ISSN (e) 2520-7393
ISSN (p) 2521-5027
www.estirj.com

Simulating the Performance of Coiled-Tubing Velocity Strings in Gas Wells to optimize production against liquid load-up problem

Zohaib Ahmed[1], Ubedullah Ansari[2] , Engr Imran Ahmed[3]

[1,]Institute of Petroleum & Natural Gas Engineering Mehran UET Jamshoro.

Abstract: During initial commissioning reservoir pressure is quite enough to produced hydrocarbons. By the time when gas wells tends to produce hydrocarbons at optimum flow rates natural depletion tends to occur and reservoir pressure depletes Most reservoir are interconnected with strong aquifers which tends to produce excessive water production at higher draw down inside wellbores. Excessive water production increasing trend restrict the gas flow and ultimately well ceased to flow. It became major challenge for field personal to resume the flow from such wellheads and optimize Gas production. Various methods are available to overcome the water load up issues inside such wells which includes wellhead compression, choke back the well. The main objective of this thesis was to evaluate the performance of VS coiled tubing in such wellheads through IPM PROSPER. This study aims production optimization using Coiled Tubing Velocity string to improve wellbore hydraulics to overcome water load up impact. In this regard Vertical/Horizontal wells are taken into consideration at different water production rates pre/post VS installations.

Keywords: *Load up issues, Water Cut, Vertical Lift Performance, Absolute open flow potential, Critical velocity*

1. Introduction

Gas Wells having excessive water production severally face load-up issues inside wellbore in later stages of production. Under those operating conditions wellbore hydraulics severally affected which ultimately results in well ceased to flow below dew point. This might be observed in gas wells having low reservoir pressures and having strong support from aquifers. In this regard following points must be kept in consideration.

• Identification of Load-up tendency in earlier stages.

•Modelling of load-up tendency inside gas wells.

•Wellhead completion to address Post Load-up effect

•Resources to overcome post load-up effects in such wellheads
•Surface facility provisions (E-Ponds availability and flare Pit) for periodic offloading to revive Production [16]

Sources of Produced water in reservoirs may be volumetric or continuously being produced from strong water aquifer which may affect production. Increasing water Gas ratio if diagnosed in earlier stages well load up tendencies might be avoided in this regards “Critical velocity” must be considered inside wellbore. Following are indications of wellheads having increased produced water trends [16]

- Orifice pressure spikes presence
- Erratic production and increase in decline rate.
- Tubing pressure decreases as casing pressure increases.
- Pressure drop survey shows a sharp, distinct change in pressure gradient Annular heading Liquid production reduces[17].

1.1.1. Velocity String

Gas producing fields through Monobore completions severely faces liquid load up issues in later stages of production. To avoid such issue requires tubing size reduction which accommodates smooth gas flow and liquid removal from such wellheads. Analysis reveals running of VS is an effective means for smooth flow from such wellheads. The CT string selection in terms of diameter is selected by engineers for velocity string to be installed to optimize production which stabilizes the flow and extend the life of the well. A too small diameter (1.5-in) may significantly lower critical rate but may restrict day by day production rate. A too large diameter (2.875-in) may optimize production but unstable the flow regime. After field analysis it is mainly concluded that 2.375-in OD is good option to enhance production [16]

Velocity string if installed in earlier stages of production prolongs the life of gas wells against frequent load up issues but the selection mainly depends upon the subsurface data. Gas wells depletion in earlier stages of production prolongs the importance of velocity string installation which is mainly to reduce tubing diameter without Rig workover. The only target is lower bottom hole pressures above perforations to avoid liquid accumulation inside wellbore which in turns depends upon understanding of velocities of such wellheads.

2. Methodology

To analyze production system performance, PROSPER application is mostly widely used by Production and reservoir engineers, to analyze different reservoirs and wellbore parameters to optimize overall production system. Different features of IPM Prosper application helps companies to monitor and forecast future strategy of wells.

To create models of different wellheads for troubleshooting IPM Prosper different features are used. It creates unique models for each node in production system to overcome the

Corresponding author Email address*: zohaib@gmail.com*

production declining parameters that contributes in production decline from wellheads. Exact programmed computation is ensured through versatile feature of IPM Prosper.

Future forecasting of wellheads under different flow regimes, fluid and petrophysical properties is accomplished through integrated production modelling. Different multiphase correlations and fluid data generate IPR curves to simulate the data with real time parameters of well also surface facility operations is designed through features of IPM prosper.

Well bore completion optimization and design in horizontal and multilayers.

Graph generation for simulation

Pressure drop survey from reservoir to surface facilities.

Skin calculation and water breakthrough determination

Production wells data compilation

Respective models for fluid type

2. Case Description

The Gradual decline of production profiles from a portentously flowing wells in mature gas field severely affects company business. Usually, this problem occurs due to liquid load issues up inside wellbore due to excessive water production. By employing velocity string methods, the bottom hole pressure is maintained, providing increased drawdown to obtain optimized production rates.

3. Results and discussion

4.1.1 Absolute Open Flow (AOF)

It is a theoretical concept, It is the maximum flow at which well is produced. It is considered as an ideal condition at which the pressure drawdown is maximum i.e. Pwf is 0.

4.1.2 Vertical Lift Performance

It is also called as outflow It is the deliverability of wellbore form bottom of well to the surface. It is affected by GOR and fraction. The point at which both curves intersect each other is called operating point.

4.1.3 Comparative analysis

By changing wellhead pressures from 2000psi to 100 psi in 500 psi intervals with Tubing sizes from 4.0" to 2.0" velocity string following graphs were generated to evaluate the performance of VS with conventional completion profiles

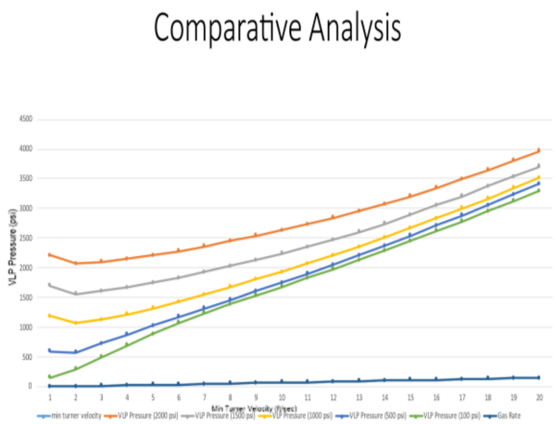

Fig: 1: Comparative analysis of various VLP pressures achieved from sensitivity analysis

Table 1 Input parameters for horizontal well

INPUT PARAMETERS TUBING SIZE 4.0" HORIZONTAL WELL						
Min turner velocity	**VLP Pressure (2000 psi)**	**VLP Pressure (1500 psi)**	**VLP Pressure (1000 psi)**	**VLP Pressure (500 psi)**	**VLP Pressure (100 psi)**	**Gas Rate**
2.192	7877.45	7330.44	5932.76	3766.55	3766.55	**0.15**
3.777	3469.05	2685.45	1114.3	718.62	718.62	8.031
4.075	3457.24	2736.4	1468.23	1230.01	1230.01	15.911
4.147	3597.25	2933.78	1879.35	1706.02	1706.02	23.792
4.052	3806.79	3194.76	2296.95	2159.39	2159.39	31.672
3.949	4058.92	3492.03	2710.73	2598.07	2598.07	39.553
3.842	4341.78	3813.75	3119.91	3026.19	3026.19	47.433
3.733	4648.02	4153.45	3528.82	3443.68	3443.68	55.314
3.624	4971.3	4508.46	3935.76	3854.14	3854.14	63.194
3.517	5308.27	4874.21	4347.68	4261.78	4261.78	71.075
3.412	5656.1	5248.83	4762.72	4672.91	4672.91	78.955
3.311	6013.73	5638.16	5186.58	5090.96	5090.96	86.836
3.213	6386.72	6038.95	5620.3	5520.96	5520.96	94.716
3.114	6774.6	6450.63	6061.99	5958.44	5958.44	102.597
3.014	7175.1	6871.66	6505.25	6402.92	6402.92	110.477
2.916	7586.15	7300.28	6958.58	6846.44	6846.44	118.358
2.824	8005.51	7734.97	7409.65	7300.38	7300.38	126.238
2.736	8431.64	8174.55	7862.61	7749.3	7749.3	134.119
2.655	8875.97	8631.51	8340.55	8225.43	8225.43	141.999
2.578	9362.88	9126.98	8844.36	8723.03	8723.03	149.88

In the above graph x-axis denotes the turner velocity and y-axis denotes VLP pressure. By taking different wellhead pressures from 2000psig to 100 psig VLP pressure and minimum turner velocity was calculated keeping tubing diameter 4.0” to know their effects on well performance and it is simply concluded through sensitivity analysis that reduction in wellhead pressure ultimately impacts well performance.

Table 2 Input parameters for Vertical well

INPUT PARAMETERS TUBING SIZE 4.0” VERTICAL WELL						
Min turner velocity	**VLP Pressure (2000 psi)**	**VLP Pressure (1500 psi)**	**VLP Pressure (1000 psi)**	**VLP Pressure (500 psi)**	**VLP Pressure (100 psi)**	**Gas Rate**
1.794	7877.45	7330.44	5932.76	3766.55	3766.55	0.117
3.117	3469.05	2685.45	1114.3	718.62	718.62	6.244
3.125	3457.24	2736.4	1468.23	1230.01	1230.01	12.37
3.032	3597.25	2933.78	1879.35	1706.02	1706.02	18.497
2.905	3806.79	3194.76	2296.95	2159.39	2159.39	24.624
2.768	4058.92	3492.03	2710.73	2598.07	2598.07	30.751
2.633	4341.78	3813.75	3119.91	3026.19	3026.19	36.878
2.504	4648.02	4153.45	3528.82	3443.68	3443.68	43.005
2.384	4971.3	4508.46	3935.76	3854.14	3854.14	49.132
2.274	5308.27	4874.21	4347.68	4261.78	4261.78	55.259
2.174	5656.1	5248.83	4762.72	4672.91	4672.91	61.386
2.083	6013.73	5638.16	5186.58	5090.96	5090.96	67.512
1.999	6386.72	6038.95	5620.3	5520.96	5520.96	73.639
1.921	6774.6	6450.63	6061.99	5958.44	5958.44	79.766
1.85	7175.1	6871.66	6505.25	6402.92	6402.92	85.893
1.784	7586.15	7300.28	6958.58	6846.44	6846.44	92.02
1.724	8005.51	7734.97	7409.65	7300.38	7300.38	98.147
1.669	8431.64	8174.55	7862.61	7749.3	7749.3	104.274
1.617	8875.97	8631.51	8340.55	8225.43	8225.43	110.401
1.566	9362.88	9126.98	8844.36	8723.03	8723.03	116.528

Table 3 Input parameters for Vertical well

INPUT PARAMETERS TUBING SIZE 3.5” VERTICAL WELL						
Min turner velocity	**VLP Pressure (2000 psi)**	**VLP Pressure (1500 psi)**	**VLP Pressure (1000 psi)**	**VLP Pressure (500 psi)**	**VLP Pressure (100 psi)**	**Gas Rate**
1.9	7782.29	7222.32	6604.6	1980.39	2580.89	0.117
2.499	3482.42	2719.9	1948.93	3392.6	961.46	6.244
1.903	3606.92	2930.1	2295.79	6066.41	1653.54	12.37
1.561	3903.72	3300.51	2768.31	8830.68	2300.48	18.497
1.346	4284.03	3741.48	3300.13	11777.35	2916.54	24.624
1.194	4717.98	4224.45	3842.32	15113.68	3515.07	30.751
1.08	5186.82	4737.62	4398.22	19074.38	4105.48	36.878
1.003	5680.71	5269.06	4966.99	23407.23	4693.34	43.005
0.952	6193.95	5817.64	5544.24	28137.86	5281.69	49.132
0.924	6727.71	6389.9	6140.51	33189.43	5886.99	55.259
0.913	7289.17	6981.63	6751.83	38763.75	6510.33	61.386
0.913	7872.72	7589.93	7380.48	44550.34	7144.23	67.512
0.912	8474.03	8211.43	8014.84	51036.53	7789.22	73.639
0.855	9088.93	8842.93	8656.37	57660.75	8431.51	79.766
0.792	9736.26	9505.6	9340.39	64509.46	9102.3	85.893
0.734	10459.39	10237.3	10078.23	71828.5	9844.86	92.02
0.681	11205.83	10990.33	10836.29	79498.18	10597.36	98.147
0.631	11974.53	11765.17	11614.73	87512.84	11392.83	104.274
0.584	12766.09	12560.99	12413.59	95796.86	12185.1	110.401
0.54	13579.79	13378.65	13233.33	104496.57	12997.23	116.528

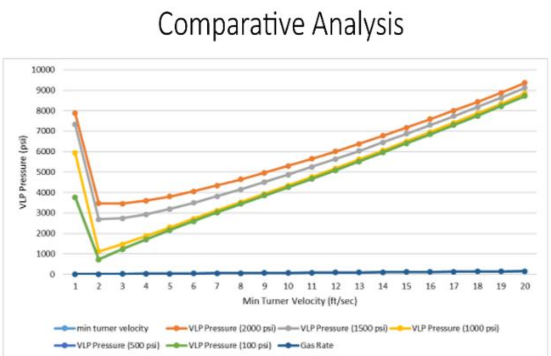

Fig: 2: Comparative analysis of various VLP pressures achieved from sensitivity analysis

In the above graph x-axis denotes the turner velocity and y-axis denotes VLP pressure. By taking different wellhead pressures from 2000psig to 100 psig VLP pressure and minimum turner velocity was calculated keeping VS tubing diameter 4.0” to know their effects on well performance and it is simply concluded through sensitivity analysis that reduction in wellhead pressure ultimately impacts well performance.

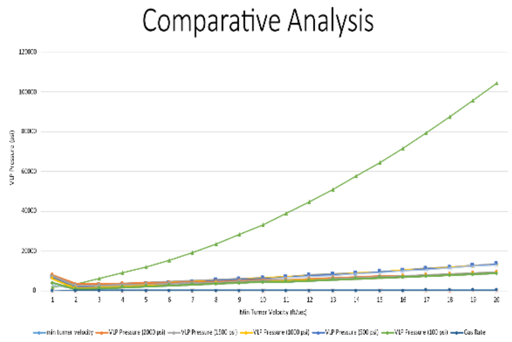

Fig: 3: Comparative analysis of various VLP pressures achieved from sensitivity analysis.

In the above graph x-axis denotes the turner velocity and y-axis denotes VLP pressure. By taking different wellhead pressures from 2000psig to 100 psig VLP pressure and minimum turner velocity was calculated keeping VS tubing diameter 3.5” to know their effects on well performance and it is simply concluded through sensitivity analysis that reduction in wellhead pressure ultimately impacts well performance.

Table 4 Input parameters for Vertical well

INPUT PARAMETERS TUBING SIZE 3.0” VERTICAL WELL						
Min turner velocity	**VLP Pressure (2000 psi)**	**VLP Pressure (1500 psi)**	**VLP Pressure (1000 psi)**	**VLP Pressure (500 psi)**	**VLP Pressure (100 psi)**	**Gas Rate**
1.779	7633.94	7052.21	6380.54	3492.45	1622.68	0.117
3.052	3567.31	2841.94	2135.47	1559.5	1342.68	6.244
2.825	3950.54	3342.92	2805.8	2458.73	2331.11	12.37
2.545	4544.49	4023.74	3605.15	3344.44	3255.96	18.497
2.295	5241.01	4789.3	4445.95	4231.84	4154.46	24.624
2.087	5996.54	5599	5309.25	5128.18	5046.06	30.751
1.918	6792.07	6441.33	6189.12	6035.45	5938.73	36.878
1.777	7630.79	7326.97	7104.64	6972.28	6863.16	43.005
1.658	8518.76	8248.41	8049.15	7933.25	7817.97	49.132
1.558	9443.45	9198.24	9023.43	8918.71	8783.76	55.259
1.472	10398.68	10173.21	10012.6	9915.95	9778.02	61.386
1.392	11488.88	11276.29	11124.59	11049.28	10886.51	67.512
1.322	12655.56	12450.36	12303.53	12233.83	12073.91	73.639
1.261	13872.17	13672.47	13555.1	13462.94	13287.71	79.766
1.207	15138.41	14942.07	14832.12	14738.09	14546.8	85.893
1.161	16454.1	16260.02	16156.41	16057.95	15888.45	92.02
1.12	17819.62	17626.54	17528.09	17464.85	17245.48	98.147
1.085	19234.04	19086.15	18948.1	18881.57	18649.16	104.274
1.054	20696.9	20554.31	20414.88	20343.74	20100.25	110.401
1.027	22208.5	22070.67	21929.18	21847.71	21597.4	116.528

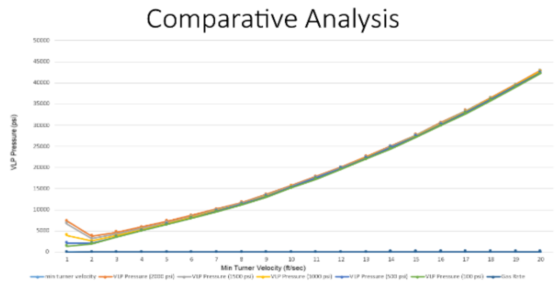

Fig: 2: Comparative analysis of various VLP pressures achieved from sensitivity analysis

In the above graph x-axis denotes the turner velocity and y-axis denotes VLP pressure. By taking different wellhead pressures from 2000psig to 100 psig VLP pressure and minimum turner velocity was calculated keeping VS tubing diameter 3.0" to know their effects on well performance and it is simply concluded through sensitivity analysis that reduction in wellhead pressure ultimately impacts well performance.

Table 5 Input parameters for Vertical well

INPUT PARAMETERS TUBING SIZE 2.5" VERTICAL WELL						
Min turner velocity	VLP Pressure (2000 psi)	VLP Pressure (1500 psi)	VLP Pressure (1000 psi)	VLP Pressure (500 psi)	VLP Pressure (100 psi)	Gas Rate
1.9	7383.08	6759.66	3948.08	2182.62	1402.16	0.117
2.499	3836.7	3180.62	2579.88	2154.14	2000.55	6.244
1.903	4769.36	4260.73	3852.82	3605.54	3517.46	12.37
1.561	5961.1	5553.05	5250.3	5064.03	4989.05	18.497
1.346	7270.67	6929.39	6688.61	6543.03	6446.73	24.624
1.194	8673.13	8397.84	8196.36	8074.84	7956.06	30.751
1.08	10180.31	9940.75	9771.74	9669.5	9532.94	36.878
1.003	11763.01	11549.63	11398.88	11321.3	11171.12	43.005
0.952	13640.89	13440.77	13321.7	13229.87	13057.35	49.132
0.924	15681.51	15517.13	15379.43	15284.11	15086.35	55.259
0.913	17850.09	17695.97	17558.83	17496.1	17273.91	61.386
0.913	20144.86	19998.99	19861.69	19795.15	19551.21	67.512
0.912	22564.8	22426.79	22285.78	22210.43	21948.31	73.639
0.855	25109.93	24977.05	24833.4	24760.63	24466.59	79.766
0.792	27778.75	27649.4	27486.71	27416	27104.23	85.893
0.734	30569.81	30444.93	30269.97	30178.77	29858.86	92.02
0.681	33481.79	33360.95	33179.73	33032.61	32707.96	98.147
0.631	36513.42	36396.41	36313.88	36140.51	35818.89	104.274
0.584	39664.01	39550.04	39469.5	39267.2	38941.91	110.401
0.54	42932.07	42820.84	42741.93	42464.21	42180.77	116.528

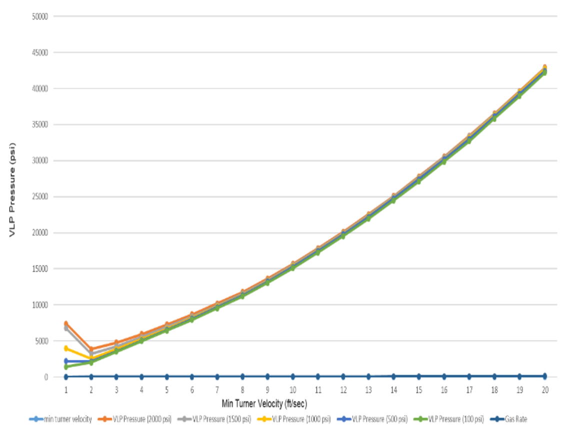

Fig: 5: Comparative analysis of various VLP pressures

achieved from sensitivity analysis.

In the above graph x-axis denotes the turner velocity and y-axis denotes VLP pressure. By taking different wellhead pressures from 2000psig to 100 psig VLP pressure and minimum turner velocity was calculated keeping VS tubing diameter 2.5" to know their effects on well performance and it is simply concluded through sensitivity analysis that reduction in wellhead pressure ultimately impacts well performance.

Table 6 Input parameters for Vertical well

INPUT PARAMETERS TUBING SIZE 2.0" VERTICAL WELL						
Min turner velocity	VLP Pressure (2000 psi)	VLP Pressure (1500 psi)	VLP Pressure (1000 psi)	VLP Pressure (500 psi)	VLP Pressure (100 psi)	Gas Rate
1.9	6904.63	6904.63	2856.34	1980.39	1227.6	0.117
2.499	4659.18	4659.18	3666.52	3392.6	3301.4	6.244
1.903	6871.44	6871.44	6230.07	6066.41	5991.83	12.37
1.561	9411.59	9411.59	8944.82	8830.68	8703.74	18.497
1.346	12230.91	12230.91	11872.448	11777.35	11618.57	24.624
1.194	15484.26	15484.26	15179.36	15113.68	1419.85	30.751
1.08	19422.09	19422.09	19133.44	19074.38	18833.42	36.878
1.003	23760.39	23760.39	23476.28	23407.23	23130.7	43.005
0.952	28495.6	28495.6	28206.85	28137.86	27810.11	49.132
0.924	33618.76	33618.76	33315.88	33189.43	32850.36	55.259
0.913	39123.53	39123.53	38926.07	38763.75	38401.21	61.386
0.913	45002.95	45002.95	44813.59	44550.34	44228.28	67.512
0.912	51249.55	51249.55	51067.64	51036.53	50423.44	73.639
0.855	57859.85	57859.85	57682.47	57660.75	56981	79.766
0.792	64830.72	64830.72	64653.44	64509.46	63905.93	85.893
0.734	72154.79	72154.79	71974.97	71828.5	71208.69	92.02
0.681	79826.91	79826.91	79631.44	79498.18	78892.86	98.147
0.631	87842.23	87842.23	87639.2	87512.84	86947.28	104.274
0.584	96196.65	96196.65	95993.91	95796.86	95365.21	110.401
0.54	104885.92	104885.9	104684.62	104496.57	104148.05	116.528

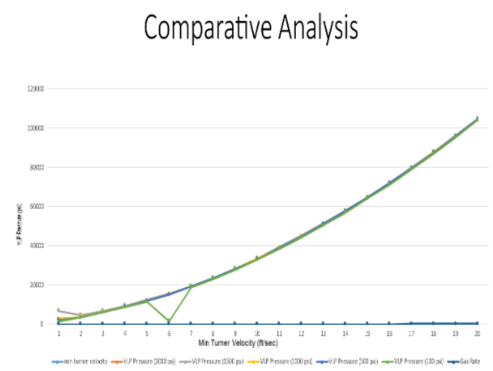

Fig: 6: Comparative analysis of various VLP pressures achieved from sensitivity analysis.

In the above graph x-axis denotes the turner velocity and y-axis denotes VLP pressure. By taking different wellhead pressures from 2000psig to 100 psig VLP pressure and minimum turner velocity was calculated keeping VS tubing diameter 2.0" to know their effects on well performance and it is simply concluded through sensitivity analysis that reduction in wellhead pressure ultimately impacts well performance.

5. Conclusions

The central objective of present study was the modelling performance coiled tubing velocity for liquid loaded wells which are flowing below turners' velocity criteria having excessive water production.

The following points have been concluded through using IPM Prosper.

First generated model through PROSPER without VS installation, shows significant pressure drop inside wellbore which severely affects wellbore hydraulics.

When velocity string diameter size tubing taken into consideration effective results obtained which includes improvement in turner velocity and overall wellbore hydraulics. It is concluded that velocity string installation is viable method in gas wells having severe wellbore hydraulic issues.

To determine the minimum gas rate to prevent liquid loading in the velocity string the obtained results were then checked to determine if this minimum rate is available for gas wells.

Simulation results were also checked for maximum possible rates through the different sizes of velocity string.

As the result have been analyzed through comparative analysis, it is concluded that VS works efficiently and shows optimized results in depletion stages of gas wells.

References

1. S. A. Asel, F. A. Gomez, D.. Ahmed, F.. Baez, T.. Elsherif, M. A. Kneina, W.. Kharrat"An Innovative Integrated Methodology to Deliquify Gas Well Using In-Well Live Performance Coiled Tubing for Velocity String Selection and Deployment": A Case Study in Saudi Arabia Publisher: Society of Petroleum Engineers (SPE) Paper presented at the SPE/ICoTA Coiled Tubing and Well Intervention Conference and Exhibition March 25–26, 2014, Paper Number: SPE-168258-MS.

2. R.R.. R. Saldeev, S.A.. A. Asel, S. H. Bo Khamseen, A. A. Mulhim, Danish Ahmed, Mohammed Aiman Kneina, Vejarano R Eduardo, Abhiroop Srivastava, Adzlan Ayob"Velocity String Helps to Revive a Standing Gas Well in Saudi Arabia" Publisher: Society of Petroleum Engineers (SPE) Paper presented at the SPE Middle East Oil & Gas Show and Conference March 8–11, 2015, Paper Number: SPE-172527-MS.

3. Juan Quintana, Eusebio Duque, Jose D. Diaz, Jose Eras, Jose Rodas, Enrique Vergara, Washington Prieto"Coiled Tubing Velocity String Hang-Off Solves and Prevents Liquid-Loading Problems in Gas Well": Case Study in the Gulf of Guayaquil, Ecuador Publisher: Society of Petroleum Engineers (SPE) Paper presented at the SPE Latin American and Caribbean Petroleum Engineering Conference November 18–20, 2015, Paper Number: SPE-177264-MS.

4. Khalid Hinai, Kees Veeken, Norbert Janusz, Laila Mabsali, Hajer Naabi, Sharifa Al-Ruheili, Musallam Ruzaiqi "Boost Capacity of Velocity String Completions in Sultanate of Oman by Including Sliding Side Door" Publisher: Society of Petroleum Engineers (SPE) Paper presented at the Abu Dhabi International Petroleum Exhibition & Conference November 13–16, 2017. Paper Number: SPE-188827-MS.

5. Satria Andrianata, Keken Rante Allo, Ade Lukman, Ari Taufiq Kramadibrata "Extending Life of Liquid Loaded Gas Wells Using Velocity String Application: Case Study & Candidate Selection" Publisher: Society of Petroleum Engineers (SPE) Paper presented at the SPE/IATMI Asia Pacific Oil & Gas Conference and Exhibition October 17–19, 2017 Paper Number: SPE-186362-MS.

6. J.. Burford; G.. Falcone"Successful Retrieval of First Installed Velocity String – Case Study from Middle East" Paper presented at the SPE Latin America and Caribbean Petroleum Engineering Conference, Buenos Aires, Argentina May 2017. Paper Number: SPE-185485.

7. Saurabh Anand, Nitin Johri, Krishana Chandak, Rachit Vijay, Shobhit Tiwari, Avinash Bohra, Utkarsh Vijayvargiya, Jivesh Khemchandani, Ishaan Singh, Arpit Agarwal"Application of Velocity String to Improve Productivity from Bottom pays after Hydraulic Fracturing in Multilayered Low Permeability Reservoir" Publisher: Society of Petroleum Engineers (SPE)Paper presented at the IADC/SPE Asia Pacific Drilling Technology Conference and Exhibition August 27–29, 2018 Paper Number: SPE-191006-MS.

8. Suat Bagci, Tina Chang "Production Modeling for Velocity String Applications in Unconventional Wells" Publisher: Unconventional Resources Technology Conference Paper presented at the SPE/AAPG/SEG Unconventional Resources Technology Conference July 22–24, 2019. Paper Number: URTEC-2019-157-MS.

9. Jovanny A. Hernandez, Jose R. Ortiz, and Luis F. Antelo, Halliburton "Successful Campaign to Install Multi-Sectional Large Diameter Chrome CT Velocity Strings in High CO2 Wells in Bolivia" This paper was prepared for presentation at the SPE/ICoTA Well Intervention Conference and Exhibition held in The Woodlands, TX, USA, 26-27 March 2019.

10. Diego Alejandro Marozzini, Jorge Pablo Arroyo, Facundo Alric, Mariano Raverta "Lessons Learned After Velocity String Campaign Using Different CT Hanger System with Out Well Head Modifications" Publisher: Society of Petroleum Engineers (SPE) Paper presented at the SPE/ICoTA Well Intervention Conference and Exhibition, 24-25 March 2020. Paper Number: SPE-199834-MS.

11. Mustafa Cobanoglu, Ibrahim Shukri "An Integrated Approach for Reservoir Characterization of Condensate Banking Using Pressure Transient Analysis PTA": A Case Study Using Data from Five Gas Condensate Fields in the Sultanate of Oman Publisher: International Petroleum Technology Conference Paper presented at the International Petroleum Technology Conference Dhahran, Kingdom of Saudi Arabia, January 2020.Paper Number: IPTC-20249-MS.

12. Abdullah Subaii; Mutaz R. Al Ghubayni; Yasser Shawli; Rustem Sunagatov, Danish Ahmed; Mohammad Arifin; Valentin Pochetnyy; Mohammed Santali "Successful Retrieval of First Installed Velocity String – A Case Study from Middle East" Paper presented at the SPE/ICoTA Well Intervention Conference and Exhibition, The Woodlands, Texas, USA, 24-25 March 2020. Paper Number: SPE-199837-MS.

13. Daniel Croce;Luis Zerpa "Mechanistic Model for the Design and Operation of an Intermittent Gas Lift System for Liquid Loaded Horizontal Gas Wells" Paper presented at the SPE Annual Technical Conference and Exhibition, Dubai, UAE, September 2021. Paper Number: SPE-205962-MS. Published: 15 September 2021.

14. Zhiyong Zhu;Guoqing Han;Ao Li;Wenqi Ke;Xingyuan Liang;Di Wang;Zhaoxi Li "Secondary Stabilization: An Explanation for Gas-Liquid Co-Production After a Rapid Production Decrease in Low Permeability Gas Wells" "Paper presented at the SPE Annual Technical Conference and Exhibition, Houston, Texas, USA, October 2022. Paper Number: SPE-209957-MS Published: 26 September 2022.

15. Ehsan Rahmati; William Michael Nathan Sim; Ross Edward Moffett; Christopher Burke Pond; Ferdinand Franziskus Hingerl " A Data-Driven Approach to Predict the Critical Gas Flow Rate in Gas Wells" Paper presented at the SPE Artificial Lift Conference and Exhibition - Americas, Galveston, Texas, USA, August 2022.Paper Number: SPE-209745-MS Published: 19 August 2022.

16. Lea, J.F., n.d. "GAS WELL DELIQUIFICATION" second edition.

17. John Martinez, Alec Martinez "Modeling Coiled Tubing Velocity Strings for Gas Wells" Journal: SPE Production & Operations Publisher: Society of Petroleum Engineers (SPE) SPE Prod & Oper 13 (01): 70–73. Paper Number: SPE-30197-PA Published: 01 February 1998.

18. Asel, S.A., Gomez, F.A., Ahmed, D., Baez, F., Elsherif, T., Kneina, M.A. and Kharrat, W., "An Innovative Integrated Methodology to Deliquify Gas Well Using In-Well Live Performance Coiled Tubing for Velocity String Selection and Deployment: A Case Study in Saudi Arabia", Paper SPE 168258, presented at the SPE/ICoTA Coiled Tubing & Well Intervention Conference & Exhibition, The Woodlands, Texas, USA, 25-26 March 2014.

19. Bartland, O., Pipe Flow 2: Multiphase Flow Assurance (2nd. Ed.) Chonburi, Thailand. Retrieved from http://www.drbratland.com/(2013).

20. Castano, D.A.F., Ruiz, N., Zabala, R., Mora, E., and Nava, D.J., "Real-Time Evaluation of a Velocity String: Case History of a Suitable Solution for Well Recovery", Paper SPE 163920, presented at the SPE/ICoTA Coiled Tubing & Well Intervention Conference & Exhibition, The Woodlands, Texas, USA, 26-27 March 2013.

21. Quintana, J., Duque, E., Diaz, J.D., Eras, J., Rodas, J., Vergara, E., and Prieto, W., "Coiled Tubing Velocity String Hang-Off Solves and Prevents Liquid-Loading Problems in Gas Well: Case Study in the Gulf of Guayaquil, Ecuador", Paper SPE 177264, presented at the SPE Latin American and Caribbean Petroleum Engineering Conference, Quito, Ecuador, 18-20 November 2015.

22. Skopich, A., Pereyra, E., Sarica, M. and Kelkar, M., "Pipe Diameter Effect on Liquid Loading in Vertical Gas Wells", Paper SPE 164477, presented at the SPE Production and Operations Symposium, Oklahoma City, Oklahoma, USA, 23-26 March 2013.

23. Cai, W., Huang, Z., Mo, X. and Zhang, H., 2022. Velocity String Drainage Technology for Horizontal Gas Wells in Changbei. Processes, 10(12), p.2640.

24. Oudeman, P., 2007, March. On the flow performance of velocity strings to unload wet gas wells. In SPE Middle East Oil and Gas Show and Conference. OnePetro.

25. Zhai, Z., Qi, S., Kartoatmodjo, G., Wang, T., Wang, J. and Bo, J., 2022. Investigation of the effectiveness of velocity string to improve gas well productivity. Petroleum Science and Technology, pp.1-16.

26. Martinez, J. and Martinez, A., 1998. Modeling coiled-tubing velocity strings for gas wells. SPE production & facilities, 13(01), pp.70-73.

27. Arachman, F., Singh, K., Forrest, J.K. and Purba, M.O., 2004, October. Liquid unloading in a big bore completion: A comparison among gas lift, intermittent production, and installation of velocity string. In SPE Asia Pacific Oil and Gas Conference and Exhibition. OnePetro

28. Lea, J.F. and Nickens, H.V., 2004. Solving gas-well liquid-loading problems. Journal of Petroleum Technology, 56(04), pp.30-36.

29. Andrianata, S., Allo, K.R., Lukman, A. and Kramadibrata, A.T., 2017, October. Extending life of liquid loaded gas wells using velocity string application: Case study & candidate selection. In SPE/IATMI Asia Pacific Oil & Gas Conference and Exhibition. OnePetro.

30. Asel, S.A., Gomez, F.A., Ahmed, D., Baez, F., Elsherif, T., Kneina, M.A. and Kharrat, W., 2014, March. An innovative integrated methodology to deliquify gas well using in-well live performance coiled tubing for velocity string selection and deployment: a case study in Saudi Arabia. In SPE/ICoTA Coiled Tubing and Well Intervention Conference and Exhibition. OnePetro.

31. Saldeev, R.R., Asel, S.A., Bo Khamseen, S.H., Mulhim, A.A., Ahmed, D., Kneina, M.A., Eduardo, V.R., Srivastava, A. and Ayob, A., 2015, March. Velocity string helps to revive a standing gas well in Saudi Arabia. In SPE Middle East Oil & Gas Show and Conference. OnePetro.

32. Zhai, Z.B., Qi, S.W. and Kartoatmodjo, G., 2023. Pressure survey, analysis and diagnostic of small diameter velocity string to improve well monitoring and surveillance. Petroleum Science and Technology, 41(9), pp.1019-1037.

33. Goedemoed, P., Al Muselhi, F. and Al Manji, A., 2010, January. Oman, 2?? Velocity Strings in Deep and Tight Gas Wells. In SPE Deep Gas Conference and Exhibition. OnePetro.

34. Chavez, M., 2011, April. Installation of velocity strings (VS) without loading-killing the well. In SPE/ICoTA Coiled Tubing & Well Intervention Conference and Exhibition. OnePetro.

35. Skopich, A., Pereyra, E., Sarica, C. and Kelkar, M., 2015. Pipe-diameter effect on liquid loading in vertical gas wells. SPE Production & Operations, 30(02), pp.164-176.

36. .De Jonge, R.M. and Tousis, U., 2007, March. Liquid unloading of depleted gas wells in the North Sea and Continental Europe, using coiled tubing, jointed pipe velocity/insert strings, and microstrings. In SPE/ICoTA Coiled Tubing and Well Intervention Conference and Exhibition. OnePetro.

37. Piteiu, M.A., Sutoiu, F., Simescu, B. and Costin, N., 2008. Changing well completion in a mature gas well using velocity string. Wiertnictwo, Nafta, Gaz, 25(2), pp.595-601.

38. Oyewole, P.O. and Lea, J.F., 2008, September. Artificial lift selection strategy for the life of a gas well with some liquid production. In SPE Annual Technical Conference and Exhibition. OnePetro.

39. Lai, F., Li, Z., Wu, W., Yang, Z., Li, H. and Zhang, H., 2016. Study on the replacement time of velocity string in production process in tight gas reservoir. Journal of Natural Gas Science and Engineering, 28, pp.254-261.

40. Andrianata, S., Allo, K.R., Lukman, A. and Kramadibrata, A.T., 2017, October. Extending life of liquid loaded gas wells using velocity string application: Case study & candidate selection. In SPE/IATMI Asia Pacific Oil & Gas Conference and Exhibition. OnePetro