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ENVIRONMENTAL RISKS OF SHALE GAS PRODUCTION FROM GAS-BEARING AREA OF UKRAINE

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In this article the problem of shortage of natural gas in Ukraine as one of the key factors of national energy security. The present state of the fuel and energy sector, the reasons for shortages of natural gas domestic production, alternative perspectives extract gas from shale. The problems and environmental threats and risks associated with the prospects of development of alternative sources of shale gas on the basis of a detailed analysis of its production technology. Comparisons experience with shale gas extraction in the United States, where the technology used for the first time, and the consequences of violations of environmental safety

Keywords*: shale gas, soil erosion, pollution of groundwater, hydraulic fracturing, horizontal drilling*

Statement of the problem. Lack of fuel and energy resources in Ukraine and its dependence on external supplies pose a potential threat to the economic security of the country as a whole, and energy security in particular. Under the country's energy security is usually understood state's ability to provide effective use of fuel and power base, make optimal diversification of sources and routes of energy supply, and realize energy saving potential balance the supply and demand for fuel and energy resources [1].

Analysis of the ratio of the production and consumption of energy in Ukraine show the difficult position oil and gas industry. Oil and condensate in Ukraine during the 1998-2011 biennium was maintained at 3,7-4,5 million tons per year, gas production at the level 18 billion m^3 per year. During the analyzed period, crude oil and condensate was approximately 19 million tons per year, the consumption of gas - 81 billion m^3 [2]. Thus, the availability of Ukraine's own energy production does not exceed 28% for gas and 24.2% - of the total oil needs. Energy dependence on imported energy, especially oil and gas, is a major threat to sustainable development of the national economy. The price of Russian gas imports (total volume of which is about 40 billion m^3) is too high ($ 436 in the second half of 2012) for the development of the industrial sector. Shortage and

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high cost of hydrocarbons pushing course of national development to increase the volume of domestic gas.

Exploring the problem of shortage of energy resources of its own production in Ukraine, its origins reveal the following picture: oil and gas, which is actively maintained, almost exhausted investment in further intensification of production they become unprofitable. Output is seen in the development of alternative fields, so-called unconventional gas. One of the areas currently considered to shale gas development feasibility of which in Ukraine is not justified, require thorough study and consideration of both economic benefits and side effects.

Analysis of recent research and publications, which discuss the problem. According to the agency US EIA (U.S. Energy Information Administration) [3], the amount of research and estimated reserves of shale gas in Ukraine is 1.2 trillion. cu. meters, which puts Ukraine in fourth place in Europe in terms of reserves of this type of fuel after Poland, France and Norway [4].

In Ukraine promising gas-bearing areas are Yuzovskiy (Kharkiv, Donetsk region) and Olesko (Lviv region) areas. As of February 2012 the State Service of Geology and Mineral Resources of Ukraine assesses prospective reserves of conventional and unconventional gas Olesky and Yuzovskiy-bearing areas in the 7 trillion cubic meters [5]. Shale gas - is, in fact, similar to the same natural gas produced in Ukraine and imported from Russia, with the only difference that it is not contained in huge natural underground reservoirs, but in small traps in the shale [7]. That is, to extract shale gas is not enough to drill a vertical hole. Technology exploitation of shale deposits is to use so-called hydraulic fracturing (GDP). Initially, during drilling, the method of horizontal directional drilling (HDD) is controlled trenchless method of laying underground utilities, based on the use of special drilling systems (plants). Symbol of the method is the HDD, or Horizontal Directional Drilling. Length of routing paths can be anywhere from a few meters to several kilometers, and the diameter - more than 1200 mm. Subsequently, drilled hold GDP that in shale rock cracks. Then injected under high pressure into the well 98,0-99,5% mixture of water and sand and 0.5-2.0% of chemicals. A mixture of tears "pores" in shale rock through which the gas is released from the many small traps.

The experience shale gas extracting shows that the application of the intensification of the flow of gas, especially fracturing combined with horizontal drilling is almost always a necessary element for extracting gas from shale gas [14]. Another essential element is the detailed evaluation of filtration-capacitive properties of gas shale. By 1998 the majority of gas wells that have been drilled in gas shale in the basin of Fort Uors (USA), methods used so-called massive hydraulic fracturing using from 40 to 400 tons of special material with granules that it pumped into reservoir to prevent the closure of cracks) in the borehole. This method is quite expensive and often ineffective due to detected problems with the "pollution" of the gel propane. In 1998 a new

methodology lightweight GRP was introduced. It involves the rejection of the application of the gel, whereas the current method requires the use of significant amounts of water. For example, in a typical horizontal wells drilled in shale gas during hydraulic fracturing, used from 11 000 to 15 000 m^3 of water. Water treatment crack formation costs less than treatment gel, but most importantly, it is effective. Note that ensure the well so much water is not always easy. During lightweight GRP than water, the total content of which is in the pumping fluid 99.5%, and add the following components: surfactants, solution of KCl (potassium chloride) gel corrosion inhibitor, acidity regulator, the regulator of iron, lubricants, hydrochloric acid, etc.

During the work of the GDP should be possible to observe the technology to chemical reagents that they pumped into reservoir with water, do not fall into groundwater and artesian pressure fresh water pools. Otherwise, you may be inflicted great damage not only to the health of people living near areas of exploration, but the ecosystem as a whole [8]. In the U.S., for example, there was a scandal involving violations of the rules of the largest hydraulic fracturing service companies [9]. In particular, in 2003 the Agency for the Environment Initiative of voluntary memorandum revealed three major service companies involved in hydraulic fracturing (Halliburton, BJ Services, «Schlumberger" "to stop using diesel fuel as a carbon agent for mixtures of GDP. Note that in 2005 Congress removed hydraulic fracturing practices of the current law on the protection of drinking water (SDWA), and service companies can use any type of fluids for hydraulic fracturing except diesel fuel. However, most service companies are systematically violated that agreement: for example, the company Halliburton has admitted that in 2005 and 2007 used 807,000 gallons of fluid containing diesel in varying combinations. Given the fact that shale gas wells requires much more than for conventional production, the American public is seriously concerned about the possible extent of groundwater contamination.

The purpose of research. The aim is to study the impact on the state agro-ecosystem and biogeocenosis unconventional gas production methods and ways to neutralize this effect.

Objective: to establish links between the characteristics of shale gas technology and environmental condition of the surrounding areas and agro-industrial complex based on the experience of leading foreign extractive companies.

Materials and methods of studies. The results are based on data from the evaluation of gas reserves in certain areas bearing Ukraine, conducted by the State Service of Geology and Mineral Resources of Ukraine, the analysis of the application of conventional methods for horizontal directional drilling and hydraulic fracturing in shale gas described by both domestic and foreign scientists. Methods graphical analysis of state geological maps of Ukraine was used [8] as well as analytical and synthetic approach to the study of environmental effects of the use of natural gas fields on the experience of international companies.

The research results. For example, consider Olesky gas-bearing region. The presence of regional faults north-western and north-eastern areas at the site and related fracturing rocks all sedimentary strata is naturally a negative factor as a real threat to drinking fresh and mineral underground waters. Impermeable strata in their natural state power of 1 km between the Silurian and chalk ceases to be impermeable during hydraulic fracturing because of the presence of zones. Drinking water in the course of work on GDP is likely to be contaminated with chemical reagents that will pump in the reservoir with water and the zones of fracturing enters the aquifer in the Upper Cretaceous sediments - the main aquifer drinking water supply in the area and Olesky in adjacent to it, and in the other aquifers. The greatest danger exists for water located in the Volyn-Podolsk Artesian Basin. It can be contaminated not only drinking water intakes available groundwater and mineral water that is bottled in factories, but also water wells settlements because there fracturing zones penetrate the entire thickness of sedimentary rocks - from Silurian to Quaternary sediments. Drinking water, located in the Carpathian Artesian Basin west Olesky areas (mainly in the Quaternary aquifer system sediments), vertically and laterally by a thick impermeable clay material (Sarmatian clay), in which almost no fracture zone.

Concern of environmentalists is that the production of unconventional gas is accompanied by exclusion of a large number of lands and intensification of human activities, including protected areas. The difference of unconventional gas extraction from the traditional is that for a fuller exploration potential field wells should cover as much of the underground gas horizon. Therefore it is necessary to drill a lot of holes. For example, in the field Barnett Shale, USA, at the end of 2010 was nearly 15,000 wells drilled in the area of 13000 km^2. The average density, thus, is about 1.15 holes per 1 km2 (100 ha), but locally the frequency of wells can be up to 6 wells per 1 km^2 [12]. On average, the development of one square mile (259 hectares) of shale gas deposits usually require 16 vertical wells, each with its own well sites, access roads and industrial pipelines [13].

So the question arises, especially in populated areas, the allocation of land for drilling, as well as access roads and construction of related infrastructure (gas and water treatment companies, network gas, etc.). Such infrastructure and construction projects at the same time realized create environmental risks of accelerated erosion. The report of the Agency for the U.S. Environmental Protection (EPA) determined that the area of one hectare (2.47 acres) is a common area for the alienation of land for drilling, access roads and pipelines. Increased traffic to deliver equipment and necessary for the drilling and hydraulic fracturing materials (for drilling one well in previous years had to be up to 1,000 truck trips) leads to disruption of existing roads, culverts and bridges, which accelerates soil erosion and increases road dust deposition in reservoirs adversely affecting the biodiversity of the aquatic environment. Construction of all-weather (paved) roads, but soil erosion,

can also lead to fragmentation of forests and fields that have a negative impact on individual living organisms [14].

The above demonstrates the need for comprehensive preliminary detailed hydrogeological studies [10], especially for the Study of fracturing as migration ways of chemicals into the upper aquifers.

In addition to high environmental risks in shale gas fields have a number of disadvantages associated with high strength rock (which makes drilling) and low capacitive-filtration properties, which negatively affects both the size of the deposit, and the mode of operation of the deposit.

Extractive companies often argue about the 30-40-year period of the production life of wells for shale gas, but time has shown [11] that the average term commercial life of horizontal wells is about 7.5 years.

The inevitable impact of shale gas (as well as other minerals) is manifested in the use of large areas of land for drilling platforms, maneuvering areas for trucks, equipment, facilities processing oil sludge and drilling mud, discharges barns and driveways. The main possible negative factors are the emissions of air pollutants, groundwater contamination uncontrollable gas and liquid flows, fluid leakage and uncontrolled discharge of formation water discharges in the barns. Extractive liquid containing dangerous substances and formation waters, in addition, also heavy metals and radioactive materials from the fields.

The U.S. experience shows: using powerful hydraulic fracturing in the shale gas occurs many accidents that cause damage to the environment and human health. Documented violations of legal requirements vary between 1-2% of subjects who received permits to conduct drilling operations. A large number of these accidents happen due to improper handling of equipment and leaking equipment. Moreover, given groundless strong GDP in large areas of developed industrial areas in the shale gas is fixed groundwater contamination by methane, which sometimes leads to explosion of residential buildings, as well as pollution of potassium chloride, which causes salinization of drinking water. The degree of influence increases as shale gas being developed with high density, up to six wells per square kilometer. Special dangers carry the greenhouse gas emissions.

Process leaks volatile methane (after hydraulic fractures can have a huge impact on the balance of greenhouse gases. Existing estimates give a range of 18 to 23 grams of CO_2, equivalent to 1 MJ of extraction of unconventional natural gas. Dimensions of methane entering the aquifers are still appreciated, but we know that at some sites they may vary (depending on the productivity of wells and other factors) is ten times [11].

Conclusions. The study methods imperfections and negative effects of shale gas in agroecosystems is to encourage the responsible persons to be conservative in making decisions on

the use of the above technologies. It should be perfect to explore the experience of countries that have been developing shale gas (eg USA, Poland): to learn more about technology and related mechanisms of their initial and subsequent impact on the agro-ecosystem. The increasing hydrocarbon own production needs and financial interests of the international gas corporations should not lead to environmental disasters, and exclusion in communities living in areas of natural gas production and its surrounding them.

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