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GIE Position Paper on impact of including Methane Number in the European Standard for Natural Gas

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What is GIE?

Gas Infrastructure Europe (GIE) is an association representing the sole interest of the infrastructure industry in the natural gas business such as Transmission System Operators, Storage System Operators and LNG Terminal Operators. GIE currently has 70 members in 25 European countries.

GIE voices the views of its members vis-à-vis the European institutions, regulators and other stakeholders. Its mission is to actively contribute to the construction of a single, sustainable and competitive gas market in Europe underpinned by a stable and predictable regulatory framework as well as by a sound investment climate.

GIE supports the general objective of the European Commission in the area of gas quality standardization, as gas quality plays a major role in the interoperability of gas systems and the free flow of gas across Europe. Therefore, GIE is committed to contribute to and participate in all the current work activities on gas quality (CEN Mandate M/400, CEN Mandate M/475, Cost/Benefit Analysis, Pilot Study, etc.).

Background

Proposal to Include Methane Number in the New Gas Standard

The CEN/TC 234 WG 11 is working on the second phase of the Mandate M/400 (EU standards for both combustion and non-combustion parameters) launched by the European Commission in 2007 to draw up a standard in the field of gas quality. During the group meetings the inclusion of the Methane Number in the standard has been discussed several times. Methane Number is a concern for manufacturers and users of gas fuelled reciprocating engines as it can affect engine efficiency and emissions.

Methane Number is the measure of resistance of fuel gases to engine knock (detonation) and is assigned to a test fuel based upon operation in a knock testing unit at the same standard knock intensity:

- Pure methane is assigned as the knock resistant reference fuel with a methane number of 100.
- Pure hydrogen is used as the knock sensitive reference fuel with a methane number of 0.

This position paper explains why GIE is against the inclusion of Methane Number in the standard and gives reasons why it should be excluded.

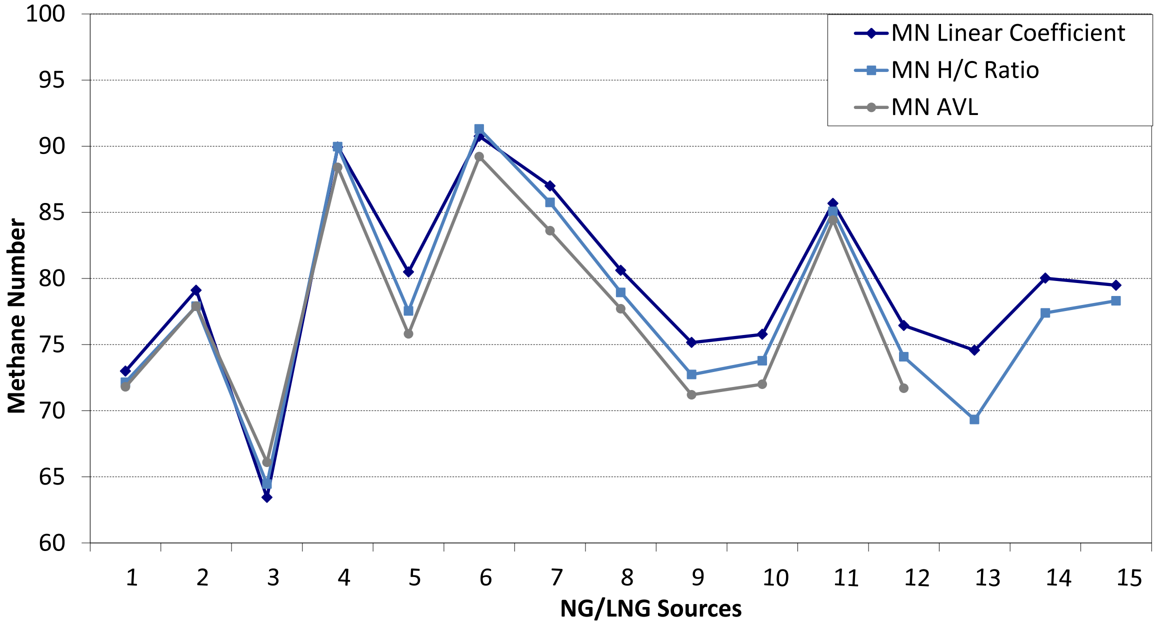
Issues

Measurement of Methane Number

One issue with the Methane Number is that it is not a thermodynamic property of gas, so no Equation of State (EOS) can be used to calculate it. Moreover, there are different calculation methods available and the results are different depending on the method applied, as illustrated in Figure 1 and listed below:

- Calculation of Methane Number from Motor Octane Number (ISO 15401-1:2006: Natural gas – Natural gas for use as a compressed fuel for vehicles — Part 1:Designation of the quality):
  - Linear Correlation method
  - Hydrogen/Carbon (H/C) Ratio method
- AVL method - AVL Inc. developed a method to calculate the methane number, based on experimental measures of different gas mixtures (up to C_4, H_2, CO_2 & SH_2).
- E.ON-GasCalculation
- Various engine manufacturer methods

Figure 1: Variations of MN depending on the calculation method (Supplies 2008-2009)



Source: Enagás

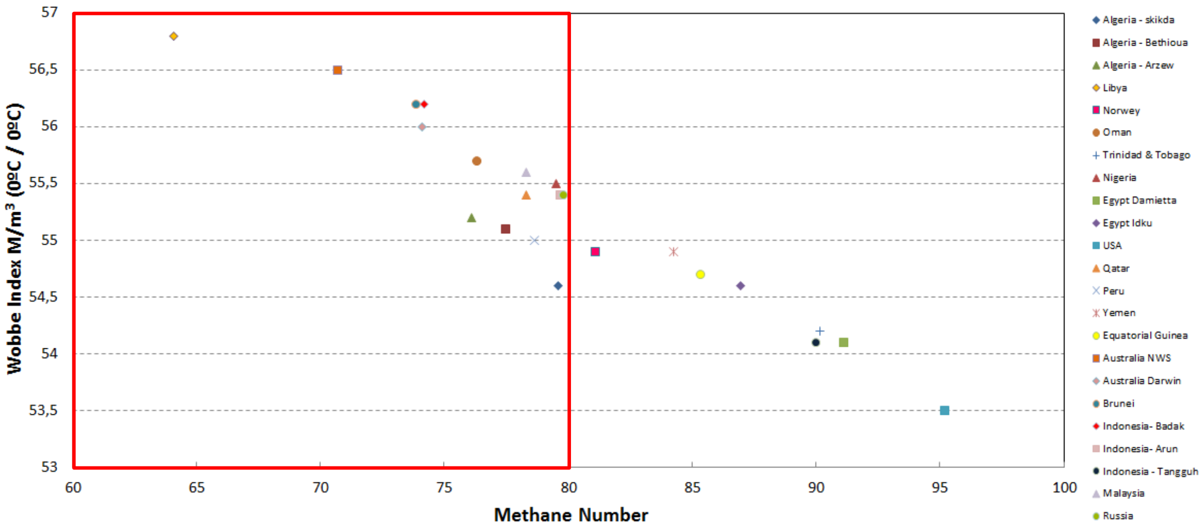
It should also be noted that some of these calculation methods do not consider components heavier than butane. As the quantity present should be small these additional components are normally added to the quantity of butane as an approximation, but for Methane Number determination, additional development of the calculation method may be needed.

Similarly, the only methods to calculate Methane Number included in an international standard (ISO 15401-1:2006) were not developed to or are not able to predict the right trend of Methane Number when hydrogen is injected to the natural gas.

Proposed Methane Number Range and Impact on Gas Supplies to Europe

During the European Commission Workshop on Gas Quality held on 5th December 2011, Euromot[1] asked for a Methane Number between 80 and 100 which would exclude the majority of available LNG from coming to Europe as shown in Figure 2.

Figure 2: Methane Number (AVL Method) vs. Wobbe Index for LNG Sources during 2011



Source: GIIGNL 2011, The LNG Industry

The Table 1 shows the quantities of LNG Europe received in 2011 from each exporting country.

Table 1: Quantities (in 10^6 T) of LNG received in 2011

	Algeria	Belgium	Egypt	Libya	Nigeria	Norway	Peru	Spain	Trinidad & Tobago	Oman	Qatar	Yemen	USA	Total Imports
Belgium	-	(0.5) *	-	-	0.1	-	-	-	0.1	-	4.2	0.3	-	**4.1**
France	4.2	-	0.6	-	2.6	0.3	-	-	0.3	-	2.4	0.1	-	**10.5**
Greece	0.6	-	0.1	-	0.1	-	-	-	0.0	-	0.1	-	-	**0.9**
Italy	1.2	-	0.3	-	-	0.1	-	0.2	0.1	-	4.4	-	-	**6.3**
Netherlands	0.1	0.1	0.1	-	0.1	0.1	-	-	0.1	-	0.2	-	-	**0.6**
Portugal	0.1	-	0.1	-	1.9	0.1	-	-	-	-	0.1	-	-	**2.1**
Spain	2.9	0.2	1.7	0,1	4.9	0.9	1.4	(0.4)*	1.7	0.1	3.6	-	0.1	**17.2**
Turkey	3.0	-	0.3	-	1.0	-	-	-	-	-	0.4	-	-	**4.8**
U.K.	0.2	-	0.1	-	0.9	0.3	-	-	0.4	-	16.1	0.5	0.1	**18.4**
Europe	**12.2**	**(0.2)**	**3.2**	**0,1**	**11.4**	**1.7**	**1.4**	**(0.3)**	**2.7**	**0.1**	**31.7**	**0.8**	**0.2**	**65.0**

(*) Re-exports

Source: GIIGNL 2011, The LNG Industry

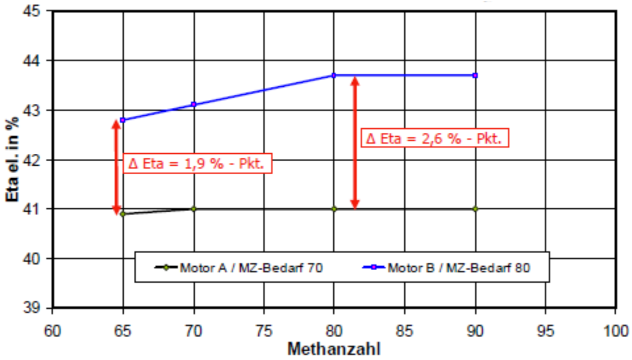
It was proposed during a CEN/TC 234 WG 11 meeting to set the methane number >65 (±2 calculated with AVL method) in the European gas standard. This lower limit would cover all the supplies currently coming to Europe, as shown in the Figure 2. It should also be noted that representatives of the automotive industry participating in the CEN/TC 19 have confirmed that a methane number of 65 could be acceptable (but raised to 75 in the future, which would endanger security of gas supplies to Europe). Consequently, if the engine manufacturers can accept a Methane Number lower than the Euromot proposal, then there is no real benefit in including this parameter in the new standard.

Scale of the problem

[1] Euromot is the European Association of Internal Combustion Engine Manufacturers: http://www.euromot.org/home

The argument of Euromot is that a Methane Number below 80 reduces the efficiency of the gas fuelled reciprocating engines and may increase the emissions or create problems to the engine, as it is stated in their Position Paper[2] and shown in Figure 3.

Figure 3: Example of Efficiency of Gas Motors (CHP) for different Methane Numbers



Source: E-on Ruhrgas

However, it should be noted that the users that may be affected by variations of the Methane Number, including transportation and power generation, are currently estimated to represent less than 2% of the gas currently consumed in Europe[3] and, the efficiency variations caused by Methane Number are small. Consequently the impact of Methane Number on gas consumption and emissions generation is in the order of 0.02% of European demand. This should be compared to the impact on risking a significant amount of Gas and LNG supply by including a Methane Number in the revised standard. It should also be noted that although gas consumption due to gas fuelled reciprocating engines is expected to increase overtime, it will still remain a very small percentage of total gas consumption in Europe.

Euromot also advocate for the secondary processing of gas in Europe to further reduce the amount of residual NGLs[4] (all gas is already processed close to the point of origin to recover marketable NGLs). Secondary processing is not an economical proposition with the current amount of residual NGLs in current gas and LNG supplies, and it should be noted that existing processing facilities in Spain and Italy that received rich LNG where decommissioned many years ago for this reason.

Introduction of Hydrogen

In the context of the development of renewable energy sources there are currently various projects in Europe focusing on the injection of Hydrogen into the gas grid. Although it is unclear at this time how these projects will develop or how much Hydrogen could be injected into the gas grid, it should be noted that any addition of Hydrogen (Methane Number of 0) will decrease the Methane Number of the gas transported, potentially limiting that supply or preventing the use of this form of renewable energy.

[2] Euromot's Position Paper: "Methane Number as a Parameter for Gas Quality Specifications", 4th April 2012. http://www.euromot.org/download/3a88a6f6-af39-4c4d-bb51-0e0be660d02d/GAS%20QUALITY%20methane%20number%20calculation%202012-04-04.pdf

[3] Total gas consumed in gas powered vehicles in Europe plus gas consumed by gas fuelled reciprocating engines for power generation in Europe compared to total gas consumption in Europe. See further details on source data and assumptions used in Appendix 1

[4] NGLs (Natural Gas Liquids) are naturally occurring components found in natural gas, and include ethane, propane and butane, among others.

GIE Position

1. A Methane Number of 80 as recommended by Euromot would endanger the Security of natural gas supply to the European market, limiting acceptable gas sources, especially LNG but also some pipeline supplies, or would require expensive gas treatment just for the benefit of a few gas consumers:

    - For example, Denmark has been supplied with natural gas with a methane number around 70 (AVL method) from the Danish part of the North Sea for more than 20 years. The span of variation is typical from 65 to 75, all of which would require further processing or curtailment if the gas standard required a Methane Number above 80. Gassco has also expressed its concerns about the inclusion of the Methane Number since it may affect Norwegian gas exportations.

    - Gas quality adjustment for Methane Number is complex and prohibitively expensive and would benefit only a very small percentage of gas consumers and impact less than 0.02% of European gas demand:

        - It is not economic to remove residual NGLs for gas imported into Europe. This will add quality adjustment cost to the gas system that, in the end, would be paid by end-users, reducing the benefit of gas quality harmonization

        - Limiting or preventing the addition of Hydrogen into the gas grid goes against the desires of the European Commission to diversify supplies and promote renewable energy sources.

    - The Methane Number can't directly be used to optimise engine operation as there is no guarantee that the Methane Number at the point of measurement will correspond to the gas quality at the engine. Automation of engine emissions monitoring and automatic optimisation is the best method of ensuring optimum operation over a range of gas qualities further making the inclusion of Methane Number unnecessary.

2. Including the Methane Number in the European Standard requires an agreed and reliable method of determination and should incur minimum costs.

    - There is no commonly agreed Methane Number calculation method and one would need to be agreed, or even developed and made available in the public domain.

        - The only methods to calculate Methane Number included in an international standard do not correctly predict the trend of the Methane Number when hydrogen is injected.

        - Current methods do not take into account the presence of hydrocarbons heavier than butane.

    - The vast majority of the chromatographs in Europe are not configured to automatically determine the Methane Number and consequently some modification would be required, including the implementation of software, which would be a significant investment. The alternative is that some calculations would need to be carried out which is labour intensive and could result in errors.

As a consequence of the above mentioned arguments there are several reasons for not including the Methane Number in the European Standard. However, if it is to be included then the maximum number in the standard needs to be 65, or a lower figure, in order to ensure security of supply. In addition, an agreed and reliable method for its determination, published in the public domain, should be a prerequisite for standardization.

Appendix 1

To estimate the gas consumption by reciprocating engines in Europe two data sources were used:

Wood Mackenzie

- Total gas consumption in Europe
- Total gas consumption in Europe for transportation

Power Generation Order Survey 1999-2012 published by Diesel and Gas Turbine Worldwide

- Gas fired reciprocating engines for power generation in Europe

Throughout the analysis a number of assumptions were made and, whenever practical, gas consumption in reciprocating engines was over estimated to try to ensure the gas consumption in this sector was fully represented:

Total gas consumption in Europe for transportation

The volume is slightly over estimated by Wood Mackenzie as the figures have the anomaly of including some natural gas consumed in transporting gas through Russian pipelines.

Total gas consumption in Europe for power generation

Gas consumption data is not readily available in this area so an estimate was made using the annual Power Generation Order Surveys for 1999-2012 published by Diesel and Gas Turbine Worldwide which lists the number of units ordered each year for a given power output range, the service type, fuel type and geographical region. Keys points to note include:

There is no data with respect to how many units were ordered for new installations versus replacement of existing installations. Also, there are various reports on how long an engine will last in service e.g. small engines may have a life cycle between 2 and 3 years depending on its service whereas a larger engines may have a life cycle greater than 15 years. It should be noted that the vast majority of engines ordered are small units. However, to further ensure gas consumption in this sector is represented, it is assumed that all engines ordered between 1999-2011 are delivered, installed and continue to run and have not been replaced. Consequently it is assumed that Installations prior to 1999 have insignificant impact on the total gas consumption in this sector.

As the power output data is aggregated and not provided for each fuel type the average engine output per unit in each output range has been assumed for the gas fuelled engines.

In the geographical breakdown of engine orders Russia is included in Europe and consequently gas consumption will be over estimated.

As the power output of gas engines used in Europe (and Russia) is not listed it is assumed that the proportion is the same as the global ratio of total gas engines to total engines ordered.

The efficiency of the units is not reported. Typically electric efficiency is in the range of 35 - 50% and heat efficiency in the range of 35 - 40% giving a high cumulative efficiency possible from CHP units. For this analysis an efficiency of 60% was assumed.

The majority of engines appear to be standby units with a small number in peaking service. However, to try to ensure all gas consumption is captured it is assumed the average utilization of all engines is 50%.

The gross heating value of gas was assumed to be 38 MJ/Sm^3.