

Advanced Modelling & Simulation - AMS

CASE STUDY :

EFFECT OF MULTIPHASE FLOW PATTERNS ON EROSION OF PIPELINES

Erosion is a complex process that is affected by numerous factors in operational conditions. Detection of erosion as it progresses is difficult. Detailed CFD can help Engineers to make more informed judgments on management of erosion.

THE ISSUES

The flow of a gas or oil in pipelines causes erosion resulting from various factors: the contact of the pipe wall and the deposited medium being transported, or the variation of pressure and wall shear due to multiphase flow intermittency, in particular at the elbows

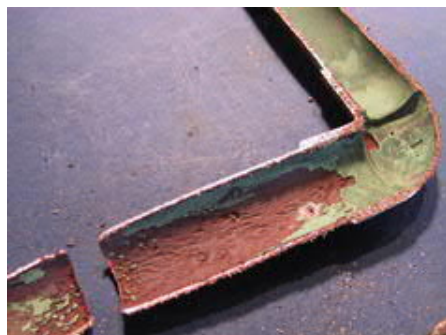


FIG.1. EXAMPLE OF PIPING STRUCTURE WITH ELBOWS SUBJECT TO EROSION

THE CHALLENGE

Two-phase flow in pipes can take various forms based on parameters such as pipe diameter, flow rate, superficial velocities: slug, bubbly, stratified or churn flow. Bubbly and stratified flow are relatively simple to model in CFD whereas slug and churn flows are more complex to reproduce.

Pipe corrosion occurs in regions of high shear which is most influenced by the flow regime.

OUR SOLUTION

Understanding the flow regime is the most important aspect of the problem. The flow regime map using empirical two-phase flow

charts indicates that this case should develop a churn flow in the vertical part. Only with the interface tracking model could the transition from stratified to churn be predicted (Fig. 2 a); the phase-average methodology could only predict a bubbly flow with no intermittency (Fig. 2b).

The comparison demonstrates indeed how flow regime determination is paramount to accurately predict the wall shear stress. The

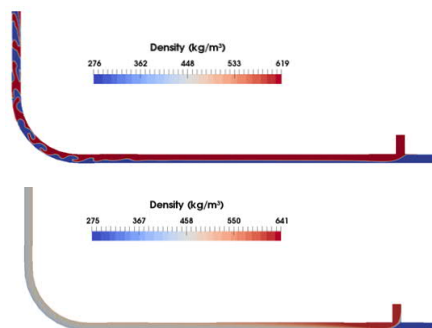


FIG.2. STRATIFIED-CHURN VS HOMOGENEOUS FLOW DENSITY DISTRIBUTION

Two phase model	Flow regime	Av. wall shear (Pa)	max wall shear (Pa)
interface tracking	Stratif.-churn	13	26
homogeneous	bubbly	7	10

two models predict different results: stratified to churn transition, and bubbly flow. More details available in the form of a presentation on request.

YOUR BENEFITS

CFD multiphase flow simulation can be used to assess the wall shear stress in various pipe geometries and operational conditions and predict the regions where intense corrosion is likely to occur and offer flow assurance support during pipeline design phases or operating point analysis..

COMPLIANCE

Avoid reliance on trial and error approach to mitigating corrosion issues and potential

PÖYRY'S AMS.

Pöyry's Advanced Modelling & Simulation (AMS) group provides consulting services in a broad range of industrial areas. The activities are centered on detailed simulation of fluid flow and heat & mass transfer processes pertinent to energy, industry and infrastructure.

AMS service is enabled by the CFD/CMFD product TransAT.

TRANSAT CFD/CMFD PLATFORM

TransAT is a versatile fluid-flow simulation platform (CFD) using the Immersed Surfaces Technology for multi-dimensional meshing. The platform is best suitable for multiphase flows using tailored predictive techniques and models for complex physics. TransAT can be used in the energy, industry and infrastructure sectors.

TransAT Website: www.transat-cfd.com