Analytical model for predicting frictional pressure drop in upward vertical two-phase flowing wells

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Abstract

In multiphase flow engineering operations, the pipelines that convey viscous fluids are subjected to interior friction where the pipe wall meets the fluid. The friction on the inner surface of the pipe causes energy losses. The losses are exhibited as a progressive pressure drop over the length of the pipe that varies with the fluid flow rate. This study develops a computational method to estimate the pressure change at any flow condition of multiphase flow (oil, gas, and water) inside a vertical pipe by developing fluid mechanics equations and using empirical correlations. Darcy and Colebrook friction factor correlations were used to ratify the predicted frictional pressure drop by computational method outcomes. OLGA dynamic simulation software was used to validate the accuracy of the computational method results. A sensitivity analysis was performed to evaluate the performance of the developed computational method, by using different well flow rate, pipe size diameter, and fluid properties. The frictional pressure drop estimation by computational method has acceptable accuracy and it is located within the accepted average relative error band (+/- 20%). The overall performance of the method is satisfactory when compared with other observations.

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Liu, Zilong; Liao, Ruiquan; Luo, Wei; et al. Friction pressure drop model of gas-liquid two-phase flow in an inclined pipe with high gas and liquid velocities. AIP ADVANCES (2019)

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1. Liquid slug holdup in horizontal and slightly inclined two-phase slug flow — Times Cited: 45
By: Abdul-Majeed, GH
JOURNAL OF PETROLEUM SCIENCE AND ENGINEERING Volume: 27 Issue: 1-2 Pages: 27-32 Published: JUL 2000

2. MEASUREMENT AND CORRELATION OF THE PRESSURE-DROP IN AIR-WATER 2-PHASE FLOW IN HORIZONTAL HELICOIDAL PIPES — Times Cited: 50
By: AWWAD, A; XIN, RC; DONG, ZF; et al.
INTERNATIONAL JOURNAL OF MULTIPHASE FLOW Volume: 21 Issue: 4 Pages: 607-619 Published: AUG 1995

3. PRESSURE-DROP IN WELLS PRODUCING OIL AND GAS — Times Cited: 72
By: AZIZ, K; FOGARASI, M; GOVIER, GW
JOURNAL OF CANADIAN PETROLEUM TECHNOLOGY Volume: 11 Issue: 3 Pages: 38-& Published: 1972

4. STUDIES ON COCURRENT GAS-LIQUID FLOW IN HELICALLY COILED TUBES .I. FLOW PATTERNS, PRESSURE DROP AND HOLDUP — Times Cited: 53
By: BANERJEE, S; RHODES, E; SCOTT, DS
CANADIAN JOURNAL OF CHEMICAL ENGINEERING Volume: 47 Issue: 5 Pages: 445-& Published: 1969

5. STUDY OF 2-PHASE FLOW IN INCLINED PIPES — Times Cited: 326
By: BEGGS, HD; BRILL, JP
JOURNAL OF PETROLEUM TECHNOLOGY Volume: 25 Issue: MAY Pages: 607-617 Published: 1973

6. FLOW IN CURVED PIPES — Times Cited: 820
By: BERGER, SA; TALBOT, L; YAO, LS
ANNUAL REVIEW OF FLUID MECHANICS Volume: 15 Pages: 461-512 Published: 1983

7. Das ahnlichkeitsgesetz bei reibungsvorgangen in flussigkeiten — Times Cited: 36
By: Blasius, H.
Forschg. Arb. Ing.-Wes Pages: 131-137 Published: 1913

8. Hold-up and pressure drop measurement in the two-phase flow of air-water mixing tubes in helical coils — Times Cited: 13
By: Boyce, BE; Collier, JG; Levy, J.
P INT S RES CONCURRE Pages: 203-231 Published: 1969
Publisher: Plenum Press, New York

9. The history of the Darcy-Weisbach equation for pipe flow resistance — Times Cited: 64
By: Brown, G. O.
Environmental and Water Resources History Pages: 34-43 Published: 2003

10. Mathematical Model For Bubbly Water-Heavy Oil-Gas Flow in Vertical Pipes — Times Cited: 3
By: Cazarez-Candia, O.; Montoya-Hernandez, D.; Vital-Ocampo, A. G.
PETROLEUM SCIENCE AND TECHNOLOGY Volume: 27 Issue: 15 Pages: 1715-1726 Published: 2009

11. Title: [not available] — Times Cited: 6
By: Chawla, JM.
Warmeubertragung und Druckabfall in waagerechten Rohren bei der Stromung von erdampfenden Kaltemitteln VDI Forschungsheft Pages: 523 Published: 1967

12. EXPLICIT EQUATION FOR FRICTION FACTOR IN PIPE — Times Cited: 238
By: CHEN, NH
INDUSTRIAL & ENGINEERING CHEMISTRY FUNDAMENTALS Volume: 18 Issue: 3 Pages: 296-297 Published: 1979

13. Turbulent flow in pipes, with particular reference to the transition region between the smooth and rough pipe laws — Times Cited: 714
By: Colebrook, C.F.
Journal of the Institution of Civil Engineers Issue: 4 Pages: 133-156 Abstract Number: A1939-01493 Published: 02 1939

14. Experimental investigation and correlation of two-phase frictional pressure drop of R410A-oil mixture flow boiling in a 5 mm microfin tube — Times Cited: 25
By: Ding, Guoliang; Hu, Haitao; Huang, Xiangchao; et al.
INTERNATIONAL JOURNAL OF REFRIGERATION-REVUE INTERNATIONALE DU FROID Volume: 32 Issue: 1 Pages: 150-161 Published: JAN 2009

15. Title: [not available] — Times Cited: 1
By: Dogen, H. A.
A Comprehensive bit hydraulics model for gasified drilling fluids Published: 2006

16. Vertical Flow of Gas and Liquid Mixtures in Wells — Times Cited: 44
By: Duns Jr, H.; Ros, N.
P 6 WORLD PETR C FRA Pages: 451-465 Published: 1963

17. Study of Two-Phase Loss in Gas-Solid Flow — Times Cited: 1
By: Fan, J; Hu, CB; He, GQ; et al.
45 AIAA ASME SAE ASE Published: 2009
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18. EXPERIMENTAL STUDY OF PRESSURE GRADIENTS OCCURRING DURING CONTINUOUS 2-PHASE FLOW IN SMALL-DIAMETER VERTICAL CONDUITS — Times Cited: 100
By: HAGEDORN, AR; BROWN, KE

JOURNAL OF PETROLEUM TECHNOLOGY Volume: 17 Issue: 4 Pages: 475-& Published: 1965

19. **Increasing Concurrent Transmissions in CDMA Adhoc Networks** Times Cited: 22
By: Hasan, A.
Proceedings of 6th 2009 International Bhurban Conference on Applied Sciences and Technology (IBCAST) Pages: 1-7 Part: vol.2 Published: 2009

20. **Wellbore heat-transfer modeling and applications** Times Cited: 103
By: Hasan, A. R.; Kabir, C. S.
JOURNAL OF PETROLEUM SCIENCE AND ENGINEERING Volume: 86-87 Pages: 127-136 Published: MAY 2012

21. **Simplified two-phase flow modeling in wellbores** Times Cited: 50
By: Hasan, A. R.; Kabir, C. S.; Sayarpour, M.
JOURNAL OF PETROLEUM SCIENCE AND ENGINEERING Volume: 72 Issue: 1-2 Pages: 42-49 Published: MAY 2010

22. **Modeling two-phase fluid and heat flows in geothermal wells** Times Cited: 31
By: Hasan, A. R.; Kabir, C. S.
JOURNAL OF PETROLEUM SCIENCE AND ENGINEERING Volume: 71 Issue: 1-2 Pages: 77-86 Published: MAR 2010

23. **A study of multiphase flow behavior in vertical wells** Times Cited: 69
By: Hasan, A.R.; Kabir, C.S.
SPE Prod. Eng. Volume: 3 Pages: 263-272 Published: 1988

24. **2-PHASE FLOW IN VERTICAL AND INCLINED ANNULI** Times Cited: 94
By: HASAN, AR; KABIR, CS
INTERNATIONAL JOURNAL OF MULTIPHASE FLOW Volume: 18 Issue: 2 Pages: 279-293 Published: MAR 1992

25. **VOID FRACTION IN BUBBLY AND SLUG FLOW IN DOWNWARD VERTICAL AND INCLINED SYSTEMS** Times Cited: 43
By: HASAN, AR
SPE PRODUCTION & FACILITIES Volume: 10 Issue: 3 Pages: 172-176 Published: AUG 1995

26. **ASPECTS OF WELLBORE HEAT-TRANSFER DURING 2-PHASE FLOW** Times Cited: 135
By: HASAN, AR; KABIR, CS
SPE PRODUCTION & FACILITIES Volume: 9 Issue: 3 Pages: 211-216 Published: AUG 1994

27. **Performance of a two-phase gas/liquid flow model in vertical wells** Times Cited: 18
By: Kabir, C. S.; Hasan, A. R.
JOURNAL OF PETROLEUM SCIENCE AND ENGINEERING Volume: 4 Issue: 3 Pages: 273-289 Published: JUL 1990

28. **A basic approach to wellbore two-phase flow modelling** Times Cited: 1
By: Kabir, CS; Hasan, HR; Sayarpour, M.
P SPE ANN TECHN C EX Pages: 1-9 Published: 2007

29. **Comprehensive Mechanistic Modeling of TwoPhase Flow in Deviated Wells** Times Cited: 1
By: Kaya, AS; Sarica, C; Brill, JP.
Paper SPE 56522 Published: 1999
presented at the

30. **VISCOSITY OF NATURAL GASES** Times Cited: 225
By: LEE, AL; GONZALEZ, MH; EAKIN, BE
JOURNAL OF PETROLEUM TECHNOLOGY Volume: 18 Issue: 8 Pages: 997-& Published: 1966

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