REPORT:
Ferry auxiliary engines

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Contents

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

Introduction

As part of its ongoing research into technological advances that reduce airborne emissions, a maritime company in charge of operating ferry services out of Marseille launched an environmental study in collaboration with XBEE SA to look at atmospheric emissions from its electric generators.

The actual measurements were conducted by experts from Kali'Air, a company that specializes in measuring air pollutants and is both certified by the French Ministry of Ecology/ Sustainable Development/Energy and accredited by Cofrac (1-1848, 1-5567).

Prior to treatment with **XBEE Enzyme Fuel Technology**, a control trial was performed to collect data from a 1440 kW DMA BTS auxiliary motor known as the GE1 (a Wärtsilä model 8L20LF) just offshore Marseille on August 26, 2022.

Treatment of the GE1's settling tank then began on September 14. Following standard procedure, this was introduced as far upstream of combustion as possible (i.e., the storage bunkers) in order to maximize the allotted time for enzymes to act to clean the systems and fuel.

A second trial was then performed on October 21, 2022, a little after a month after the treatment process began.

Measurements

1 | Test Cycle

As the E3 test cycle recommended by the International Maritime Organization involved running the generator at a near-constant 75% load, the ferry company chose to simplify the experimental procedure in holding the load fixed for the entire span of measurements in both trials.

2 | Measurements

Experts from Kali'Air performed the following measurements:

- Average Speed (m/s)
- Average Humidity (% H_2O)
- Flue Gas Temperature (°C)
- Average Flow Rate (m^3/h)
- RPM
- Power (kW and %)
- O_2 (%)
- CO (mg/m^3)
- CO_2 (%)
- Total Volatile Organic Compounds (TVOC) (mg/m^3)

3 | Normalizing Data Between Trials

Reproduction of exact experimental conditions between the two trials was unfortunately not feasible, and significant variations in flow rate (m^3/h) due to inconsistent average gas velocities were readily observed on the instrument panels, as can be seen below (see appendix for instrumental panel screen shots).

Control Trial (Aug. 26, 2022)

- RPM: 24,639
- Average Speed: 17.10 m/s
- Average Flow: 3,886 m^3/h

Test Trial (Oct. 21, 2022)

- RPM: 31,963 (+29.73%)
- Average Speed: 26.53 m/s (+55.17%)
- Average Flow: 6,570 m^3/h (+69.07%)

This variation then required a normalization technique in order to perform a meaningful comparison between the two trials. To accomplish this, measurements in the test trial were simply weighted according to the measured flow factor. This method then also provided a basis to evaluate and compare hourly concentrations in gaseous emissions over time.

Analysis

Kali'Air's results show that **XBEE Enzyme Fuel Technology** produces a significant reduction in diesel engines' carbon dioxide, nitrogen oxides, and particle emissions.

Parameters	August 26, 2022	October 21, 2022*	Diff.
Humidity (%)	4.47	4.10	-8.21%
Temperature (°C)	385.33	332.27	-13.77%
O_2 (%)	12.83	7.12	-44.54%
CO_2 (%)	5.97	3.79	-36.56%
Particulates (mg/m³)	15.63	9.23	-40.98%
CO (mg/m³)	218.33	105.68	-51.60%
NO_x (mg/m³)	1,217.33	924.67	-24.04%
COVT (mg/m³)	88.17	39.90	-54.74%

**As discussed above, measurements in the October 21 test trial were weighted based on average flow rates.*

Furthermore, fuel consumption calculations based on observed GE1 performance factors:

- Control Trial (Aug. 26): 279.80 g/kWh
- Test Trial (Oct. 21): 230.00 g/kWh

show a 17.8% reduction in diesel fuel consumption.

Conclusions

CO_2

-36%

Particulates

-41%

Consumption

-18%

These results show equivocally that **XBEE Enzymatic Technology** had a positive impact on the electric generator's combustion and efficiency through both measured emission volumes and energy output.

The reduction of carbon monoxide/dioxide, nitrogen oxide, and particle emissions, as well as volatile organic compounds, is naturally symptomatic of a more complete combustion and reduced fuel consumption, and this was then confirmed independently by the company's own consumption calculations.

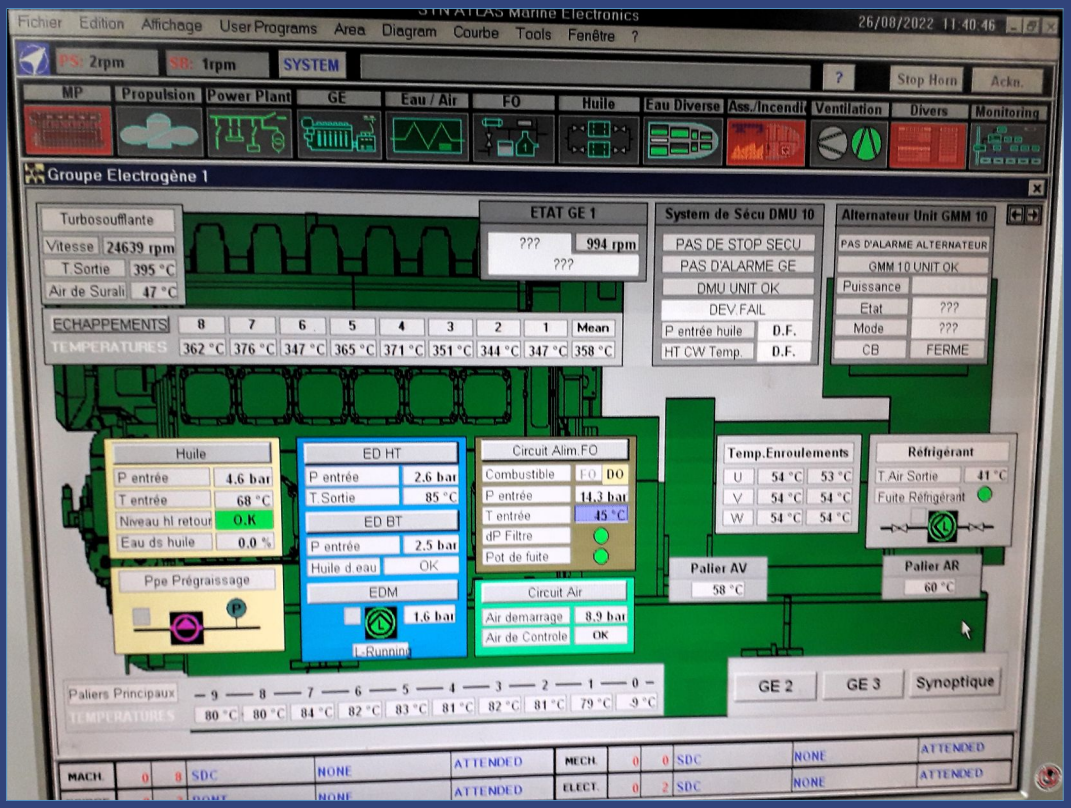
While elucidating a more exact normalization procedure between velocity and gas flow rate variation would require additional research, we still manage to see a prominent trend towards reductions in greenhouse gas emissions and fuel consumption.

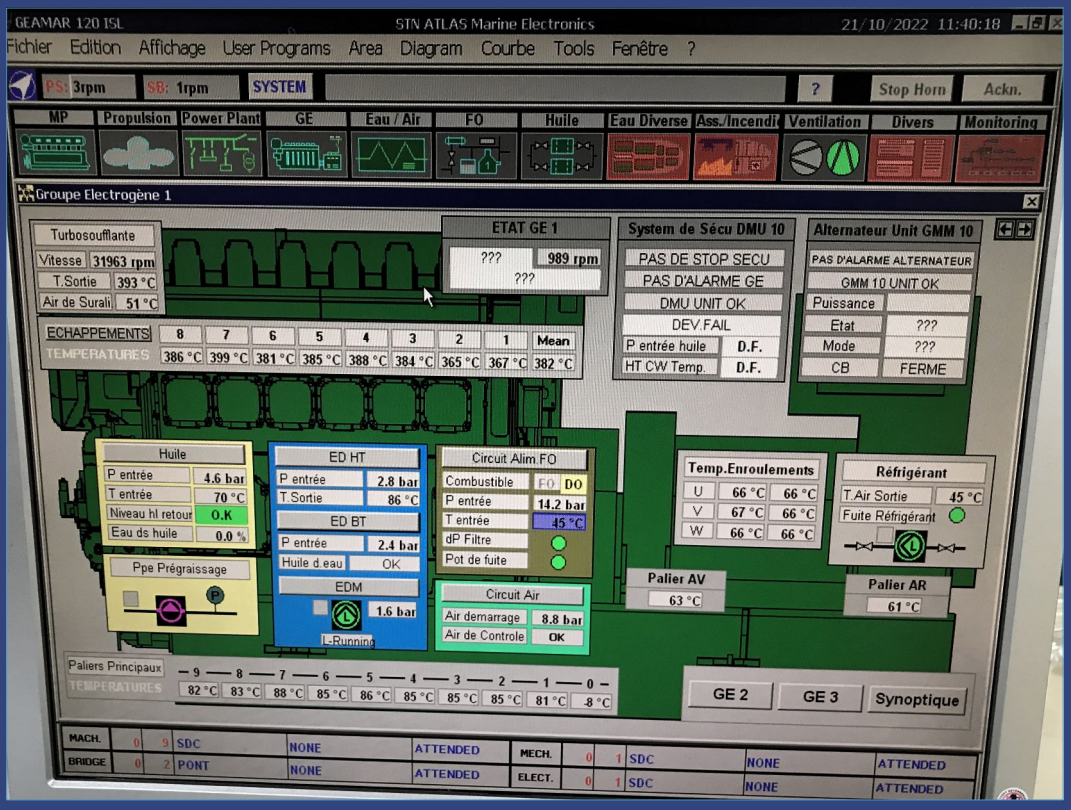
In addition, the same trends have repeatedly been verified in trials performed by diverse accredited laboratories, and on all engine and fuel types.

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!

Appendix

GE1 Instruments control panels





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