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THE QUALITY OF NATURAL GAS AND THE CONSUMERS

Dumitru CHISĂLIȚĂ

Building Services Faculty, Technical University of Civil Engineering, Bucharest
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Corresponding author: Dumitru CHISĂLIȚĂ, E-mail: dumitru.chisalita@romgaz.ro

Abstract: Like any "product" (good) the quality of natural gives have to:
- correspond to technical norms and standards in all technological the possibility of correct measurement of the quantity;
- characterise the purchased product and his price;
- turn to good account the base product and his subproduct;
- not produce damages in product's circulation and neither the utilization of natural gases;
- have not technical and human injuriousness degree in producers/import underground storage, transport, distribution and their utilisation.

Key words: conditioning, quality, flow, merchandise, pressure, humidity

1. GENERALITIES

Securing the quality of natural gas as merchandise is incumbent to:
- the domestic producers;
- exporters/importers of natural gas;
- the companies taking over natural gas from producers/importers and which have to permanently check the "quality" of natural gas, to undertake the necessary steps for the observance of the same. This could go onto the refusal of taking over the "merchandise" and in special cases, the settlement of litigations as per the regulations and commercial provisions in effect;

It is the producers' interest to "process" the natural gas for the optimal valuing of their components (ethane, propane, butane, pentane, helium, sulphur, nitrogen, carbon dioxide, etc.) thus also ensuring the quality of natural gas with high methane content (CH_4).

Even if the "merchandise" is within the allowed tolerance limits provided by norms at the producers/importers, the transporters, storers, distributors and, as the case may be the users may be obliged to protect their pipelines, own installations and consumers against any accidental causes which may corrupt the quality, and most of all against such alteration which may occur due to the changes of the natural gas depending on the temperature, compression, expansion and other changes of parameters (pipeline pigging, separation, filtration and drying).

2. CONDITIONING OF NATURAL GAS AT THE PRODUCERS/IMPORTERS WITH A VIEW TO SECURING THE REQUIRED QUALITY FOR INTERNAL AND INTERNATIONAL TRANSMISSION, STORAGE, DISTRIBUTION AND CONSUMPTION.

The expansion of the "market" at European level and its dependence from other areas imposes the knowledge of composition features of gas from different reservoirs, especially as Romania produces, imports from the Russian Federation, is to diversify its imports (from the Near East, from the Caspian region through Turkey, probably use LNG produced on the Black Sea coast, etc.) and transits natural gas.

Table 1 Composition of natural gas from Romania (%)

	Free -gas Transylvania	Free-gas Extra-Carpathian	Oil field gas	Gas from import
He	0,00	0,00	0,00	0,00
N_2	0,09	0,00	0,00	0,78
C_1	99,19	94,25	73,02	98,66
C_2	0,05	1,46	7,63	0,40
C_3	0,17	1,77	5,98	0,08
C_4	0,15	1,11	3,97	0,02
C_5	0,05	1,21	2,66	0,02
H_2S	0,00	0,00	0,00	0,1
CO_2	0,30	0,20	4,09	0,03
Total	100	100	100	100

Table 2 Composition of natural gas from Europe (%)

	Le Lacq France	Gröningen Holland	Frigg Norway	Odolanov Poland
He	0,00	0,05	0,00	0,40
N_2	0,00	14,3	0,70	40,73
C_1	68,90	81,2	94,20	58,14
C_2	2,90	2,90	4,60	0,44
C_3	0,90	0,40	0,10	0,02
C_4	0,60	0,15	0,02	0,00
C_5	1,00	0,10	0,08	0,00
H_2S	15,90	0,00	0,00	0,00
CO_2	9,80	0,90	0,30	0,20

Tabelul 3 Composition of natural gas from Asia and Africa (%)

	Kangan-Asia	Kirkuk-Iraq	Hassi R'Mel - Algeria
He	0,00	0,00	0,19
N_2	4,90	0,03	5,80
C_1	85,50	56,60	83,00
C_2	4,10	17,10	7,10
C_3	1,40	8,70	2,25
C_4	1,20	3,50	1,00
C_5	1,00	1,50	0,45
H_2S	0,05	6,80	0,00
CO_2	1,90	3,90	0,21

From Table 1 results that the free gas in Transylvania, Extra-Carpathian area and imports has a satisfying composition, with a non-significant percentage of acid gas, inert gas and condensable heavy hydrocarbons and the methane (CH_4) exceeds 94% of the volumetric content.

On the other hand, the associated gas produced by Petrom's subsidiaries, where CH4 represents approx. 73%, the condensable heavy hydrocarbons exceed 20% and CO_2 exceeds 4%, require strict conditioning technologies prior to the delivery from the producer to the transporter, distributor and users.

Tables 1 and 2 reveals the fact that generally the volume content of the natural gas components in Europe, Asia and Africa is disadvantageous as compared to Romania, especially with respect to:

- nitrogen (N_2) present in almost all reservoirs with extremely high values in Groningen 14.3%, Odolanov 40.73%;
- Sulphur hydrogen (H_2S) is also present in high percentage in Kirkuk 6.80%, Le Lacq 15.90%;
- Carbon dioxide (CO_2) is present in all fields in Europe, Africa and Asia, with high percentages in Le Lacq 9.80%, Kirkuk 6.80%;
- Condensable heavy hydrocarbons are present in all reservoirs between 7% - 14%;
- Methane (CH_4), the product presenting interest for the natural gas market is between approx. 50% and 85%;

Tables 1, 2, 3 only refer to information concerning the volumetric composition of natural gas.

The composition of gas has to be also combined with:

- Water as vapour in the natural gas
- Free water in the reservoir (salty);
- Free water resulted further to condensation of the water vapours or which accidentally entered the pipelines or installations;
- Liquid hydrocarbons, condensed or driven in from the producers;
- Solid impurities from the deposit rock or the ones accidentally entered or originating in oxidation processes, internal corrosions and erosions of the pipelines and afferent technological installations.

The presence of other gaseous components except methane (CH_4) and the driving of liquid and solid impurities are economically inefficient, dangerous and polluting in the entire supplier-user chain, due to:

- H_2S is toxic, leads to the fragility of the metal structure and combined with liquids (free waters) results in internal corrosion of pipelines and any installations and equipment passed by the gas flow;

- CO_2 is toxic, has no calorific power and decreases the calorific content of merchandise gas;

- N_2 is an inert gas, may become corrosive in the presence of free waters and decreases the calorific power of gas;

- heavy hydrocarbons (C2 – C5) condense in transmission and distribution pipelines, technological installations, at the consumers, spoil the metering and calorific power of the gas, affects the membranes of household meters, causes hydraulic drops due to local deposits on the gas route, losses causes by their suppression from the pipelines, pollute the environment, may cause fires, technical and human accidents in the separation, accumulation and suppression areas.

The lack of treatment of gas determines the following:

- the components of natural gas, other than CH_4, besides the negative effects shown above and which are due to their non-retaining and marketing to producers, are also generating economic losses to them;

- salt water and sweet water under liquid form which facilitate the internal corrosion in the presence of acid fractions, increase the energy consumption to overcome the hydraulic losses in the pipelines and installations, causes the inefficiency of the metering of gas irrespective of the method and performances of the equipment used, decreases the energy of the gas at the end users due to the energy consumed for the vaporisation of free water in the gas to be burned, disturbs the chemical processes and induces direct gas losses through the suppressing of gas quantities together with free liquids from the pipelines and installations, cause the pollution of the environment and possible technical and human accidents;

- the solid impurities from the deposit rock or accidentally entered into the pipelines lead to the internal erosion of the same and of the afferent technological installations, disturb the metering process, determines hydraulic losses through their deposit on the piping or in other areas, decrease the efficiency and life period of the installations and also generate direct gas losses through their discharge by suppression.

The negative effects due to the inadequate treatment of natural gas by the Romanian producers during 1998 – 2001 (informative data and probably underestimated) together with the reference to free liquids and with respect to the transmission activity are presented in table 4.

For instance, the volume of the national transmission system (excepting the international gas transit) is of approx. 0.52m (equivalent diameter) x 11,000,000 m (length) = a volume of 2,160,000 c.m.

Assuming that only 5% of the pipeline volume show liquid deposits, we can determine that they represent over 100,000 c.m. of liquid in the transmission system. This was proved by the abnormal pressure drops along the pipelines and after their suppressing together with the natural gas.

The yearly suppressing from the pipeline of approx. 20% of the free liquids which are un-evenly distributed along the pipelines causes the un-controllable behaviour of the rest of them. They could be driven into massive “plugs” depending on the variation of transmission parameters (flow rates, pressures, flow velocities), with extremely negative consequences which have been detailed above (erroneous metering, decrease of calorific power of gas, important quantity and metering losses, low efficiency at the consumers, un-justified energy consumption, technical and human accidents, pollution of the environment, etc.), and the conclusions which may be drawn are:

- The consumers in all categories pay for a merchandise they do not receive, from the quality point of view and possibly from the quantity too;

- The actual and apparent losses of natural gas on the chain between producers and end users reach high values;
- The safety of operation, energy intensity, the protection of interests of producing companies, of consumers and of the environment remain simple slogans if they are not backed by severe, clear, technical and coercive measures, and they will have a totally negative impact on the energy supply, social, economic and environmental security of Romania.

3. TECHNICAL SOLUTIONS CONCERNING THE TREATMENT OF NATURAL GAS AT THE PRODUCERS

In the import and international transit contracts, the partners recalculate the gas quantities depending on the calorific power provided in the contract and do penalise a range of deviations from the contract provisions.

An elementary example shows that the methane gas merchandise of 1 mil. c.m./h is considered in fact from the calorific energy point of view contained and paid for (the merchandise purchased and not volumes without certain content).

Due to the fact that the actual calorific power is influenced by:
- the volumetric composition of the gas;
- inert gases (H_2S, CO_2, N_2O_2);
- Free water driven by the gas,

the calorific power is reduced.

In the EU countries, North America and other countries, there is a generalisation trend, the gas flow rates being expressed in energy units (kWh), which allows the comparison to other alternative energy sources.

Of course, for the conversion in kWh the chromatograph analysis of natural gas is required (for flow rates over 30000 c.m./h), calorimeter standardisation verifications, the removal of the free liquid phase from pipelines and installations (monophase natural gas) and to ensure the contracted dew point.

The required operations for the treatment of gas extracted from the reservoir are the following:
- retaining the free water by separation;
- retaining solid impurities by filtering;
- reducing water vapours in gas in order to ensure the contracted dew point;
- reinjection in the layer by a specially designed system of the separated and captured water in order to avoid the pollution of the environment;
- retaining the heavy fractions (C2 – C5+) by a simple degasolination process, the suitable and efficient fractioning being subsequently performed on the account of the separated “gasoline”;
- retaining of H_2S, CO_2, N_2 fractions if there is a significant percentage within the natural gas;
- the natural gas conditioned (treated) at the supplier with a view to achieving the standard provisions, norms and contracts under the quality point of view, have to be compressed (given the flow and pressure decline in Romania) in order to ensure the other component of the quality, the “pressure”, required for the transmission to the consumer by distribution systems, under the pressure conditions provided by regulations and projects, and for which the pipelines and technological installations have been built;
- further to securing the pressure for the various transmission directions (consumers located relatively close to the producer, consumers located at a distance between 50 – 100 km, consumers located at over 100 km) the gas has to be rigorously metered by considering not only their volume

or mass but also the calorific (energy) content and the treatment degree (lack of free liquids, dew point, pressure, etc.), these documents being in fact the delivery of the merchandise from the supplier through the "carrier" (transporter) to the distributor and end users (eligible).

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