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МАЛОТОННАЖНОЕ ПРОИЗВОДСТВО СЖИЖЕННОГО ПРИРОДНОГО ГАЗА НА БАЗЕ ПОПУТНЫХ НЕФТЯНЫХ ГАЗОВ МЕСТОРОЖДЕНИЙ

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В данной статье рассматриваются способы утилизации попутного нефтяного газа, который является ценным источником энергии и сырьевой базой для топливной и химических отраслей промышленности. Обсуждается возможность получения сжиженного природного газа на базе попутного нефтяного газа, предлагается энергоэффективная технологическая схема для получения СПГ на базе ПНГ.

Ключевые слова: Попутный нефтяной газ, сжиженный природный газ, фракционирование, малотоннажное производство, утилизация попутного нефтяного газа, широкая фракция легких углеводородов (ШФЛУ).

LOW-TONNAGE PRODUCTION OF LIQUEFIED NATURAL GAS BASED ON ASSOCIATED PETROLEUM GAS FIELDS

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This article discusses the ways of utilization of associated petroleum gases, which is a valuable source of energy and a feed base for the fuel and chemical industries. The possibility of liquefied natural gas production based on associated petroleum gas is considered and an energy-efficient technological scheme for LNG production based on the usage of APG is proposed.

Keywords: Associated petroleum gas, liquefied natural gas, fractionation, low-tonnage production, utilization of associated petroleum gas, natural gas liquids (NGL).

Scientists have been thinking about a useful utilization of APG in industry since the last century. Originally, oil and gas condensate fields APG was considered as a difficult to transport by-product, it was burned at gas flares most often. It was regarded as the simplest way of utilization, which did not require complex production technologies and implementation of expensive facilities. However, gas flaring leads to huge missions of pollutants such as carbon dioxide, soot, etc. Such releases have a negative impact on the world's environmental situation.

Associated petroleum gas is a form of natural gas, which is dissolved in oil, a mixture of hydrocarbon and non-hydrocarbon gases containing a significant proportion of C₃₊ alkanes, which in turn are the feed base for the chemical and energy industries.

Nowadays, the majority of promising APG utilization methods have emerged due to the development and deepening of production technologies, manufactures and machines designing:

- gas is injected into the reservoir to increase oil production at the field. In order to recover gas condensate fields, a full or partial sidetracking process is used, which consists in injecting of light hydrocarbons obtained after processing of produced gas condensate into the reservoir. This method is expensive and is mostly realized abroad. [3,5]
- APG is used to generate electricity for own needs of production because of the great remoteness of the field from the consumer. This option is beneficial for small fields, which can also provide electricity to local consumers. [3,5]
- fractionation to obtain natural gas, natural gas fluids (NGL), as well as heavier C₅₊ components. Gas petrol obtained from heavy fractions is used as fuel. Then NGLs are sent for further processing and obtaining a feed base for production of polymers, motor fuels, oils, plastics, alcohols, etc. This option is suitable for medium-sized fields. [3,5]
- Cryogenic processing using small liquefaction or process features in LNG plants and gas processing plants, which include facilities for production of LPG for the usage of gas field or for transportation to energy markets [3,5].

Let us consider more detailly the direction of APG utilization with the production of liquefied hydrocarbon fuel. The reason of small realization at low-tonnage LNG projects is considered to be low profitability because of limited production capacity. In comparison, large-scale production facilities require a necessary LPG separation as a part of the process chain in most of liquefaction processes. At the same time, cryogenic APG generation is successfully realized at small liquefaction plants on the basis of gas distribution stations (GDS) and automobile gas filling compressor stations. The efficiency of these plants in terms of final product's yield is not as high as it could be due to application of an open refrigeration cycle. The liquefaction ratio of these plants depends on the pressure drop and chosen cooling method, such as throttling, expanding or energy separation in a vortex tube. The undoubted benefit of these plants is the minimal energy consumption for liquefaction [2,4].

Currently, one of the most innovative technologies for APG processing and LNG production is NGL Pro, developed and patented by ASPEN, which is widely used in the USA and Canada (Figure 1).

The technological process is as follows: feed goes into a three-phase separator, where the liquid phase, associated petroleum gases and depleted gas are extracted. APG, passing through pre-cooling, is sent to the stabilization column, where the residue light hydrocarbons are separated and then are sent back to the cycle, which passes through a reboiler. Heavy hydrocarbons are sent to the reservoir [1].

This method is suitable for processing associated petroleum gases and obtaining light hydrocarbon fractions, which can be liquefied at the refrigeration plant further. Also, it should be noted that this cycle does not require any of expensive equipment, absorbers for gas drying, refrigeration cycles. The advantages of this technological scheme can be mentioned:

- the possibility of obtaining LNG as one of the methods of APG utilization;

- removal of most of the water and liquid phase in the three-phase separator reduces a chance of hydrate formation in the units;
- small number of equipment units hence the portability and easy maintenance of such plants.

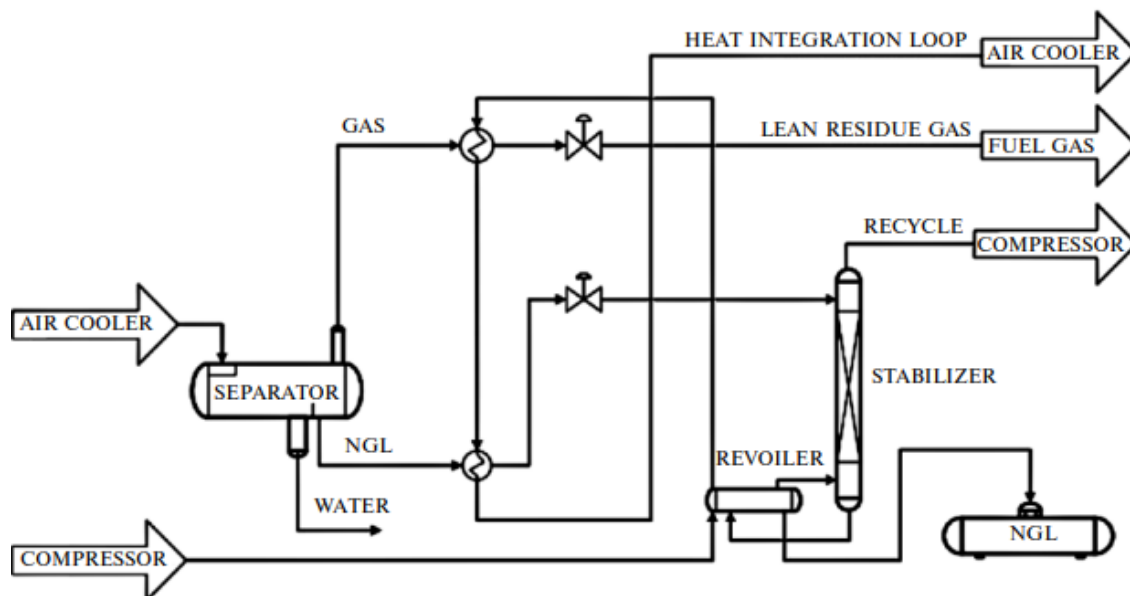


Figure 1 – Flow diagram of the NGL Pro process

Source: Shcherba V.A., Gomez A.S.S., Vorobyev K.A. *Problems and prospects of associated petroleum gas utilization in the Russian Federation. Problems of regional ecology*. 2019. №1. pp. 134-144.

Thus, it can be concluded that associated petroleum gas processing technology of LNG production is a perspective and important area of the oil and gas industry of in country. The use of available technologies and those considered in this paper can significantly increase the depth of APG processing, as well as provide energy autonomy of individual modules and territories due to the use of LNG. Moreover, modern approaches of gas processing will allow our country not only to reduce the number of harmful emissions (by reducing the amount of fuel flared), but also to provide consumers with a high-quality product. It cannot be denied that that Russia has great potential to become a leader in the global market for gas and oil refined products.

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