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## QUALITY COMPLIANCE OF NATURAL GAS, PRODUCED BY UKRAINE, WITH EUROPEAN REGULATIONS

**Background.** According to the report established by British Petroleum in 2014 [1] global gas consumption in Europe (except natural gas suppliers such as Russia, Turkmenistan, Uzbekistan, Kazakhstan, Azerbaijan) increased up to 490.8 bln m<sup>3</sup>. The volume of gas extracted by European countries is 260.9 bln m<sup>3</sup>, with proven reserves of 4.1 trillion m<sup>3</sup>. With this amount of natural gas reserves the share of Ukrainian gas extracting companies is 600 bln m<sup>3</sup> (14.6%), the share in gas production is 10.2% (18.6 bln m<sup>3</sup>), the share in gas consumption is 7.8% (38.4 bln m<sup>3</sup>).

If Ukrainian gas consumption tends to decrease at a level of 15.6% per year (due to implementation of energy-saving programs), then Ukraine will consume only 16 bln m<sup>3</sup> of natural gas by 2020. In these conditions Ukraine may cut down the consumption of European natural gas. Moreover the implementation of energy saving programs is supported by Ukrainian government, so there is a high possibility of refusing gas supplies from Slovakia, Poland and Hungary. Unlike Ukraine, which has reserves to reduce natural gas consumption, same reserves of European countries are running low, so European countries still tend to depend on gas supplies from Russia, and Asian countries.

**The main aim.** Ukraine may become a full member of European natural gas market because of its developed gas transit system, and its gas reserves. In conditions of reducing of gas consumption in Ukraine, Ukrainian gas-producing companies may supply European market with the excessive natural gas, if it meets the European regulations.

**Project concept.** The program “20/20” of the largest natural gas production company of Ukraine UGV provides for natural gas production increase up to 20 bln m<sup>3</sup> by 2020 which that is 25% more than current 14.5 bln m<sup>3</sup> (approximately 1.5 bln m<sup>3</sup> per year). It's

worth mentioning that the natural gas production by other companies such as Ukrnafta, Burisma, DTEC is about 6 bln m<sup>3</sup>, so the total volume of gas produced in Ukraine may be increased up to 26 bln m<sup>3</sup> using only proven gas reserves.

While tending to reduce gas consumption in 2020 Ukraine will be able to export 10 bln m<sup>3</sup>. In addition, using of approved but not proven gas reserves, putting new booster compressor stations into operation and natural gas flow optimization in Ukrainian and neighboring transmission lines allows on the one hand to increase gas exports from Ukraine, on the other – to reduce energy consumption while gas transmitting.

Project implementation includes:

- Assessment of hardly recoverable reserves of gas, evaluation of new exploration actions carried by foreign and Ukrainian companies;
- Installation of the optimum compressor equipment for mature fields with volumetric reservoirs;
- Evaluation of reduction of natural gas consumption for Ukraine and Eastern-European countries;
- Planning of gas flows through the pipeline systems to reduce energy consumption;
- The gas flow planning and balancing for receiving gas from Azerbaijan, Iran, Kazakhstan, Turkmenistan, by using the existing gas transmission network and the Black Sea.

**Results of implementation.** The main outcome of the project is drawing attention to Ukrainian gas production system, increasing proven reserves of gas, using of Ukrainian gas transmission network to reduce energy consumption while transporting of natural gas, attracting new investors to Ukraine. For European countries it is an opportunity to get cheaper gas by transmission cost reducing.

In this article the issues concerning the quality of natural gas produced by Ukraine will be highlighted. Also the quality compliance of natural gas produced by and transported through Ukraine will be evaluated according to European regulations.

The final version of the European standard EN 16726:2015 [2] sets requirements for gas quality to allow the free gas flow of between the CEN member states and to enable the supply taking into account the impact on the whole chain supply value from production to the customers. CEN members have to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Management Centre or to any CEN member. CEN members are the national standards departments of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and United Kingdom. If Ukraine is considered as one of the European natural gas market participant, the produced and transported gas quality must be in ranges established by these regulatory documents.

But for Ukrainian companies some of the abovementioned requirements may seem difficult, since some of gas quality parameters are not regulated by somehow dated but still using former Soviet Union regulatory documents. Therefore, the main problem is the harmonization of Ukrainian and European standards, so it is needed to focus on new requirements for Ukraine gas quality.

The first stage of harmonization is to determine which group Ukrainian gas belongs to. The final draft of EN 16726 specifies gas quality characteristics, parameters and their limits, for gases classified as group H that are to be transported, injected into and extracted from storages, distributed and utilized according to the EN 437:1993 «Test gases – Test pressures – Appliance categories» [3]. The EN 437 specifies the test gases, test pressures and appliance categories

relative to combustible gases of the first, second and third families. This particular document is referred to the specific standards for appliances which are under control of the Council Directive on the approximation of laws concerning gas detecting appliances (90/396/ EC).

Test gases composition and test pressures, which are specified in this standard, are intended to be used in testing of all of the appliances in order to establish conformity with the corresponding standards.

Gases are classified into three main families. Each family is divided into groups, according to the gross Wobbe index range. The values are given in Tab. 1.

Table 1 – Classification of gas families and groups by the Wobbe Index

Gas families and groups	Gross Wobbe Index at 15 °C and 1,013.25 mbar·MJ/m <sup>3</sup>	
	minimum	maximum
First family Group a	22.4	24.8
Second family	39.1	54.7
Group H	45.7	54.7
Group L	39.1	44.8
Group E	40.9	54.7
Third family	72.9	87.3
Group B/P	72.9	87.3
Group P	72.9	76.8
Group B	81.8	87.3

The Wobbe Index indicates the interchange ability of fuel gases and it is the best indicator of similarity between the natural gas and a specific propane-air mixture. Since the Wobbe index relates the heating characteristics of blended fuel gases it may be used to obtain heat flow constants of gases with various compositions.

The second stage of harmonization is to provide the energetic requirements of EN 16726 for produced, injected to and extracted from the storage gas, and transmitted gas. Gas must comply with the requirements given in Tab. 2 and must be accepted for transmission.

Technically, water dew point can be measured by using condensation hygrometers with cooled surface. This method is described in EN ISO 6327 [4].

Hydrocarbon dew point may be measured directly (e.g. using appliances according

to ISO/TR 12148 [5]) or calculated basing on the detailed composition according to the guidance provided in ISO 23874 [6].

Ukrainian standards, concerned routinely measuring and controlling of the dew point, are fully harmonized with European ones, so the main attention must be paid to the specific gas gravity and methane number.

According to the component composition of natural gas, gathered from different points of gas transmission system, it was carried out the classification of gases which were

extracted in Ukraine, transported up to the border with Eastern Europe, injected and extracted from storages.

The results of classification are shown in Tab. 3. They are performed according to the parameters below:

- Group classification (according to EN 437);
- Gross (higher) caloric value;
- Specific gas gravity;
- Gross Wobbe index;
- Methane number.

Table 2 – Energetic requirements of EN 16726

Parameter	Unit	Limits based on standard reference condition 15/15		Limits based on normal reference condition 25/0 (for information)		Reference standards for test methods (informative)
		Min.	Max.	Min.	Max.	
Relative density (specific gas gravity)	no unit	0.555	0.700	0.555	0.700	EN ISO 6976, EN ISO 15970
Hydro carbon dew point, °C at any pressure from 0.1 to 7 MPa (70 bar) absolute pressure	°C	not applicable	-2	not applicable	-2	ISO 23874, ISO/TR 12148
Water dew point <sup>a</sup> at 7 MPa (70 bar) or, if less than 7 MPa (70 bar), at maximum operating pressure of the system in which the gas flows	°C	not applicable	-8	not applicable	-8	EN ISO 6327, EN ISO 18453, EN ISO 10101 parts 1 to 3
Methane number <sup>b</sup>	no unit	65	not applicable	65	not applicable	see calculation below

<sup>a)</sup> Under certain climatic conditions, a higher water dew point and hydrocarbon dew point may be accepted at national level.

<sup>b)</sup> The methane number of a gas indicates the knock tendency of a fuel. It is a product of different constituent gases within the natural gas, particularly the proportions of methane, ethane, propane and butane. Understanding of the knock resistance is important to prevent the damage that may be caused to an engine.

The results of this simple analysis of natural gas energetic parameters show that the Ukrainian producers meet the requirements of new EN 16726, because both extracted and transported gases are related to the group H (second family) according to EN 437 with enough value of specific gas gravity and methane number. Some deviations need be removed to harmonize Ukrainian and European standards. That assumes 3 steps:

1) Adoption of safety regulations for domestic gas production;

2) Harmonization of domestic standards according to EN 16726;

3) Correction of requirement for quality characteristics of gas transmitted by existing gas transmission network [7].

**Conclusions.** In the past, the regulations and standards for gas quality and gas balancing principles were put under control only in the countries-producers and transmitting companies. With interconnections between countries and gas market increased, the EU rules have become increasingly necessary

to effectively manage the gas flows. Taking into account the proven quality of Ukrainian domestic gas the abovementioned 3 steps allow the Ukrainian producers to become the

members of the EU energy market in the near future.

Table 3 – Quality characteristics of Ukrainian extracted and transported gas<sup>a</sup>

Enter point to the transmission network	Specific gas gravity	Gross caloric value, MJ/m <sup>3</sup>	Net (lower) caloric value, MJ/m <sup>3</sup>	Gross Wobbe index, MJ/m <sup>3</sup>	Family	Group	Methane number
Eastern production region							
Shebelynka BCS	0.605	39.0	35.2	50.2	second	H	73
Yefremivka GOSP	0.600	38.7	34.9	49.9	second	H	77
Sosnivka GOSP	0.606	38.8	35.0	49.8	second	H	74
Yuliivka GOSP-2	0.622	39.0	35.3	49.5	second	H	76
Western oil and gas production region							
Pasichna valve station	0.608	39.5	35.7	50.7	second	H	74
Puckenychi valve station	0.560	37.0	33.3	49.4	second	H	97
Locachi GOSP (H <sub>2</sub> S)	0.594	37.0	33.3	48.0	second	H	85
Poltava oil and gas production region							
Mashivka GOSP	0.610	37.7	34.0	48.3	second	H	79
Abazivka GOSP	0.653	40.4	36.5	50.0	second	H	69
Bairak GOSP	0.658	40.5	36.6	49.9	second	H	69
Komyshnya GOSP(CO <sub>2</sub> )	0.642	37.7	34.0	47.0	second	H	82
Kolomak GOSP	0.635	37.8	34.2	47.5	second	H	81
Stepova GOSP	0.635	39.5	35.7	49.5	second	H	72
Typical private oil and gas field							
Semerenyk GOSP	0.604979	36.91	33.29	47.5	second	H	90
Transmitted gas							
Lviv region	0.578423	37.92	34.21	49.9	second	H	87

<sup>a</sup> The table represents typical energetic parameters of natural gas extracted from Ukrainian oil and gas fields.

**REFERENCES:**

- [Site of British Petroleum. «Statistic report by BP about energy consumption n 2014»]. <http://www.bp.com>. Retrieved from <http://www.bp.com/en/global/corporate/sustainability/reporting/verified-site-reports.html>.
- EN 16726:2015. Gas infrastructure - Quality of gas - Group H. – Brussels: CSN, 2015.
- EN 437:1993. Test gases - Test pressures - Appliance categories. – Brussels: CEN, 2015.
- EN ISO 6327 Gas analysis - Determination of the water dew point of natural gas - Cooled surface condensation hygrometers. – Berlin: DIN, 1981.
- ISO/TR 12148 Natural gas - Calibration of chilled mirror type instruments for hydrocarbon dewpoint (liquid formation). – British. 2009.
- ISO 23874 Natural gas - Gas chromatographic requirements for hydrocarbon dewpoint calculation – British. 2006.
- Сайт ПАТ «УКРТРАНСГАЗ» [Електронний ресурс]. – Режим доступу: <http://utg.ua>.