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PREVENTION OF AIR POLLUTION FROM SHIPS

Fuel Oil Quality and Quality Control of Bunkers – Relevant Data

Submitted by Norway and INTERTANKO

SUMMARY

Executive summary:	This document provides follow up information from proposals to BLG 15 on the impact of bunker quality problems reported by ships and identifies as examples some instances during the recent years
Strategic direction:	7.3
High-level action:	7.3.1
Planned output:	7.3.1.1
Action to be taken:	Paragraph 12
Related documents:	MEPC 61/4/7, MEPC 61/24; BLG 15/11/4 and BLG 15/19

Introduction

1 The Marine Environment Protection Committee, at its sixty-first session, instructed the BLG Sub-Committee to review document MEPC 61/4/7 (Norway and INTERTANKO) for further consideration (paragraph 4.26 of document MEPC 61/24). At BLG 15, the co-sponsors submitted document BLG 15/11/4 further elaborating on their proposals for the consideration of the Sub-Committee. As a result of the extensive discussions at BLG 15, the Sub-Committee called for more information and data to be supplied to enable appropriate consideration of the matters (paragraph 11.32 of document BLG 15/19).

Data Supply

2 Norway and INTERTANKO (the co-sponsors) have collected data relating to this issue reflecting the extent of problematic bunker supply for the recent years. This data was collected from two bunker testing laboratories and probably represents the status for roughly 50% of all bunker deliveries that are tested by shipowners worldwide. As an overview from one of the laboratories, and based upon the analysis of more than 100,000 bunker samples or bunkering events, the receiving vessels have reported that on 1,468 occasions they have had machinery problems as a result of using the fuels as supplied. When extrapolated to the total, this would represent a figure of approximately 1.4% of all bunkering worldwide.

3 As a result of using the bunkers received on board, the ships' reported problems for year 2010 can be further sub-divided into differing types of machinery problems and represented by the following pie chart in figure 1:

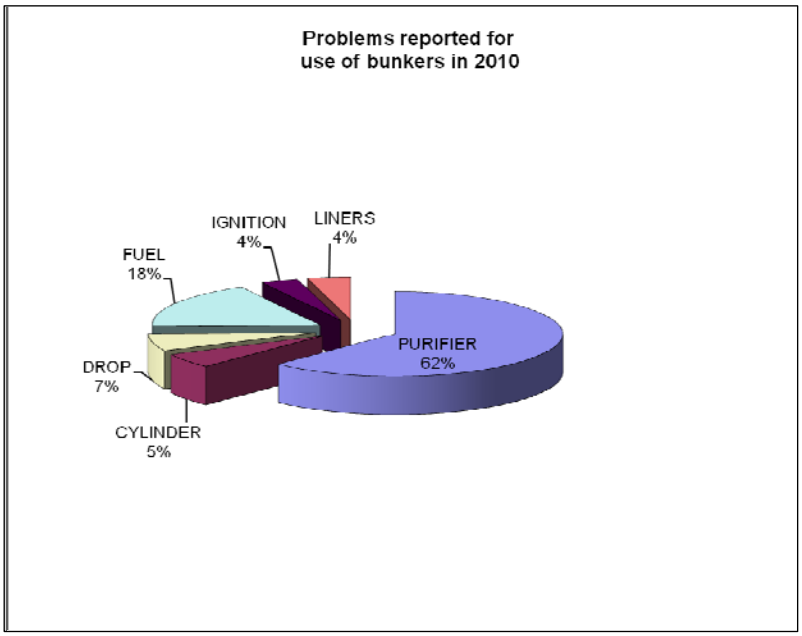

Figure 1: Problems reported for use of bunkers in 2010

Each of the sub-divisions shown in Figure 1 above can be correlated to typical issues with a bunker quality that could impact the safety of the ship and its crew. These circumstances can be further correlated to examples of specific events as set out in annexes 1 and 2 to this document.

4 Purifier – represents excessive sludging of the purifier or filter blockage leading to fuel starvation of the engine. Such problems could be caused as a result of one or more of the following parameters:

.1 High Density fuel;

.2 Excessive Cat Fines[1] – Aluminium/Silicon content – of the fuel;

.3 Excessive emulsions due to, amongst other reasons, the existence of Used Lubricating Oil or water content;

.4 Instability of the fuel; and

.5 Inclusion of oil from differing origins such as "shale oil" or bacterial growth.

[1] Cat Fines means the residues of a Catalyst as entrained in the fuel from Catalytic Cracking process in refineries.

5 Cylinder – represents fouling of the engine cylinders and exhaust system including turbo charger. This could be caused by incomplete combustion as a result of:

.1 High MCR[2]; and

.2 High CCAI[3].

6 Drop – represents a drop in engine power. This could be caused by ignition quality problems, fuel starvation due to partial filter blocking or fouling of the turbo charger and includes the following parameters:

.1 Ignition Quality;

.2 CCAI;

.3 MCR;

.4 Ash; and

.5 Water.

7 Fuel – represents fouling or damage to fuel pumps or injection systems. This could be caused by either or both:

.1 High content of Cat. Fines – Aluminium + Silicon; and

.2 Chemical contamination of the fuel.

8 Ignition – represents events relating to ignition problems or poor ignition. Such events could be caused by:

.1 Poor ignition quality of the fuel;

.2 CCAI; and

.3 Viscosity problems.

9 Liners – represents high liner and piston ring wear as a result of the use of the fuel. Such events could be caused by:

.1 High content of Cat. Fines – Aluminium + Silicon; and

.2 High molecular weight compounds such as the asphaltene content of the fuel.

10 Annexes 1 and 2 to this document supply examples of a selection of incidents related to poor quality bunkers that exposed ships and crew to unsafe situations. The examples provide the number and details of ships involved with each event together with details of the event and problems encountered as a result of the bunkering of the ships.

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2 MCR means Micro Carbon Residue and relates to residues from combustion.

3 CCAI means Calculated Carbon Aromaticity Index and can be associated with the ignition and combustion characteristics of a residual fuel oil.

11 These incidents and data have prompted the co-sponsors to submit documents MEPC 61/4/7 and BLG 15/11/4 with suggested actions aimed to an improved enforcement of current MARPOL Annex VI regulations, particularly 18.1, 18.9.4 and 18.9.6.

Action requested of the Committee

12 The Committee is invited to consider this additional data when discussing the report from BLG 15 (BLG 15/19) with regard to the need of proper enforcement of the current MARPOL Annex VI requirements on fuel oil quality and the need for further improvement of the IMO regulatory regime on fuel oil quality, and take appropriate action.

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ANNEX 1

MAJOR PROBLEM

Major problem fuel cases in 2010

Date of Bunkering	Number of vessels involved	Type of bunker (ISO classification)	Sulphur content of the bunker (% wt)	Bunkering port	Flag State of ships	Summary of reported problems and engine damage	Cause
January-10	4	RMG 380 (x3), RMG 380 LS (x1)	1.20%, 1.51%, 1.61%, 1.61%	Rotterdam, Antwerp, Zeebrugge (x2)	Greece, Cyprus, Liberia, Belgium	Rapid filter choking, purifier sludging	Chemical Contamination detected by GCMS
April-10	3	RMG 380	2.47%, 2.48%, 3.59%	New Orleans (x1), Houston (x2)	Panama (x1), Liberia (x2)	Fuel pump jamming, Rapid filter choking, Damage to fuel valves	Chemical Contamination detected by GCMS
May-10	2	RMG 380	0.96%, 0.98%	Lagos, Nigeria	Marshall Islands (x2)	Fuel pump jamming, injector problems, filter clogging	Chemical Contamination detected by GCMS (including waste/offspec biodiesel)
May-10	2	RMG 380	1.84%, 2.47%	Mobile, Houston	Panama, Liberia	Fuel pump jamming, Rapid filter choking	Chemical Contamination detected by GCMS (including waste/offspec biodiesel)
July 2010 to August 2010	4	RME 180 (x2), RME 180 LS (x1), RMG 380 (x1)	1.03%, 1.8%, 2.06%, 2.16%	Rotterdam (x3), Amsterdam (x1)	Liberia, Panama, Marshall Islands (x2)	Fuel pump jamming, Rapid filter choking	Chemical Contamination detected by GCMS

Date of Bunkering	Number of vessels involved	Type of bunker (ISO classification)	Sulphur content of the bunker (% wt)	Bunkering port	Flag State of ships	Summary of reported problems and engine damage	Cause
September-10	2	RMG 380	2.27%, 2.66%	Cotonou, Benin	Bermuda, Liberia	Fuel pump seizure	Chemical Contamination detected by GCMS (including waste/offspec biodiesel)
Throughout 2010	7	RMG 380	2.21%, 2.23%, 2.26%, 2.44%, 2.69%, 3.09%, 3.45%	Singapore	Singapore (x4), Panama (x2), Bahamas (x1)	ME Piston Ring breakage, in some cases purifier sludging	Combination of high asphaltene (>10.5%), high MCR (>11.5%) and high CCAI (>848)
	3	RMG 380	2.40%, 2.79%, 3.10%	Gibraltar	Bahamas, Panama, Singapore	ME Piston Ring breakage, in some cases purifier sludging	
	3	RMG 380	2.17%, 2.35%, 3.47%	Piraeus (x2), Elefsis	Greece, Panama, Bahamas	ME Piston Ring breakage, in some cases purifier sludging	
	1	RMG 380	1.5	Callao, Peru	Singapore	ME Piston Ring breakage, in some cases purifier sludging	
	1	RMG 380	3.31	Houston	Panama	ME Piston Ring breakage, in some cases purifier sludging	

Major problem fuel cases in 2009

Date of Bunkering	Number of vessels involved	Type of bunker (ISO classification)	Sulphur content of the bunker (% wt)	Bunkering port	Flag State of ships	Summary of reported problems and engine damage	Cause
Jan 2009 to Feb 2009	6	RMG 380	1.76%, 1.82%, 1.94%, 2.1%, 2.17%, 2.19%	Long Beach/ Los Angeles	Netherlands, Malta, Marshall Islands, Singapore, Liberia (x2)	Loss of power, major fuel pump wear	Highly acidic fuel with low pH and high SAN
April 2009 to June 2009	3	RMG 380	1.44%, 1.80%, 1.87%	Houston	Malta, Panama (x2)	Main Engine Filter choking	Chemical Contamination detected by GCMS (including waste/offspec biodiesel)
April 2009 to June 2009	3	RMG 380	1.59%, 2.19%, 2.47%	Panama	Panama, Hong Kong (x2)	Main Engine Filter choking	Chemical Contamination detected by GCMS (including waste/offspec biodiesel)
September-09	3	RMG 380 LS	1.29%, 1.40%, 1.51%	Rotterdam	Liberia, Panama, Cyprus	Rapid filter choking, purifier sludging	Chemical Contamination detected by GCMS
October-09	3	RMG 380	2.23%, 2.53%, 3.03%	Houston (x1), Lake Charles (x1), Galveston (x1)	Panama (x3)	Fuel Injectors and Fuel pump Damage	Chemical Contamination detected by GCMS as well as high H_2S/mercaptan in the fuel at elevated fuel pump temperatures

Date of Bunkering	Number of vessels involved	Type of bunker (ISO classification)	Sulphur content of the bunker (% wt)	Bunkering port	Flag State of ships	Summary of reported problems and engine damage	Cause
Throughout 2009	2	RMG 380	2.23%, 2.53%	Gibraltar	Malta, Panama	ME Piston Ring breakage, in some cases purifier sludging	Combination of high asphaltene (>10.5%), high MCR (>11.5%) and high CCAI (>848)
	2	RMG 380	2.61%, 2.68%	Singapore	Bahamas, Liberia	ME Piston Ring breakage, in some cases purifier sludging	
	1	RMG 380	2.05%	Balboa	Panama	ME Piston Ring breakage, in some cases purifier sludging	
	1	RMG 380	2.65%	Algeciras	Panama	ME Piston Ring breakage, in some cases purifier sludging	
	1	RMG 380	2.50%	Piraeus	Cayman Islands	ME Piston Ring breakage, in some cases purifier sludging	

Major problem fuel cases in 2008

Date of Bunkering	Number of vessels involved	Type of bunker (ISO classification)	Sulphur content of the bunker (% wt)	Bunkering port	Flag State of ships	Summary of reported problems and engine damage	Cause
Mid 2007 to Early 2008	30	RMG 380 LS	< 1.50%	St. Petersburg	Varied	Catastrophic fuel pump damage	H_2S/mercaptans present at elevated fuel pump temperatures
January-08	3	RMG 380	2.13%, 2.45%, 2.55%	Port Arthur, Houston (x2)	Panama, Liberia, Greece	Wear of fuel pumps	Highly acidic fuel with low pH and high SAN and highly contaminated fuel detected by GCMS
Feb 2008 to April 2008	3	RMG 380	1.99%, 2.33%, 2.64%	Panama	Panama (x2), Liberia	Fuel pump seizure	Chemical Contamination detected by GCMS
June 2008 to Sept 2008	8	RMG 380 (x2), RMG 380 LS (x6)	1.31%, 1.33%, 1.40%, 1.41%, 1.48%, 1.54%, 2.17%, 2.6%	Rotterdam	Liberia (x1), Belgium (x1), Greece (x1), Panama (x5)	Purifier/Filter Choking, Seized fuel pumps	Chemical Contamination detected by GCMS
Jul-08	2	RMG 380	0.52%, 2.26%	Mawei, China	Cyprus (x1), Panama (x1)	Major fuel pump wear	Highly acidic fuel with low pH and high SAN and highly contaminated fuel detected by GCMS
August-08	2	RMG 380 LS (x2)	1.10%, 1.27%	Nakhodka	Liberia, Hong Kong	Major fuel pump wear	Highly acidic fuel with low pH and high SAN

Date of Bunkering	Number of vessels involved	Type of bunker (ISO classification)	Sulphur content of the bunker (% wt)	Bunkering port	Flag State of ships	Summary of reported problems and engine damage	Cause
Throughout 2008	4	RMG 380	2.23%, 2.53%, 2.93%, 3.08%	Singapore	Malta, Panama	ME Piston Ring breakage, in some cases purifier sludging	Combination of high asphaltene (>10.5%), high MCR (>11.5%) and high CCAI (>848)
	2	RMG 380	2.61%, 2.68%	Piraeus	Bahamas, Liberia	ME Piston Ring breakage, in some cases purifier sludging	
	2	RMG 380	2.05%	Gibraltar	Panama	ME Piston Ring breakage, in some cases purifier sludging	
	1	RMG 380	3.15%	Elefsis, Greece	Panama	ME Piston Ring breakage, in some cases purifier sludging	
	1	RMG 380	2.21%	Panama	Bahamas	ME Piston Ring breakage, in some cases purifier sludging	
	1	RMG 380	1.97%	Rotterdam	Liberia	ME Piston Ring breakage, in some cases purifier sludging	
	1	RMG 380	1.27%	Callao, Peru	Marshall Islands	ME Piston Ring breakage, in some cases purifier sludging	

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ANNEX 2

EXAMPLES OF MAJOR BUNKER QUALITY CASES IN 2010

Date of Bunkering	Number of vessels involved	Type of bunker (ISO classification)	Sulphur content of the bunker (% wt)	Bunkering port	Flag State of ships	Bunker Quality problem	Comments
22-Jan	3	RMG380	1.74-1,81	Portland, Maine, US	Marshall Islands (x2), Norway	High Abrasives, Al+Si: 84-104	
08-Feb	9	RMG380	2.38-2.77	Fujairah	Panama (x3), Qatar, Bahamas, Marshall Islands (x2), Kuwait	High Abrasives, Al+Si: 84-116	
22-Feb	3	RMG380	1.72-1.76	Seattle, USA	USA (x2), Bahamas	High Abrasives, Al+Si 81-83	
26-Feb	10	DMA	*	Greater ARA (Rotterdam, Antwerp, den Helder)	Norway, Germany, Cyprus, France, Sweden, Russian, Isle of Man, Denmark, Bahamas, Marshall Islands	Low Flash Point : 55-59	

Date of Bunkering	Number of vessels involved	Type of bunker (ISO classification)	Sulphur content of the bunker (% wt)	Bunkering port	Flag State of ships	Bunker Quality problem	Comments
10-Mar	6	RMG380	1.02-1.77	New York, USA	Hong Kong, China (x2), Liberia (x2), Panama (x2), Greece	High Abrasives, Al+Si: 84-107	
31-Mar	3	RMG380	0.51-0.55	Manaus, Brazil	Bermuda (x 2), Malta	High Abrasives, Al+SI: 92-120	
27-Apr	16	(LS) RMG380	0.74- 0.81	Santos, Brazil	Norway (x2), Malta, Marshall Islands, Cyprus, Portugal, Panama (x2), Liberia (x4), Singapore (x2), Gibraltar, Bahamas	High Density: 991.6 - 993.2, bad ignition and combustion properties, AL-Si: 25-55	
30-Apr	5	RMG380	4.07 - 4.3	Malta	Antigua and Barbuda (x2), United Kingdom, Italy, Panama	High Density: 994 - 996.1, (high CCAI)	
06-May	5	RMG380	1.01 - 2.60	Rotterdam, NL	Hong Kong, China (x2), Antigua and Barbuda, Baharein, Greece	High Abrasives: Al+Si 84-87	

Date of Bunkering	Number of vessels involved	Type of bunker (ISO classification)	Sulphur content of the bunker (% wt)	Bunkering port	Flag State of ships	Bunker Quality problem	Comments
07-May	6	RMG380	3.28-3.81	New Orleans, USA	Switzerland, Marshall Islands (x3), Bahamas, People's Rep. of China	Contaminated: The analysis revealed presence of various bio derived components (organic acids and amides)	The affected ships all experienced fuel pump sticking. Some ships have reported that the engines failed to start
20-May	6	RMG380	2.53 - 2.78	Tenerife, Canary Islands	Bahamas, Italy, Portugal, Marshall Islands, Panama (x2)	High Density: 991.5 - 994.7	
25-May	4	<100 cSt	1.42 - 2.28	Mobile, USA	Antigua and Barbuda, Isle of Man, Panama, Bahamas	High Density: 991.3 - 1000.7, CCAI: 871- 902	
02-Jul	5	DMA	0.06 - 0.10	Antwerpen, Belgium	Bahamas, Mauritius, People's Rep. of China, Denmark, United Kingdom	Low Flash Point: 55-59	

Date of Bunkering	Number of vessels involved	Type of bunker (ISO classification)	Sulphur content of the bunker (% wt)	Bunkering port	Flag State of ships	Bunker Quality problem	Comments
09-Jul	3	RMG380	3.00 - 3.12	New Orleans, USA	Bahamas, Liberia, Marshall Islands	High potassium (K): 114 - 124	At such level of Potassium in the fuel, increased post-combustion deposits are probable. Past experience with similar fuels suggests a particular link between bunkers with elevated Potassium levels and deposition as well as corrosion of turbo charger nozzle rings and SCR (Selective Catalytic Reactor) units
09-Jul	5	RMG380	0.86 - 1.74	Valparaiso, Chile	Bahamas, Panama (x3), Greece	High Density: 992.1 - 996.7 (Al+Si: 66-72)	
15-Jul	3	< 120 cSt	0.91 - 0.99	Gdansk, Poland + surroundings	Netherlands, Liberia, Gibraltar	Total Sediment Potential: TSP 0.23 - 0.30	Feedback from one of the ships has confirmed that heavy separator and filter problems have been experienced while using these fuels
21-Jul	4	> 300 cSt	4.66 - 4.72	Singapore	United Kingdom (x2), Panama, Hong Kong, China	High Sulfur: 4.66 - 4.72	
03-Sep	4	RMG380	0.34 - 0.35	Buenos Aires, Argentina +surroundings	Italy, USA, Panama, Greece	High abrasives, Al+SI: 81 - 92	

Date of Bunkering	Number of vessels involved	Type of bunker (ISO classification)	Sulphur content of the bunker (% wt)	Bunkering port	Flag State of ships	Bunker Quality problem	Comments
09-Sep	6	DMA	0.04 - 0.08	Rotterdam NL + surroundings	Isle of Man, Bermuda, Panama, Greece Italy, Gibraltar	Low Flash Point: 56-59	
16-Sep	4	3 x < 120cSt + 380	0.91 - 0.95 + 2.3	Singapore	Isle of Man, Bahamas, Panama, United Kingdom	Low Flash Point: 47-59 (CCAI 862 - 864 for < 120cSt fuels)	
17-Sep	3	180, + 2 X 380 cst	0.96 - 1.16	Singapore	Hong Kong China, Panama, People's Rep. of China	High Abrasives Al+Si 128 - 375 (sea water 1.4-4.5%.)	
20-Dec	9	200- 250 cSt	1.20 - 1.37	Genoa, Italy	Italy (x4), Turkey, Liberia, Marshall Islands, Spain, United Kingdom	High Density: 991,6 - 997,0	