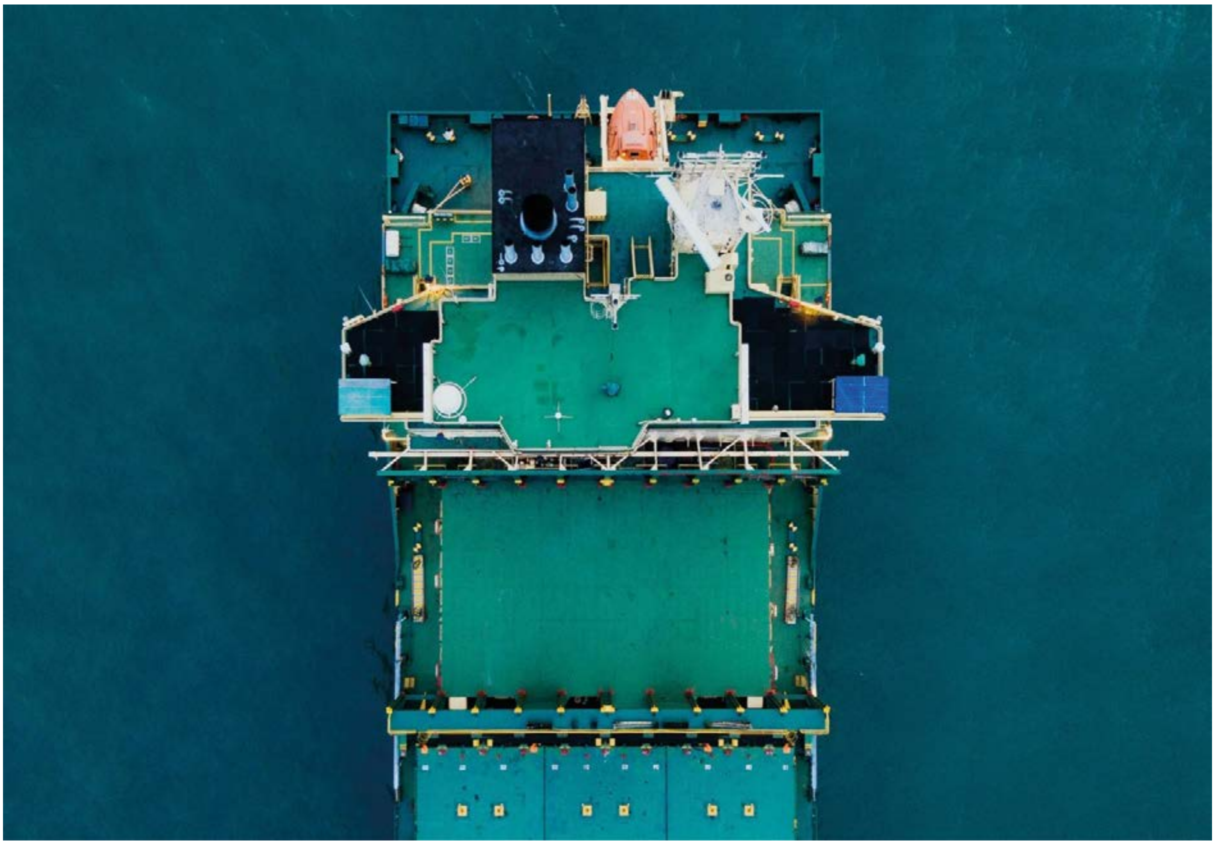
Marine fuel additive (SulNOx Eco) assessment

Company: SulNOx Group PLC

Report no: FOBAS/15-074/UM

17 March 2022

Lloyd's Register



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Date of approval:	
16.03.2022	

Version history	Date	Reason for Revision:
V_1	17 March 2022	Final report

Contents

1. Introduction

The client: SulNOx Group PLC ("SulNOx") requested Lloyd's Register (LR) Fuel Oil Bunker Analysis and Advisory Service ("FOBAS") to carry out an impact assessment of their marine fuel additive SulNOx Eco. The additive claims to improve marine fuel lubricity characteristic and engine performance and in turn, having a positive impact on rate of fuel consumption. Evaluating the improvements in fuel economy is not within the scope of this report.

The objective of this report is to provide an overview of the testing performed in the lab on six sets (3 distillate (DM) fuels + 3 residual (RM) fuels) of samples and commentary thereof. The testing programme was agreed between LR and the client as per proposal reference FOBAS/22-11.

2. Methodology

To test the additive for full ISO 8217 (table 1 and 2) parameters twice (i.e., with & without additive) require significant quantities for each set of fuel. LR FOBAS receives thousands of samples per month in their labs from around the world however a single leftover sample quantity is insufficient to be reutilised for full ISO 8217 testing. Hence, it was agreed to make composite samples for both DM and RM fuel grades in the lab by reviewing the database, picking out similar fuels in terms viscosity, density, sulphur and other characteristics. FOBAS prepared three sets (A, B, & C) of DM fuel and three sets (D, E, & F) of RM fuels. Due to huge variability in residual fuels and client's indication that the additive is expected to perform better for lower viscosity (<100 cSt @50°C), the selected RM blend viscosities were circa 30 cSt, 60 cSt and 90 cSt.

During the trial, DM fuels were subjected to ISO 8217 (table 1) parameters + Ignition Quality Testing (IQT – IP 498) whilst RM fuels were subjected to ISO 8217 table 2 parameters.

3. Results

The main objective of the trial has been to observe differences in the results after the selected fuels are additised with SULNOx Eco. Table 1 and Table 2 given below provides an overview of the results from the lab analysis.

3.1. DM results

- All the selected DM blends tested without the additive complied with the ISO 8217 (table 2) requirements. After dosing the fuels with 500ppm of SulNOx Eco, all three sets of fuels remain within the defined ISO 8217 limits. There were no significant changes observed with and without the additive on standard testing.

- Additional IQT (IP498) analysis to evaluate the ignition characteristic of the fuel does not show significant difference with or without the additive.

- For set B & C, there has been slight improvement in lubricity after adding SulNOx Eco however results are within the repeatability (as per precision statement defined in the test method) hence cannot be conclusively said to improve the results based on single test result.

Table 1: Test results for DM fuels

	Set A		Set B		Set C	
	BEFORE SulNOxEco	AFTER SulNOxEco	BEFORE SulNOxEco	AFTER SulNOxEco	BEFORE SulNOxEco	AFTER SulNOxEco
Sample Ref	895816	895833	895817	895834	895818	895835
Job Ref	223540511	225399311	223981311	225763011	221307611	223754811
Density @ 15°C	884.6	884.7	854.1	854.1	887.5	877.5
K Viscosity at 40°C	5.57	5.569	2.795	2.803	4.005	4.002
Flash Point	>70.0	>70.0	67	67	>70.0	>70.0
Pour Point	<-9	<-9	<-9	<-9	<-9	<-9
CFPP	5	6	<-9	<-9	3	3
Cloud Point	15	15	5	4	9	9
Ash	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Water Content	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Sulphur Content	0.087	0.085	0.045	0.044	0.074	0.074
Colour	Orange	Orange	Green	Green	Yellow	Yellow
Appearance	Clear and Bright	Clear and Bright	Clear	Clear	Clear and Bright	Clear and Bright
Total Sediment Existent	-	-	<0.01	<0.01	-	-
Cetane Index	43	42	46	47	44	43
MCR 10%	0.02	0.03	0.04	0.05	0.04	0.03
Total Acid Number	<0.05	0.06	<0.05	0.05	<0.05	<0.05
Strong Acid Number	0	0	0	0	0	0
Net Specific Energy	42.32	42.32	42.7	42.7	42.58	42.41
Gross Specific Energy	45.01	45	45.49	45.49	45.33	45.12
Lubricity	351	358	398	351	379	330
IQT (IP 498)						
Ignition Delay	4.6	4.56	4.7	4.71	4.72	4.73
Derived Cetane Number	45.1	45.3	44.1	44.1	44	43.9

3.2. RM results

- All three RM blends tested without the additive complied with the ISO 8217 (table 2) requirements. After dosing the fuels with 500ppm of SulNOx Eco, all three sets of fuels remain within the defined ISO 8217 limits.
- There were no significant changes observed with and without the additive on standard testing.

Table 2: Test results for RM fuels

	Set D		Set E		Set F	
	BEFORE SulNOxEco	AFTER SulNOxEco	BEFORE SulNOxEco	AFTER SulNOxEco	BEFORE SulNOxEco	AFTER SulNOxEco
Sample Ref	896445	896483	896446	896484	896447	896485
Job Ref	225060811	226628011	225060811	226628011	225060811	226628011
Density @ 15°C	930.6	930.5	928.5	928.5	902.9	902.9
K Viscosity at 50°C	97.2	96	60	59.2	28.6	29
Flash Point	> 70.0	> 70.0	> 70.0	> 70.0	> 70.0	> 70.0
Pour Point	21	21	27	27	18	15
MCR	7.13	6.96	3.94	3.81	0.15	0.14
Ash	0.03	0.03	0.021	0.019	< 0.010	< 0.010
Water Content	0.05	0.05	0.15	0.15	0.1	0.05
Sulphur Content	0.48	0.49	0.49	0.5	< 0.030	< 0.030
Total Sediment	0.06	0.07	0.02	0.01	< 0.01	< 0.01
Vanadium	19	20	2	6	< 1	< 1
Aluminium	9	7	15	15	< 1	1
Silicon	11	8	16	15	< 1	< 1
Aluminium + Silicon	20	15	31	30	< 2	< 2
Calcium	33	31	17	16	< 1	< 1
Phosphorus	2	2	< 1	< 1	< 1	< 1
Zinc	4	4	1	1	< 1	< 1
Sodium	13	12	10	10	< 1	< 1
Iron	11	11	12	7	< 1	< 1
Nickel	10	9	8	4	3	< 1
Magnesium	1	2	2	2	< 1	< 1
Lead	< 1	< 1	< 1	< 1	< 1	< 1
Potassium	1	< 1	1	1	< 1	< 1
Total Acid Number	0.22	0.23	0.41	0.33	0.26	0.2
Strong Acid Number	0	0	0	0	0	0
CCAI	807	807	812	812	798	798
Net Specific Energy	41.83	41.83	41.82	41.83	42.33	42.35
Gross Specific Energy	44.35	44.36	44.35	44.36	44.96	44.97

4. Conclusion

In summary, it has been observed during the testing that dosing various blends of DM and RM fuels with SulNOx Eco did not impact the ISO 8217 (table 1 & 2) fuel parameters. We understand that the primary benefits claimed by the additive manufacturer is the improvement in fuel economy. As a next phase, it is advisable that this aspect is assessed through either onshore or offshore engine trials. Please note, the comments made in this report are purely based on the selected fuel samples and tested in our lab and should not be taken in the context of type approval or technology validation which needs to follow a different protocol.

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