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Solid Particle Erosion in Contraction Geometries: Development and Validation of a CFD-Driven Model

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Abstract

Erosion in oil and gas production systems in critical components like choke valves featuring contraction geometries poses significant operational and economic challenges. The high-velocity and accelerated solid particle-laden flows in contractions result in material degradation, diminished equipment lifetime, and serious safety risks. The main goal of this study is to develop and test a robust erosion model using Computational Fluid Dynamics (CFD) that can accurately predict erosion in these challenging geometries. A three-step CFD analysis method was adopted, modeling the flow of fluids, tracking particles, and quantifying the erosion wear. Various parameters have been examined, such as fluid velocity, particle size and concentration, and most importantly, how different contraction ratios affect erosion rates. The model developed for the first time in the industry and has been checked against experimental data to ensure its predictability. The results of this study will help improve the design and operation of choke valves with contraction geometries. This will lead to longer component lifespans, lower maintenance costs, and better system reliability in environments that cause erosion. This is an open access article under the CC BY-NC-SA 4.0 license.

Author keywords

CFD; contraction expansion; Erosion; particulate flow; positive choke

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