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PETROLEUM PRODUCTION IN THE ARCTIC: COST-EFFECTIVE TECHNOLOGIES AND APPROACHES

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According to the United States Geological Survey (USGS), the area of the Arctic Circle holds enormous reserves of hydrocarbons estimated at 90 billion barrels and could also contain up to 1,770 trillion cubic feet of natural gas. Five countries have claimed some of the resources – Russia, Canada, Denmark, Norway, and the USA. .

However, Arctic oil exploration and production is much more technically challenging compared to other environments [1], [5]. It is considered to be a high cost venture with many risks and facing numerous obstacles such as an extreme climate, a poor existing infrastructure, very long project lead times, more complex spill containment contingencies and competition from other sources of hydrocarbons. Despite these challenges, technological improvements are making Arctic oil more accessible, and though the oil price is not as high as it used to be, some countries have implemented approaches and technologies, which allow reducing the cost of Arctic oil production.

This paper describes the experience of different countries in applying enhanced oil recovery (EOR) technologies and implementing cost-effective approaches to petroleum production under the harsh climate and fragile environmental conditions of the Arctic.

Since exploration activities in the Arctic are connected with high costs and short operating time, Schlumberger is focusing on integrating techniques to prioritize exploitation targets. For instance, PetroMod petroleum system modelling software is used to assess basin potential by tracking hydrocarbon generation, maturation and accumulation. The results are presented as 3D geologic models that are fully scalable from regional to prospect scale. The experts believe that such modelling allows improving exploitation risk assessment in advance of field operations, and time and effort can be concentrated in the areas with greatest exploration potential, while avoiding the areas with lower chances for success.

As for the next stage of oil production, i.e. drilling operations, one of the improving measures is using casing while drilling (CWD) [1]. This technique employs well casing as a drillstring: the casing is equipped with a drill bit at the bottom rotated until the target depth is reached and then cemented. CWD allows drilling and setting casing through problematic zones in one operation with relatively low flow rates to avoid hole enlargement. The low flow rates, in their turn, make it possible to use lighter rig equipment reducing the minimum ice thickness required during rig moves, thereby lengthening the winter-season operating time.

Since well cementing in the Arctic area is particularly challenging, Schlumberger developed ARCTICSET, the cement designed for low-temperature operations across permafrost zones. this cement is of specific composition, which implies low heat of hydration and makes heat release in cement setting minimal.

British Petroleum has operated in the US Arctic for several decades and develop nine onshore fields on Alaska's North Slope. Over this time, the company successfully implemented a number of innovative technologies. The case in point is Bright Water, which is a microscopic, thermally-activated particle based on a BP concept [2]. It expands deep in the reservoir, diverting injection water into poorly swept areas of the reservoir, thereby increasing oil recovery. BP has deployed Bright Water in more than 14 wells Arctic-wide - at an average cost of 6 dollars a barrel.

Another development is LoSal EOR, which is a BP breakthrough low salinity waterflooding technology that increases oil recovery compared to conventional seawater flooding. The world's first deployment of LoSal EOR will be at Clair Ridge in the North Sea - at a development cost of 3 dollars a barrel. There are additional benefits with the use of low salinity water, such as reduced risks of reservoir souring.

A new polymer EOR project planned by BP for Quad 204 in the North Arctic follows a different low-cost approach. Whilst the operating costs of adding polymers to injection water are not immaterial, the project requires only limited capital expenditure and is expected to give significant improvement to reservoir sweep and oil recovery.

Gazprom's operating concept for the Russian shelf implies a comprehensive approach to the pre-development of the fields in the Barents, Kara and Pechora Seas and the Sea of Okhotsk [2]. This approach implies the development of groups of closely located fields, which allows optimizing costs and creating conditions for the simultaneous development of large and relatively small offshore fields. For instance, the Prirazlomnoye and Dolginskoye oil fields in the Pechora Sea are scheduled for joint development.

The above-given overview shows that it is not only EOR that can significantly improve the petroleum production and reduce relevant costs. Different companies apply various methods and approaches to enhance their operations within different sectors of petroleum industry (exploration, recovery, refinery, transportation, etc.). Currently, when the global petroleum market is not stable and there are peaks and troughs in oil prices, the adequate way to make petroleum production cost effective is to implement a complex of measures relevant to all three petroleum production component- upstream, midstream, and downstream.

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