GUIDELINES FOR TUBING SIZE AND FLOW PATH SELECTION IN UNCONVENTIONAL WELLS: INSIGHTS FROM NODAL ANALYSIS AND PRODUCTION DATA

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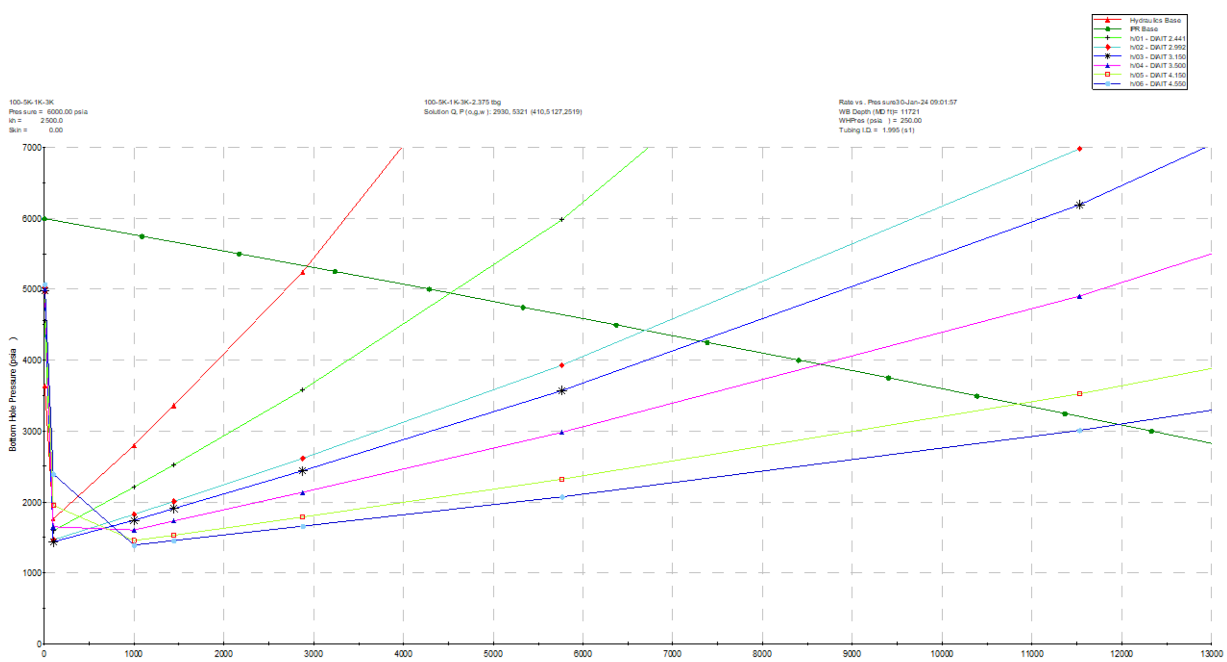
Production engineers often face crucial decisions regarding tubing size and flow path selection in unconventional wells. These decisions impact various aspects of well performance, including productivity, stability, and efficiency. However, existing literature predominantly focuses on artificial lift selection, leaving a gap in understanding tubing size and flow path selection, particularly in gas lift and naturally flowing wells. This paper addresses this gap by presenting guidelines for tubing size and flow path selection based on nodal models and production data from diverse operators in unconventional plays across the United States, including the Eagle Ford, Oklahoma Granite Wash, Permian/Delaware, and DJ Niobrara formations.

The consequences of choosing an inappropriate tubing size or flow path are significant, ranging from operational challenges such as heading and loading up to decreased production and increased friction losses.

Fig.1



By leveraging nodal analysis software, specifically SNAP, and real-world production data, this paper offers insights into the sensitivities associated with tubing size and flow path selection under varying liquid rates and gas-to-liquid ratios (GLRs). Additionally, it briefly discusses the selection of hydraulic models to ensure accurate production matching in nodal analysis.

The methodology employed involves utilizing nodal models to simulate well performance and calibrating these models with production data from unconventional wells across different regions. By analyzing the performance sensitivities under various operating conditions, such as different GLRs and liquid rates, this study provides practical guidelines for production engineers to optimize tubing size and flow path selection in unconventional wells.

Fig. 2:

Flow Area Compatibility Table

	2 7/8" x 5.5" Annular Flow			2 3/8" x 5.5" Annular Flow			3.5" x 7.0" Annular Flow			2 7/8" x 7.0" Annular Flow		
Rate - BFPD	GLR			GLR			GLR			GLR		
	>3000 scf/bbls	1000-3000 scf/bbls	<1000 scf/bbls	>3000 scf/bbls	1000-3000 scf/bbls	<1000 scf/bbls	>3000 scf/bbls	1000-3000 scf/bbls	<1000 scf/bbls	>3000 scf/bbls	1000-3000 scf/bbls	<1000 scf/bbls
10,000 bfpd	U	U	U	U	U	U	U	U	U	U	U	U
8,000 bfpd	U	U	U	U	U	U	U	U	U	U	U	U
6,000 bfpd	U	U	U	U	U	U	U	U	U	U	U	U
4,000 bfpd	U	U	U	U	U	S	U	U	S	U	U	S
2,000 bfpd	U	U	S	U	S	S	S	S	S	S	S	S
1,000 bfpd	S	S	N	S	N	N	S	N	N	N	N	N
500 bfpd	N	N	N	N	N	N	N	N	N	N	N	N

	2-3/8" Tubing Flow			2-7/8" Tubing Flow			3.5" Tubing Flow		
Rate - BFPD	GLR			GLR			GLR		
	>3000 scf/bbls	1000-3000 scf/bbls	<1000 scf/bbls	>3000 scf/bbls	1000-3000 scf/bbls	<1000 scf/bbls	>3000 scf/bbls	1000-3000 scf/bbls	<1000 scf/bbls
10,000 bfpd	N	N	N	N	N	N	N	N	F
8,000 bfpd	N	N	N	N	N	N	N	F	F
6,000 bfpd	N	N	N	N	F	F	F	U	U
4,000 bfpd	N	F	F	F	U	U	U	U	U
2,000 bfpd	F	U	U	U	U	S	U	S	S
1,000 bfpd	U	U	U	U	S	S	S	S	S
500 bfpd	U	S	S	U	S	S	S	S	S

U	Unrestricted Usage - Production rates match flow area to ensure stable flow regime
S	Short Term Usage - Production rates are slightly below stabilizing rates without the addition of gas lift injection
N	No Usage - Production rates or GLR are too high/low for the flow area
F	Frictional Issues

This research builds upon the work of Mohamed A. Abd El Moniem and Ahmed H. El-Banbi, who discussed the importance of proper selection of multiphase flow correlations in their paper titled "Proper Selection of Multiphase Flow Correlations," published in 2015 (SPE-175805-MS). Additionally, insights from Islam Fetoui's work on multiphase flow correlations, as outlined in "Production Technology Multiphase flow correlations," further inform the methodology employed in this study (https://production-technology.org).

Overall, this paper contributes to the existing body of knowledge by offering actionable insights into tubing size and flow path selection, addressing a critical aspect of production engineering in unconventional reservoirs. By bridging the gap between theoretical models and empirical data, it equips engineers with the tools and knowledge necessary to enhance the performance and longevity of unconventional wells.