LNG 연료선 기인 메탄 배출에 관한 연구 동향

최재혁*† · 천정민** · 김성현*** · 노범석****

* 한국해양대학교 기관시스템공학부, ** 조선해양기자재연구원, *** 한국조선해양플랜트협회, **** 한국해양수산연수원

Trend Study on Methane Emission from LNG Fueled Ship

Choi, Jae-Hyuk*† · Cheon, Jeongmin** · Kim, Sunghyun*** · Roh, Beomseok***

* KMOU, ** KOMERI, ** KOSHIPA, ** KIMFT

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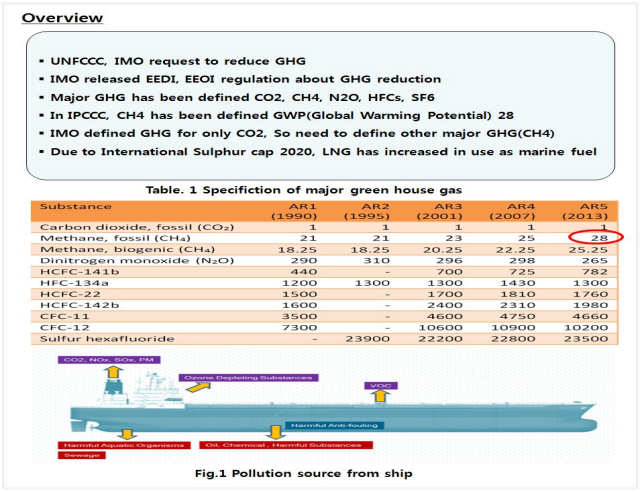


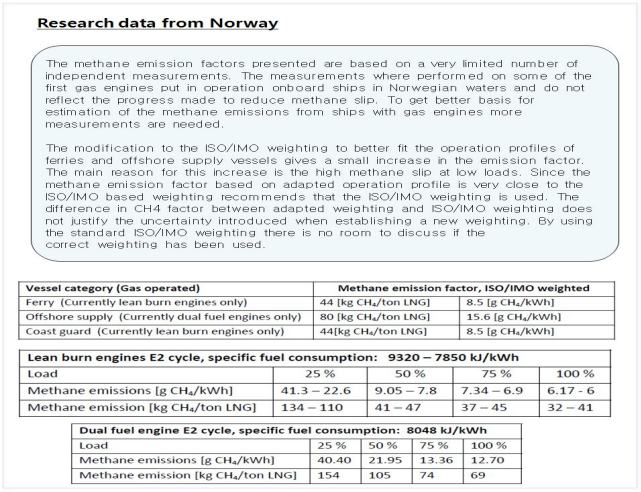
Overview

- UNFCCC, IMO request to reduce GHG
- IMO released EEDI, EEOI regulation about GHG reduction
- Major GHG has been defined CO2, CH4, N2O, HFCs, SF6
- In IPCCC, CH4 has been defined GWP(Global Warming Potential) 28
- IMO defined GHG for only CO2, So need to define other major GHG(CH4)
- Due to International Sulphur cap 2020, LNG has increased in use as marine fuel

Table. 1 Specifiction of major green house gas

Substance	AR1 (1990)	AR2 (1995)	AR3 (2001)	AR4 (2007)	AR5 (2013)
Carbon dioxide, fossil (CO_2)	1	1	1	1	1
Methane, fossil (CH_4)	21	21	23	25	28
Methane, biogenic (CH_4)	18.25	18.25	20.25	22.25	25.25
Dinitrogen monoxide (N_2O)	290	310	296	298	265
HCFC-141b	440	-	700	725	782
HFC-134a	1200	1300	1300	1430	1300
HCFC-22	1500	-	1700	1810	1760
HCFC-142b	1600	-	2400	2310	1980
CFC-11	3500	-	4600	4750	4660
CFC-12	7300	-	10600	10900	10200
Sulfur hexafluoride	-	23900	22200	22800	23500

Fig.1 Pollution source from ship



Research data from Norway

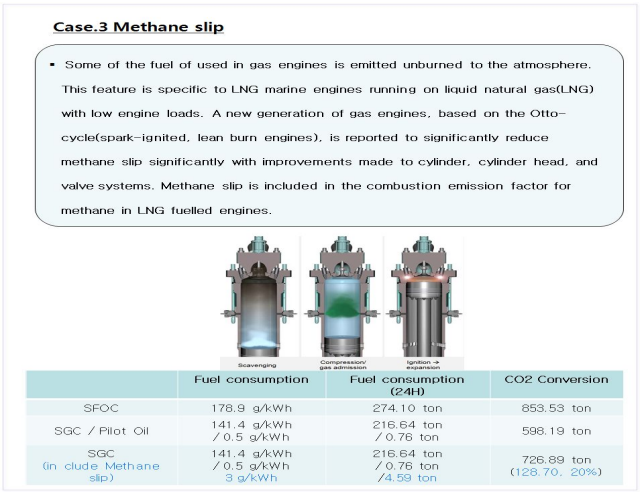
The methane emission factors presented are based on a very limited number of independent measurements. The measurements where performed on some of the first gas engines put in operation onboard ships in Norwegian waters and do not reflect the progress made to reduce methane slip. To get better basis for estimation of the methane emissions from ships with gas engines more measurements are needed.

The modification to the ISO/IMO weighting to better fit the operation profiles of ferries and offshore supply vessels gives a small increase in the emission factor. The main reason for this increase is the high methane slip at low loads. Since the methane emission factor based on adapted operation profile is very close to the ISO/IMO based weighting recommends that the ISO/IMO weighting is used. The difference in CH4 factor between adapted weighting and ISO/IMO weighting does not justify the uncertainty introduced when establishing a new weighting. By using the standard ISO/IMO weighting there is no room to discuss if the correct weighting has been used.

Vessel category (Gas operated)	Methane emission factor, ISO/IMO weighted	
Ferry (Currently lean burn engines only)	44 [kg CH_4/ton LNG]	8.5 [g CH_4/kWh]
Offshore supply (Currently dual fuel engines only)	80 [kg CH_4/ton LNG]	15.6 [g CH_4/kWh]
Coast guard (Currently lean burn engines only)	44[kg CH_4/ton LNG]	8.5 [g CH_4/kWh]

Lean burn engines E2 cycle, specific fuel consumption: 9320 – 7850 kJ/kWh				
Load	25 %	50 %	75 %	100 %
Methane emissions [g CH_4/kWh]	41.3 – 22.6	9.05 – 7.8	7.34 – 6.9	6.17 - 6
Methane emission [kg CH_4/ton LNG]	134 – 110	41 – 47	37 – 45	32 – 41

Dual fuel engine E2 cycle, specific fuel consumption: 8048 kJ/kWh				
Load	25 %	50 %	75 %	100 %
Methane emissions [g CH_4/kWh]	40.40	21.95	13.36	12.70
Methane emission [kg CH_4/ton LNG]	154	105	74	69



Case.3 Methane slip

- Some of the fuel of used in gas engines is emitted unburned to the atmosphere. This feature is specific to LNG marine engines running on liquid natural gas(LNG) with low engine loads. A new generation of gas engines, based on the Otto-cycle(spark-ignited, lean burn engines), is reported to significantly reduce methane slip significantly with improvements made to cylinder, cylinder head, and valve systems. Methane slip is included in the combustion emission factor for methane in LNG fuelled engines.

	Fuel consumption	Fuel consumption (24H)	CO2 Conversion
SFOC	178.9 g/kWh	274.10 ton	853.53 ton
SGC / Pilot Oil	141.4 g/kWh / 0.5 g/kWh	216.64 ton / 0.76 ton	598.19 ton
SGC (in clude Methane slip)	141.4 g/kWh / 0.5 g/kWh 3 g/kWh	216.64 ton / 0.76 ton /4.59 ton	726.89 ton (128.70, 20%)

Conclusions

LNG 연료의 문제점 식별 및 대응기술 개발을 통한 시장선도

* First Author : choi_jh@kmou.ac.kr, 051-410-4257

† Corresponding Author : choi_jh@kmou.ac.kr, 051-410-4257