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A Numerical Comparison of 2D and 3D CFD Modelling for Contraction and Expansion Geometries with an Emphasis on Solid Particles Erosion

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Abstract

In this study, erosion patterns and magnitude are compared between the outputs of 2D and 3D CFD models in contraction and expansion geometries. ANSYS Fluent software was used to model a circular cross-section geometry with a contraction and the results were compared to published experimental data. The simulation findings showed that there is good agreement between the 2D and 3D CFD models and the experimental data in terms of fluid flow properties such as velocity profiles and magnitude. It also demonstrated that the 2D and 3D CFD models' representations of erosion patterns and magnitudes are equivalent. The 3D CFD simulations were able to provide more information than the 2D CFD simulations, particularly in terms of erosion distribution over the entire geometry. © 2024, Semarak Ilmu Publishing. All rights reserved.

Author Keywords

2D Vs 3D; Contraction expansion; Erosion; Particles tracking

References

- Abdulla, Akar
(2011) *Estimating erosion in oil and gas pipe line due to sand presence*,
- Xu, Yan, Wang, Zunce, Li, Sen, Lv, Fengxia, Yan, Yuejuan, Wen, Houzhen
Analysis of Erosion and Failure in the Sudden Expansion Fracturing Tubing of Deep Gas Wells
(2010) *In International Conference on Offshore Mechanics and Arctic Engineering*, pp. 293-299.
49149
- Cheng, Jiarui, Dou, Yihua, Zhang, Jiding, Zhang, Ningsheng, Li, Zhen, Wang, Zhiguo
Experimental Study on Particle Erosion Failure of Abrupt Pipe Contraction in Hydraulic Fracturing
(2018) *Journal of Failure Analysis and Prevention*, 18, pp. 382-391.
- Duarte, Carlos Antonio Ribeiro, de Souza, Francisco José
Dynamic mesh approaches for eroded shape predictions
(2021) *Wear*, 484, p. 203438.
- Darihaki, Farzin, Hajidavalloo, Ebrahim, Ghasemzadeh, Amir, Safian, Gholam Abbas
A localized sand erosion prediction approach for multiphase flow in wells: application for sudden-expansions
(2021) *Particulate Science and Technology*, 39 (8), pp. 954-970.
- Li, Qi
(2015) *Erosion Prediction on Contractions and Expansions Based on Computational Fluid Dynamics (CFD)*,
PhD diss., University of Tulsa
- Zhang, Jun, Darihaki, Farzin, Rajkumar, Yeshwanthraj, Karimi, Soroor, Shirazi, Siamack A.
Erosion in Sudden Contractions and Expansions

(2019) *NACE CORROSION*, pp. NACE-2019.
NACE

- Darihaki, Farzin, Zhang, Jun, Shirazi, Siamack A.
Solid particle erosion in gradual contraction geometry for a gas-solid system
(2019) *Wear*, 426, pp. 643-651.
- Agrawal, Madhusuden, Khanna, Samir, Kopluku, Ardjan, Lockett, Tim
Prediction of sand erosion in CFD with dynamically deforming pipe geometry and implementing proper treatment of turbulence dispersion in particle tracking
(2019) *Wear*, 426, pp. 596-604.
- Prasad, S. S., Satish, G., Panduranga, G.
Comparison of Flow Analysis through Sudden Contraction and Enlargement of Pipes by Providing Smooth Corners
(2015) *Int. J. Eng. Trends Technol*, 25, pp. 205-211.
- Darihaki, Farzin, Hajidavalloo, Ebrahim, Ghasemzadeh, Amir, Safian, Gholam Abbas
Erosion prediction for slurry flow in choke geometry
(2017) *Wear*, 372, pp. 42-53.
- Tsai, Chien-Hsiung, Chen, Han-Taw, Wang, Yao-Nan, Lin, Che-Hsin, Fu, Lung-Ming
Capabilities and limitations of 2-dimensional and 3-dimensional numerical methods in modeling the fluid flow in sudden expansion microchannels
(2007) *Microfluidics and Nanofluidics*, 3, pp. 13-18.
- Li, Tingwen, Pannala, Sreekanth, Shahnam, Mehrdad
2D versus 3D CFD Simulations of Circulating Fluidized Bed Risers
(2012) *Multiphase Flow Workshop*,
- Upadhyay, Mukesh, Seo, Myung Won, Naren, Parlikkad Rajan, Park, Jong-Ho, Dang Binh Nguyen, Thanh, Rashid, Kashif, Lim, Hankwon
Experiment and multiphase CFD simulation of gas-solid flow in a CFB reactor at various operating conditions: Assessing the performance of 2D and 3D simulations
(2020) *Korean Journal of Chemical Engineering*, 37, pp. 2094-2103.
- Cammarata, Luca, Lettieri, Paola, Micale, Giorgio DM, Colman, Derek
2D and 3D CFD simulations of bubbling fluidized beds using Eulerian-Eulerian models
(2003) *International Journal of Chemical Reactor Engineering*, 1 (1).
- Salehi, M. A., Rahimi, R.
COMPARISON BETWEEN 2D AND 3D TRANSIENT FLOW SIMULATION OF GAS-LIQUID DYNAMICS IN TWO-PHASE CYLINDRICAL BUBBLE COLUMN REACTORS BY CFD
(2009) *Int. J. Chem. Sci*, 6, pp. 857-872.
- Bullen, P. R., Cheeseman, D. J., Hussain, L. A.
A study of turbulent flow in pipe contractions
(1996) *Proceedings of the Institution of Mechanical Engineers, Part E: Journal of Process Mechanical Engineering*, 210 (3), pp. 171-180.

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