ADVANTAGES OF USING LIQUEFACTION TECHNOLOGY, UTILIZATION OF PETROLEUM GAS ON THE EXAMPLE OF THE NORTHERN SHURTAN FIELD

B.M.Abdullaev
Karshi state technical university
Email: bakhtishod.abdullaev@gmail.com
S.F.Mirzayev
Shurtan Gas Chemical Complex
Email: Saidolim123@yandex.ru

Abstract: Petroleum gas is a mixture of light hydrocarbons accompanying oil both in a free state in the form of bubbles and in a dissolved form. It consists of saturated hydrocarbons - methane, ethane, propane, butane, isobutane. According to preliminary estimates, about 1.2 - 1.5 billion m^3 of associated gas per year are burned at the operating fields of the Uzneftegazdobycha NHC Uzbekneftegaz. The use of the method of liquefying petroleum gases in oil field conditions suggests the use of new technologies.

Key words: oil gas, associated gas, field, pressure reduction, liquid fuel, hot pipe, gas-reducing, throttled, vortex tubes.

Annotatsiya: Neft gazi - bu neft bilan birga erkin holatda ham pufakchalar, ham erigan holda bo'lgan engil uglevodorodlar aralashmasi. U to'yingan uglevodorodlar - metan, etan, propan, butan, izobutandan iborat. Dastlabki hisob-kitoblarga ko‘ra, “O‘zbekneftgaz” MXK “O‘zneftgazdobicha” MKKning ishlayotgan konlarida yiliga 1,2-1,5 milliard m3 ga yaqin qo‘shma gaz yoqiladi. Neft konlari sharoitida neft gazlarini suyultirish usulidan foydalanish yangi texnologiyalardan foydalanishni taklif qiladi.

Kalit so'zlar: neft gazi, qo'shma gaz, kon, bosimni pasaytirish, suyuq yoqilg'i, issiq quvur, gazni kamaytiruvchi, drosselli, vorteks quvurlari.

Аннотация: Попутный нефтяной газ (ПНГ) представляет собой смесь лёгких углеводородов, сопутствующих нефти как в свободном состоянии в виде пузырьков, так и в растворённом виде. Он состоит из предельных углеводородов – метана, этана, пропана, бутана, изобутана. По предварительным оценкам, на действующих месторождениях НХК «Узбекнефтегаз» сжигается около 1,2–1,5 млрд м3 попутного нефтяного газа в год. Использование метода сжижения нефтяных газов в нефтепромысловых условиях предполагает применение новых технологий.

Ключевые слова: нефтяной газ, попутный нефтяной газ, месторождение, редуцирование давления, жидкое топливо, горячая труба, газоредукционный, дросселируемый, вихревые трубы.

Introduction

ISSN 3030-3907

During oil production, the gas dissolved in the oil (the so-called associated gas) is released from it when the pressure decreases. From one ton of oil in the field gas separations, up to 350 m^3 or more of petroleum gas are obtained, consisting of methane, ethane, propane, butane, etc. At first, associated gas was released into the atmosphere and burned in flares, and only a small part of it was used as fuel. In recent years, the LNG sector has been actively developing in the world.

In addition, small-scale LNG production is of considerable interest in the development of low-resource natural gas fields, since about 80% of natural gas fields in the world are low-resource fields. To develop low-resource fields, the global economy and energy sector need new, more efficient low-tonnage processes for liquefying natural gas. The introduction of fundamentally new technologies for liquefying hydrocarbon gases is especially important for modern Uzbekistan. The creation of such technologies can help solve the problem of energy supply to gas-rich regions at the local level, where large quantities of petroleum liquid fuel are imported annually, and increase the energy security of both individual regions and the country as a whole. Small-scale production of liquefied natural gas makes it possible to supply energy not only to the area where the mini-LNG plant is located, but also to other regions, including LNG exports.

Table 1

Characteristics of small-scale LNG plants

№	Customer	Liquefaction capacity	Объем хранения, $м^3$	Liquefaction process	Commissioning, year
1	BayerwerkAG, Gablen (Germany)	45 kmol/h (6700nm^3/h)	60	Condensation of CH_4 with liquid N_2	1998
2	AGA Company, Tjeldbergodlen (Norway)	58 kmol/h (6700nm^3/h)	200	Condensation of CH_4 with liquid N_2	1997
3	EnergyEquityCorp.Ltd. AliSpringe(Australia)	58 kmol/h (6700nm^3/h)	200	Nitrogen cycle with turboexpander	1989
4	InlusrtyandCommereeGrupCo.Ltd Tuha deposit, Chang Chang, Hin-Yang (China)	58 kmol/h (6700nm^3/h)	30000	Closed loop cooling implemented in MRI	2004

Currently, gas from the Northern Shurtan oil field is pumped to a gas processing plant using a compressor station for the utilization and processing of

ISSN 3030-3907

associated gases.

Table 2

Composition and parameters of associated petroleum gas from the Severny Shurtan field sent for compression to the BCS

Composition of PNG S.Shurtan		CH_4	C_2H_6	C_3H_8	iC_4H_{10}	nC_4H_{10}	iC_5H_{12}	nC_5H_{12}	C_6H_{14}	N_2	CO_2	H_2S	Total
%		**84,94**	**7,15**	**2,47**	**0,63**	**0,87**	**0,29**	**0,23**	**0,34**	**0,81**	**2,19**	**0,08**	**100**
year	m^3/year												
2016	17,41	14,7881	1,2448	0,4300	0,0027	0,1515	0,0505	0,0400	0,0592	0,1410	0,3813	0,0139	**17,30**
2017	14,965	12,7113	1,0700	0,3696	0,0023	0,1302	0,0434	0,0344	0,0509	0,1212	0,3277	0,0120	**14,87**
2018	14,215	12,0742	1,0164	0,3511	0,0022	0,1237	0,0412	0,0327	0,0483	0,1151	0,3113	0,0114	**14,13**
2019	9,856	8,3717	0,7047	0,2434	0,0015	0,0857	0,0286	0,0227	0,0335	0,0798	0,2158	0,0079	**9,80**
2020	8,151	6,9235	0,5828	0,2013	0,0013	0,0709	0,0236	0,0187	0,0277	0,0660	0,1785	0,0065	**8,10**

Technological parameters of gas:

- pressure 0.05-0.1 MPa;
- temperature – 10-40 °C.

To utilize associated petroleum gas from the Severny Shurtan field, it is necessary to provide a gas transportation system to the Shurtan gas compressor station. Due to the fact that the pressure of the utilized gas is very low, it is proposed to build a booster compressor station (BCS) located on the Severny Shurtan joint venture site for its transportation to the Shurtan gas compressor station.

Associated petroleum gas from the joint venture with a pressure of 0.1 MPa enters the gas compression system of the Severny Shurtan BCS.

Compressed gas from the DKS Severny Shurtan with a pressure of 1.0 MPa is sent to the DKS GS Shurtan, located in the area of GS Shurtan. Preliminary hydraulic calculation of the gas pipeline-collector "DKS Severny Shurtan - GS Shurtan" was performed for a capacity of 47.7 thousand m^3/day. The pressure and

ISSN 3030-3907

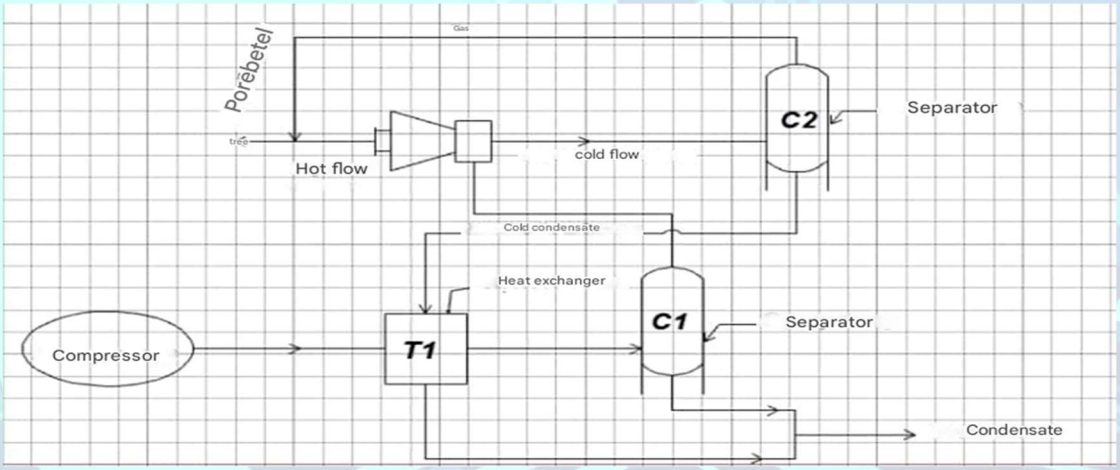
temperature of the gas at the beginning of the gas pipeline are 0.5 MPa and 50 °C, respectively. The length of the gas pipeline-collector is 17.0 km.

Table 3

Total loads

Name	Estimated power, kW	Annual electricity consumption thous. kWh
Main area	219,67	1460,43
Auxiliary purpose area	33,60	152,71
Total for DKS	253,27	1613,14

This technology is most advantageous for use in northern fields, and since the vortex tube produces heat in addition to cold, it is possible to use free arctic cold to cool hot gas, which, intensively cooling in a hot heat exchanger, also goes to liquefaction, which in practice allows doubling the liquefier's productivity. And this creates the possibility of obtaining a significant economic effect. That is, with this technology for producing liquefied natural gas, the used arctic cold also becomes a commodity. In natural gas liquefaction units (NGLU) for small-scale LNG production, liquefied natural gas is used as a refrigerant. In this case, liquefaction CYCLES are used: with throttling, expander, vortex tube. In these units, the liquefaction coefficient does not exceed 0, and natural gas must be pre-compressed



by a compressor or use the pressure of the main gas pipeline.

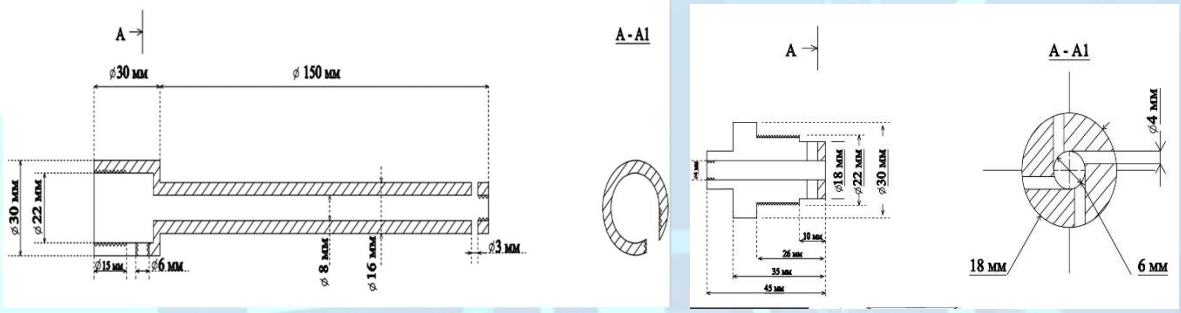
Figure 1. Proposed flow chart for utilization of associated gas from the Northern Shurtan field

A vortex tube can be used as a liquefaction unit instead of an expander. A vortex tube is a short section of a conical metal pipe with one inlet and two outlet pipes. Between these pipes there is a so-called "snail" - a gas guide, made according to the Archimedes spiral.

ISSN 3030-3907

When a gas flow is fed to such a spiral, it spins around the geometric axis of the pipe, is compacted under the action of centrifugal forces and forms a peripheral vortex, moving in its rotation along the inner wall of the cone towards the hot end. Having reached the end of the pipe, part of the flow exits through the throttle, and the other part, having reflected from the rear wall (reflector), forms a reverse axial flow. During rotation, the gas flow is subjected to very intense centrifugal accelerations reaching several thousand g (g = 9.81 m / sec^2 - acceleration of gravity), leading to the appearance of powerful inertial forces that initiate the occurrence of an intensive (but still unclear to researchers) process of energy exchange between the counter-moving flows. As a result, the peripheral flow is heated and in a hot state exits through the branch pipe of the hot end, and the axial flow is cooled and in the cold end.

When compressed gas with a temperature of +200 C is supplied to the inlet pipe, gas with a temperature of -35 ^{0} C emerges from the cold pipe (in Fig. 4.37, you can see how the pipe freezes intensively), and from the hot pipe - with a temperature of +500 C. Although vortex tubes have been known since 1931, they have not yet found wide application as refrigeration devices.



A) B)

Figure 2. Vortex tubes. A) "Snail" B) Vortex body

But time goes by, and new types of vortex tubes with increased efficiency appear. At the same time, it becomes clear that the economic efficiency of their use is not always limited to efficiency, and if all technological, operational, environmental and other aspects are taken into account, then such very simple refrigeration devices often turn out to be the most suitable for widespread use, including for creating original gas liquefiers. Such liquefiers are mounted on gas-reducing stations (GRS) and use the “free” pressure drop when distributing gas to consumers for their work.

CONCLUSION

The conducted studies have shown that liquefiers with a vortex tube instead of an expander have the following main advantages:

- less sensitivity to changes in gas composition;

ISSN 3030-3907

- less sensitivity to the appearance of liquid droplets (a centrifugal expander can suffer a serious accident because of this);
- very short start-up time (the vortex tube has low inertia and reaches operating mode within a few seconds);
- simple design and no requirements for highly qualified service personnel - the liquefier is capable of operating for a long time in autonomous mode without qualified maintenance;
- no need for external load devices (electric generator, etc.);
- high service life due to the absence of moving parts and determined only by the wear resistance of the materials used and the degree of gas purification from abrasive particles;
- the possibility of more flexible regulation for continuous optimization of operation with changing input pressure, changing gas composition, etc. That is, the same liquefier can operate in different fields without significant modifications;
- very low cost.

REFERENCES

1. Рачевский Б.С. Сжиженные углеводородные газы. -М.: Изд-во «Нефть и газа», 2009.
2. **Бузником В.М. И**новационные технологии переработки и использования попутного нефтяного газа.-М.: Изд-во «Оригинал-макет», 2010.
3. Кисленко Н.Н., Мурин В.И. Сурков Ю.В. Технология переработки природного газа и конденсата. //Справочник. М. «Недра-Бизнесцентр» 2002.
4. Bakhtishod, A., & Abdurasul, B. (2025). NATURAL GAS PURIFICATION FROM HIGH HYDROCARBONS IN A VORTEX TUBE. Universum: технические науки, 11(5 (134)), 29-32.
5. Abdullaev, B. M., & Sayfullaev, T. K. (2023). Analysis of the causes of accidents in gas pipelines transport, national economy and main pipelines. journal of multidisciplinary bulletin, 6(4), 123-126.
6. Torayevich, K. M. (2023). Determination of the influence of the composition of catalysts on the catalytic characteristics. journal of multidisciplinary bulletin, 6(5), 8-15.
7. Torayevich, K. M. (2023). Development of hybrid catalyst and synthesis of liquid hydrocarbons based on them. journal of multidisciplinary bulletin, 6(5), 1-7.
8. Karshiev, M. T., Kh, S. T., & Abdullaev, B. M. (2023). Purification of natural gas from co2 by adsorption method. journal of multidisciplinary bulletin, 6(5), 62-76.

ISSN 3030-3907

9. Xayrulla o‘g‘li, S. T. (2022). Yo‘ldosh gazlarni qayta ishlash zavodlaridagi korroziya bilan bog‘liq muammolarni yechishda ingibitorlardan foydalanish. Journal of new century innovations, 10(4), 20-22.
10. Rahmatovich, C. N., & Xayrulla o‘g‘li, S. T. (2022). Yo‘ldosh gaz-kondensatlarini barqarorlashtirish qurilmalarida ingibitorlardan foydalanish. Journal of new century innovations, 10(4), 23-25.
11. Abdullaev, B. M., & Sayfullaev, T. K. (2024). Cobalt fischer–tropsch catalyst regeneration. journal of multidisciplinary bulletin, 7(1), 105-113.
12. Kh, K. S., & Abdullaev, B. M. (2025). EFFECT OF PROMOTER METALS ON CATALYST ACTIVITY IN PROPANE-BUTANE FRANCOATION. FARS International Journal of Education, Social Science & Humanities., 13(6), 453-461.
13. Boboniyozovich, R. X., Mengliqulo‘G‘Li, A. B., Ulug‘Beko‘G‘Li, U. E., & Rustemuli, M. B. (2025). KREMNIYLI SEOLITLARDA N-GEKSANNI AROMATLASH. Sanoatda raqamli texnologiyalar/Цифровые технологии в промышленности, 3(1), 186-189.

ISSN 3030-3907