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Editorial

Advances in Oil and Gas Production: A Viewpoint

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Nowadays, there is a global trend towards "green" industry, which implies the reduction in carbon emissions from various industrial processes. In this regard, power generation is seen as one of the key contributors to the greenhouse effect. Renewable energy is considered to be the main means of transition to a carbon-neutral economy. Although the share of renewables in global power generation has steadily increased since the beginning of the century, it accounted for only 13% in 2021 [1]. Not accounting for coal, which saw a rapid increase in consumption in 2021 after a continuous decline, oil and gas are the major resources used for energy production. Thus, until renewable energy is able to cope with such problems as the efficient generation and storage of produced energy, oil and gas will provide a steady power supply for consumers. As the sustainable development of modern society is impossible without reliable energy sources, hydrocarbons will be essential for the world energy market for years to come.

At the same time, traditional petroleum fields are being depleted. New deposits of oil and gas are located in remote and hard-to-reach regions, such as the Arctic, with complex geological and rock characteristics. In addition to complicated conditions of petroleum production in these areas, environmental concerns are of great importance. An urgent trend is the reduction in carbon footprint in oil and gas production [2]. In this regard, this Special Issue of *Energies*, "Advances in Techniques of Construction, Development and Operation of Oil and Gas Wells", dealt with the problems of modern techniques and approaches during the entire life cycle of petroleum wells, including the topics of well construction and operation.

Complex geological and rock conditions of the petroleum fields found in remote areas require a specific approach to well drilling in such circumstances. One of the important and fast-developing topics here is the various technical fluids, used for drilling, cementing, and the completion of wells. Various-based drilling muds are used for construction of wells under conditions of abnormally high or low formation pressure, unstable wellbore walls, narrow mud weight window in horizontal wells, temperature distribution along the wellbore, etc. At present, there is an existing tendency to replace the water-based drilling muds, which are the most widespread type of such systems, with hydrocarbon or synthetic-based fluids. These systems enhance the stability of weakly cemented wellbore and increase the rate of penetration, specifically if used together with polycrystalline diamond composite bits. Another advantage is undoubtedly efficient penetration of the reservoir, which allows the preservation of its filtration characteristics for subsequent production. Several investigations showed the results of lab experiments on hydrocarbon-based systems, as well as its pilot tests under field conditions, together with destructor solutions. Hydrocarbon-based solutions with corresponding destructors may be efficiently used for well cleaning from reaction products in the wells with low bottomhole temperature [3]. On the other hand, it is more difficult to control the equivalent circulation density of such drilling systems, because the increasing temperature along the well will affect the rheological properties of the fluids. Ecological issues are another concern. When constructing offshore wells, it is often undesirable to use hydrocarbon fluids because of the possible damage to the environment. Therefore, water-based muds remain the relevant solution for drilling. A

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promising type of the water-based drilling system is the formate system. Today, research is aimed at developing new compositions of these fluids, which are able to overcome existing limitations [4].

Subsequent operation of the wells, characterized by complex geological and rock conditions and fluid properties, is often complicated by various factors, such as curved wellbores, excessive fracturing, high viscosity and density of oil, the presence of solids in the extracted product, increased content of asphalt–resin–paraffin particles in the fluid, a high gas–oil ratio, etc. In this regard, new equipment and technologies of its application are required to provide for stable and productive oil and gas extraction. Thus, directional and horizontal wells with high-viscosity oil can be efficiently operated by progressive cavity pumps. New insights into their design allow a reduction in the vibration and shock effects, which may occur in the deviated wellbores. Another issue, for example, is the increasing content of gas and solid particles in the produced oil in the wells operated by submersible electric pumps. This complex problem may be countered by equipping the pumps with special separators and filters [5].

The operation of offshore fields with platforms of various structure is a separate issue. The Arctic region, which is seen as one of the most promising in terms of hydrocarbon reserves, is characterized by especially complicated climate conditions. This requires new approaches to calculating the environmental loads, e.g., ice loads, acting on the surfaces of offshore platforms and ships. These methods are surely important for the efficient development of oil and gas fields located at sea [6].

Several other issues, which were not directly addressed in the Special Issue, are also relevant for the efficient operation of the petroleum fields. They consider the processing and treatment of the extracted crude. Often, complicated conditions of field operation require the injection of various agents into the well or addition of reagents to extracted fluid. In remote fields, where it is difficult to transport the required chemical compounds, it is possible to produce them from the crude or associated petroleum gas. This will allow not only to lower the logistical costs but also to reduce the carbon footprint of petroleum extraction [7,8].

Regarding the development of the oil and gas industry, we should stress another important issue: the qualification of the engineers and specialists working in this field. The sustainable-development goals set by the United Nations, such as affordable and clean energy, require a specific approach to education, obtained by future specialists, primarily at universities [9]. In this regard, the educational programmes of Saint Petersburg Mining University may be taken as a relevant example. There, students of petroleum specialities are studying not only the main principles of oil and gas production but also the questions of its energy efficiency and environmental safety [10].

We conclude that oil and gas will be vital for the sustainable development of the society in the coming decades. The trend is undoubtedly towards renewable and alternative sources of energy. However, until renewables are able to cope with the enormous task of efficient and stable power supply, the issue of advancing the petroleum industry is urgent.

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Short Biography of Author

Valentin Morenov is an associate professor of Department of Oil and Gas at Saint Petersburg Mining University, Saint Petersburg, Russia. His scientific interests include the issues of sustainable petroleum production. Related topics are also considered in the research projects: utilization of petroleum gas; power supply of oil and gas fields; treatment and processing of crudes in the field conditions; carbon capture, use and storage at petroleum fields.