Objectives/Scope:  
The objective of this paper is to develop a methodology for modeling hydrate precipitation processes in the bottomhole zone of wells and to assess their impact on well productivity. The study aims to address the growing need for advanced simulation tools capable of accounting for hydrate formation under complex geological and thermodynamic conditions, which are increasingly encountered in the development of unconventional and challenging oil and gas fields.

Methods, Procedures, Process:  
The approach involves a comprehensive review of current trends in the oil and gas industry, with a focus on the shift toward the exploitation of more complex reservoirs both in Russia and internationally. The methodology is based on the integration of advanced numerical modeling techniques for heat and mass transfer processes, utilizing commercial hydrodynamic simulators such as tNavigator. The research includes a comparative analysis of the functional capabilities of leading simulators (ECLIPSE, CMG, tNavigator) regarding dual porosity and permeability models, thermal methods, and hydrate identification. The study proposes the adaptation of the Langmuir hydrate formation model, as implemented in tNavigator, in combination with the Leontiev model for simultaneous colmatation and suffusion of particles, to dynamically evaluate changes in reservoir porosity and permeability due to hydrate precipitation.

Results, Observations, Conclusions:  
The analysis reveals that, among the reviewed simulators, only tNavigator explicitly provides functionality for hydrate identification, while other features are largely interchangeable. The need for such functionality has arisen due to the challenges faced by oil and gas companies in the CIS when modeling reservoirs with abnormal temperatures and pressures, where hydrate formation can negatively affect production dynamics. Current implementations, such as the Langmuir model in tNavigator, indicate the possibility of hydrate formation but do not account for its impact on fluid flow or reservoir properties. By adapting the Leontiev model for particle deposition, it becomes possible to dynamically assess the reduction in porosity and permeability caused by hydrate precipitation, offering a more realistic simulation of reservoir behavior. This integrated approach can be implemented as an extension for tNavigator, leveraging its API for seamless integration. The proposed methodology addresses key technical challenges in the industry, such as prolonged drilling times, the need for phase transition modeling, and the selection of effective reservoir stimulation methods, particularly for unconventional and geologically complex fields.

Novel/Additive Information:  
This paper introduces a novel methodology that combines existing hydrate formation models with advanced particle deposition modeling to simulate the dynamic impact of hydrates on reservoir properties. The proposed extension for tNavigator fills a gap in current simulation capabilities and provides a practical tool for addressing hydrate-related challenges in oil and gas field development, particularly in regions with complex geological and thermodynamic conditions.