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The Instability of Salt Cavern Hanging Strings and Proposed Completion Modifications

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Abstract

For cavern operators, there are incentives to increase rates at which brine and stored product are transferred. However, high flow velocities have been associated with the failure of hanging strings resulting from flow induced instability. To avoid hanging string instability, standard practice has limited the maximum flow velocity to 15 ft/s (4.6 m/s). While this flow velocity limit is typically applied to all caverns, this limit may be too conservative for some caverns and may be excessive for others.

With the purpose of preventing hanging string instability and achieving greater cavern deliverability and cavern development rates, modifications to standard industry completions can be made. In this paper the effect of radially diverting the fluid exiting the hanging string, the effect of stiff centralizer installation, and the effect of increased annular area are analyzed as methods to avoid instability. A theoretical model that predicts the maximum stable flow velocity limit was developed to describe this system and is compared to the standard completion design. Theoretical results are then compared with bench scale experimental results.

Key words: Fluid Structure Interactions, Flow Induced Vibrations, Buckling, Flutter, Salt Cavern Hanging Strings.

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