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## INNOVATIVE TECHNOLOGIES FOR HEAVY OIL PRODUCTION INTENSIFICATION IN UKRAINE

Heavy oil fields are characterized by increased density, low mobility, and high content of resins and asphaltenes, which makes conventional production methods inefficient. In Ukraine, the relevance of heavy oil extraction has increased due to the depletion of light oil reserves and the growing importance of domestic hydrocarbon sources for national energy independence [1]. Therefore, the application of innovative Enhanced Oil Recovery (EOR) technologies becomes essential to improve recovery efficiency in heavy-oil-bearing formations.

The aim of this research is to analyze innovative methods of heavy oil production intensification and to assess their applicability to Ukrainian geological conditions. The study is based on a comparative analysis of international and Ukrainian experiences, focusing on thermal, chemical, and hybrid recovery technologies.

Thermal methods such as cyclic steam stimulation (CSS) and steam-assisted gravity drainage (SAGD) are proven to reduce oil viscosity and increase mobility through heat transfer (Figure 1). These methods typically yield an additional recovery factor of 10–30% for viscous and extra-heavy oils, depending on formation depth and temperature [2]. Chemical EOR, including polymer and surfactant flooding, modifies interfacial tension and improves displacement efficiency, often being used as a follow-up stage after thermal treatment [3]. Combined or hybrid approaches, such as thermal methods coupled with nanofluids or biopolymers, have recently gained attention for their lower environmental impact and better thermal efficiency. Additionally, digital twin systems are increasingly being used for process optimization and real-time control of steam injection and production parameters, as demonstrated by Petrobras and other major operators [4].

In Ukraine, the Dnipro-Donetsk Basin remains the most prospective region for heavy oil development. Laboratory analyses of crude samples from the Yablunivske and Hnidyntsivske fields have revealed extremely high viscosities (up to 15,000 mPa·s at 20°C) and a high concentration of asphaltenes and nickel compounds, which complicates extraction and processing [5]. These characteristics indicate the necessity for thermal or hybrid recovery methods adapted to local geological and economic conditions.

For shallow or heterogeneous reservoirs, cyclic steam stimulation (CSS) campaigns with adaptive “heating–soaking–production” cycles are more feasible than full-scale SAGD. Literature data show that such projects can increase oil recovery by 20–25% with moderate capital investment [6]. This finding is particularly relevant for Ukrainian oilfields with thin pay zones and moderate formation permeability.

Innovative EOR technologies offer significant potential for increasing heavy oil recovery in Ukraine. The integration of thermal and chemical methods with digital monitoring tools creates a promising direction for sustainable and efficient field development. The presented analytical review lays the groundwork for the methodological framework of integrated heavy oil recovery optimization, which will be further developed in the author’s dissertation research.

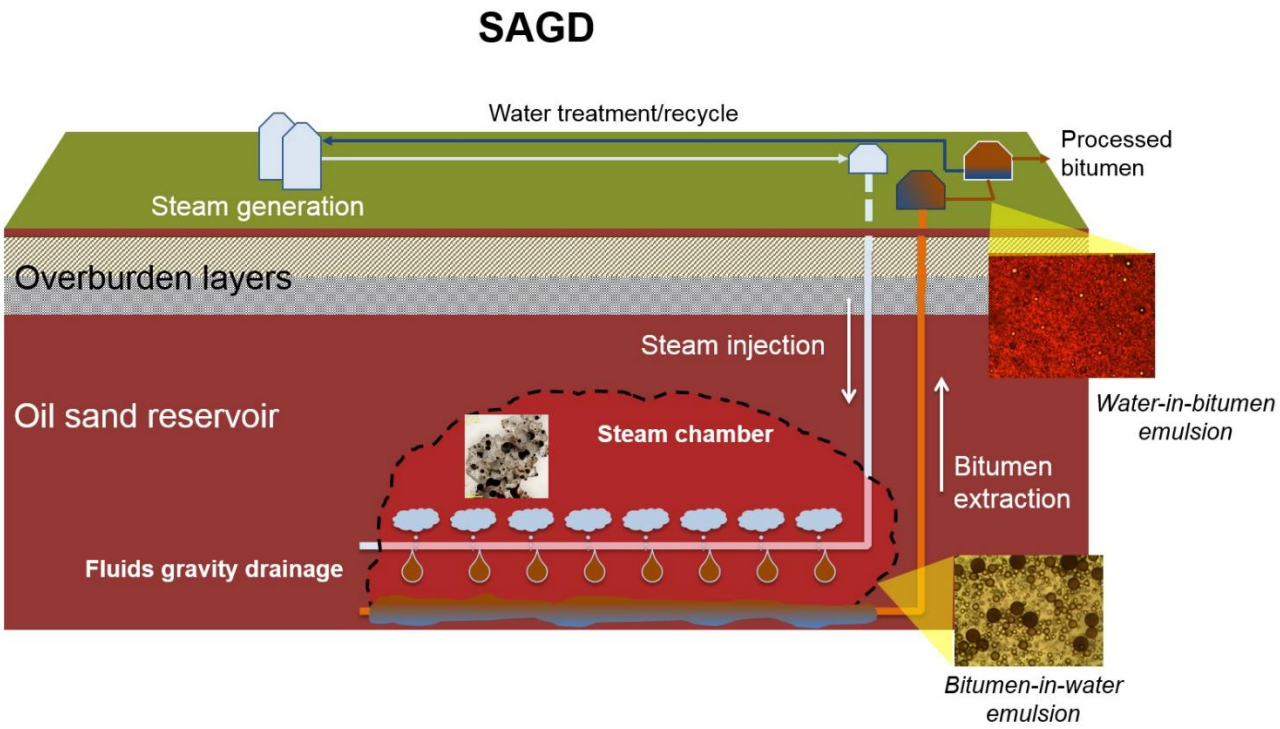


Figure 1 - Typical schemes illustrating the CSS and SAGD processes (source: Taylor, 2018)

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