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Editorial

Recent Advances in Reservoir Stimulation and Enhanced Oil Recovery Technology in Unconventional Reservoirs

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In the past decade, significant advances in reservoir stimulation and enhanced oil recovery technologies have resulted in rapid production growth in unconventional reservoirs. To further increase and stabilize the production of unconventional reservoirs, researchers continue to develop new technologies and apply them to this field. This Special Issue combines unconventional reservoir stimulation and enhanced oil recovery technologies and the latest research on geology, reservoir, drilling, and completion.

The rapid increase in the production of fossil energy has been made possible by effective reservoir stimulation and enhanced oil recovery (EOR) technologies for unconventional oil and gas reservoirs. As one of the most important reservoir stimulation technologies, hydraulic fracturing usually injects high-pressure fluid to create enough fractures in the target reservoir, which aims to improve the seepage conditions and increase the contact area between the target formation and production well. Such stimulation technologies usually involve complex fluid–solid coupling processes, including fracture initiation, propagation, conductivity, etc.

Enhanced oil recovery has been used to solve the problem of sharply declining oil rates after a production period. In this process, some special chemicals (e.g., surfactants and nano-emulsions) are injected into the reservoir to increase the recovery effectiveness of the residual oil. EOR processes often involve complex physical–chemical processes, including liquid emulsification, water–rock reactions, etc. [1–4]. Therefore, the progress of reservoir stimulation and EOR technology will contribute to the rapid development of unconventional oil and gas resources. Meanwhile, these technologies are also used to develop geothermal and coal resources [5–8].

This collection, which accompanies the Special Issue of Processes, emphasizes theory, technology, and application innovation and compiles 35 current publications on original applications of new ideas and methodologies in unconventional oil and gas reservoirs.

Review of Research Presented in This Special Issue

The papers published in this Special Issue describe recent advances in reservoir stimulation and EOR technology in unconventional reservoirs. These studies are divided into four categories.

The first type involves numerical and experimental simulation studies on fracture propagation patterns in unconventional reservoir stimulation techniques. For numerical simulation, Ran et al. systematically investigated the expansion patterns of multi-branch hydraulic fractures using finite element and extended finite element methods [9]. The characteristics of the target reservoir and the expansion patterns of hydraulic fractures under conditions such as formation dip angle, wellbore orientation, fracturing fluid backflow rate, low temperature, stress effects, artificial plugging, interlayer heterogeneity, and

Citation: Zhang, L.; Pan, L.; Zou, Y.; Wang, J.; Li, M.; Feng, W. Recent Advances in Reservoir Stimulation and Enhanced Oil Recovery Technology in Unconventional Reservoirs. *Processes* **2024**, *12*, 234. https://doi.org/10.3390/pr12010234

Received: 9 January 2024
Accepted: 11 January 2024
Published: 22 January 2024

the presence of multiple branched horizontal wells were systematically investigated. For experimental studies, the influence of various factors on drag reducer performance was studied. Moreover, utilizing microscopic methods, the drag reduction mechanism of the drag reducer was also investigated. Shi et al. and their colleagues investigated the crack propagation patterns and influencing factors during hydraulic fracturing in four different reservoir types: offshore unconsolidated sandstone, high-salinity reservoirs, gravel formations, and deep shale formations [10].

The second type is acidizing and acid fracturing technology in unconventional reservoir stimulation technology. The acidizing potential for enhanced oil recovery in gravel formations was evaluated by comparing changes in rock porosity, permeability, and rock mechanics before and after acidizing. A novel high-temperature cross-linked acid's acid corrosion capability and acid-induced fracture conductivity were assessed. The temperature field of acid-rock reactions and the incremental production effects of multistage acidizing processes during acidizing were studied based on theoretical analysis and mathematical model establishment.

The third type involves unconventional oil and gas reservoir-enhanced oil recovery (EOR) technologies. These EOR technologies include the use of 3D-printed artificial cores for experimental research, the development of salt-resistant displacement polymers, studies on fluid flow behavior in shale oil and gas reservoirs, optimization of gas injection methods in low-permeability heterogeneous gas reservoirs, exploration of post-pressurization water injection development techniques, and technologies aimed at improving recovery rates in heavy oil reservoirs and salt cavern gas storage facilities.

The fourth type involves reservoir, drilling, and completion technologies related to reservoir modification and enhanced oil recovery (EOR). In terms of reservoirs, the sedimentary history of the Qiongdongnan Basin in the northern South China Sea and the Yinggehai Basin was investigated. A model for calculating the axial force on the drill string was proposed in drilling, and a simulation study on the rheological properties of lost circulation materials during drilling was performed. Regarding completion, this includes casing safety assessment and case studies on the field application of a novel gas lift valve.

Many academics from various fields, from the natural sciences to engineering, have been researching reservoir stimulation and EOR technology in unconventional reservoirs. New theories and technologies are proposed in this Special Issue, including experimental methods, numerical simulation technology, and pilot cases that can help readers and researchers better understand and be inspired by the cutting-edge technologies in reservoir stimulation and EOR technology in unconventional reservoirs.

Author Contributions: Investigation, L.Z.; writing—original draft preparation, J.W.; writing—review and editing, L.Z., J.W., W.F., M.L., Y.Z. and L.P. All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest: The authors declare no conflicts of interest.

List of Contributions

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