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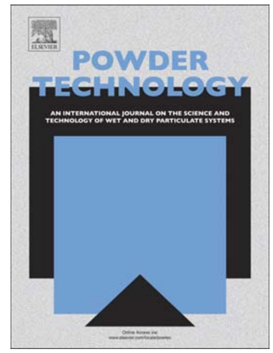

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Computational Fluid Dynamics Based Optimal Design of Hydraulic Capsule Pipelines transporting Cylindrical Capsules

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Abstract
Rapid depletion of energy resources has immensely affected the transportation sector, where the cargo transportation prices are rising considerably each year. Efforts have been made to develop newer modes of cargo transportation worldwide that are both economical and efficient for a long time. One such mode is the use of energy contained within fluids that flows in the pipelines for transportation of bulk solids. After appropriate modifications to these pipelines, bulk solids can be transported from one location to another very effectively. Solid material can be stored in cylindrical containers (commonly known as capsules), which can then be transported, either singly or in a train through the pipeline. Both the local flow characteristics and global performance parameters associated with such pipelines need careful investigation for economical and efficient system design. Published literature is severely limited in establishing the effects local flow features on system characteristics of Hydraulic Capsule Pipelines (HCPs). The present study focuses on using a well validated Computational Fluid Dynamics (CFD) tool to numerically simulate the solid-liquid mixture flow in HCPs, installed both on-shore and off-shore, along-with the pipe bends. Local static pressure fields have been discussed in detail for a wide range of geometrical and flow related parameters associated with the capsules and the pipelines. Numerical predictions have been used to develop novel semi-empirical prediction models for pressure drop in HCPs, which have then been embedded into a pipeline optimisation methodology that is based on Least-Cost Principle. This novel optimisation methodology that has been developed for HCPs is both robust and user-friendly.

Keywords: Computational Fluid Dynamics (CFD), Hydraulic Capsule Pipeline (HCP), Discrete Phase Modelling (DPM), Particle-Particle Interaction, Least-Cost Principle

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