/h)
- CO₂ (g/kWh)
- NO_x (ppm; mg/m³; kg/h)
- SO₂ (ppm; mg/m³; kg/h)
- COT (mg/m³)

3 | Weighing factor

On September 20, 2011 flue gas speed has been measured at an average of 15,020 m³/h. The same parameter has been measured at 15,498 m³/h on February 28, 2013. That represents an increase by 3.18%. In order to get more accurate results, all gas emissions of the second campaign have been pondered on a basis of 15,020 m³/h.

Data by Coterena

1 | IMO E2 test cycle

The International Maritime Organization has developed several test cycles to compare technologies. In the case of the *M/V Finita R*, Coterena followed the chapter 6 of procedures for NO_x emissions measurements. (Cf. MARPOL Annex VI Technical Code.)

E2 Test cycle				
Power	100%	75%	50%	25%
Weighing factor	-	0.62	0.19	0.19

2 | Measured parameters

Coterena inspectors have measured an extensive list of parameters:

- Power (kW)
- Speed (rpm)
- Specific fuel consumption (g/kWh)
- O₂ (%)
- CO (ppm)
- CO₂ (ppm)
- NO_x (ppm)
- SO₂ (ppm)

Gas emissions have then been translated into kilograms per hour.

3 | Weighing factor

All measurements have been weighted as per the engine manufacturer's protocol data.

Data analyses

Results reported by Dekra are straight forward and speak for themselves:

Parameters	Without XBEE	With XBEE	Diff.
Temperature (°C)	296	254	-14.22%
Flue gas speed (m ³ /h)	15,020	15,498	+3,18%
O ₂ (%)	13.0	14.7	+13.32%
CO ₂ (%)	6.5	5.4	-16.50%
CO (mg/m ³)	77.0	65.9	-14.41%
NO _x (mg/m ³)	1,866.0	788.9	-57.72%
SO ₂ (mg/m ³)	1,984.0	680.3	-65.71%

Whereas the same clear tendency to reduce gas emissions has been observed by Coterena, the most interesting results concern the specific fuel oil consumption:

Wärtsilä protocol	25%	50%	75%	E2 average
Power (kW)	690.0	1,380.0	2,070.0	1,676.7
Speed (RPM)	749.9	749.9	750.0	750.0
SFC (g/kWh)	230.68	198.91	190.71	199.90
Measured data	25%	50%	75%	E2 average
Power (kW)	675.3	1,477.8	2,065.3	1,689.6
Speed (RPM)	756.8	754.7	752.6	754.7
SFC (g/kWh)	205.0	181.1	189.0	190.5
Reduction SFC	-11.14%	-8.97%	-0.90%	-4.67%

Conclusions

CO₂

-16.5%

NO_x

-57.7%

E2 SFOC

-4.67%

Gas emissions measurements and specific fuel consumption data both show a significant improvement of the fuel combustion. The lack of correlation between -16.5% reduction of CO₂ emissions and -4.67% reduction of fuel consumption is explained by the fact that consumption is based on Wärtsilä's protocol data supplied by the laboratory.

On the field, engines always over consume after a few months of work, as carbon and soot build up in the engine. Although we do not have the specific fuel consumption of the ship before using **XBEE**, it is generally assumed that engines having worked more than 15,000 hours do consume more than the same brand new engine on the factory bench.

Moreover, the pictures enclosed in the annexes confirm the same, as we can see a clear improvement in cleanliness of pistons, valves, and rings.

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 location



November 29, 2013
21,268 working hours



November 29, 2013
21,268 working hours





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