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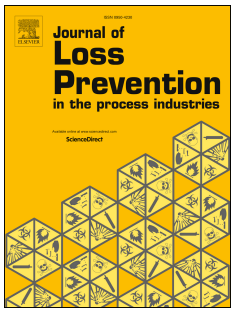

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A new integrated approach to study the thermal and mechanical response of vessels subject to a safe blowdown process

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ABSTRACT

The problems related to the blowdown of pressure vessels containing mixtures of hydrocarbons are well known amongst industries involved in plant design and hydrocarbons extraction. In this paper a new integrate approach to study the rapid two-phase depressurization (blowdown) of a vessel containing a mixture of hydrocarbons is presented. The method presented is based on a new mathematical model developed by some of the authors for the thermo-fluid dynamic characterization of the process (VBsim) and the finite element analysis for the mechanical simulations. Indeed, the pressure and thermal stress levels to which the vessel is exposed during the blowdown can present a number of consequences, such as cracks in the walls that have to be predicted by an accurate simulation of the blowdown process. In addition, from the economic point of view it is important to properly simulate the two-phase vessel blowdown to ensure the selection of the most cost-effective materials to conduct this operation in safe conditions. To demonstrate the effectiveness of the present approach, a vessel blowdown case from literature has been simulated and the most critical points in terms of thermal and mechanical stresses of the vessel wall have been identified. In addition, the FEM model build up can be used also for a complete Design of Experiments (DOE) analysis.

NOMENCLATURE

A	Matrix A
a	Element of matrix **A**
b	Matrix b
b	Element of matrix **b**
D	Diameter
h	Convective heat transfer coefficient
K	Fracture toughness
Nu	Nusselt Number
Ra	Rayleigh Number
T	Temperature
x	*x* axis
x	Generic variable
λ	Thermal conductivity
μ	Viscosity

Acronyms

DOE	Design of Experiments
FEA	Finite Element Analysis
HSE	Health Safety Environment
PPE	Partial Phase Equilibrium
PR	Peng-Robinson
SRK	Soave-Redlich-Kwong
VBsim	Vessel Blowdown Simulator

Subscripts

a	Air
f	Fluid
L	Liquid
Min	Threshold
w	Wall