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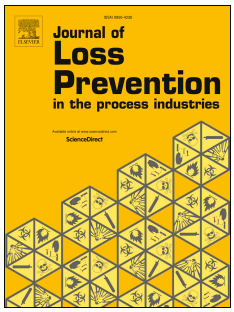

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A new approach to determine relieving temperature and thermodynamic behavior of trapped single and multi-phase fluid exposed to fire

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Abstract

Process safety plays a key role in modern industries. This is more significant specifically in off-shore oil and gas platforms where releasing hydrocarbons could cause irreversible damages to both environment and personnel. An important instrument device which can provide safety for process equipment in oil and gas fields is safety relief valve. Correct sizing procedure of such devices depends strongly on physical properties of fluid and relieving condition. The present study revolved around applying thermodynamic concepts and modeling to throw some light on the behavior of trapped fluid exposed to fire in order to evaluate precise temperature and fluid properties at relieving condition. Peng-Robinson equation of state together with a three phase flash has been utilized to handle the calculation. Effect of different design parameters has been evaluated for three distinct categories of fluids namely natural gas, gas-condensate mixture, and gas-oil mixtures. These parameters encompass of operating temperature, operating pressure, Difference of Operating and Design Pressure, gas and oil specific gravities, gas-oil ratio, and water cut. The study depicted that American Petroleum Institute practice number 521 which suggests an ideal gas assumption fails to provide reliable predictions as it significantly overestimate the relieving temperature. Moreover, black oil correlations were also used for the relief temperature estimation of gas-oil-water mixtures. Comparison with HYSYS results as a prominent engineering software proved that black oil models are reliable tools to predict relief temperature.

Keywords: Safety Relief Valve, Process Safety, Thermodynamic Modeling, Relieving Temperature,

1. Introduction

Generally speaking, safety relief valves act as a “last resort”. Chemical processes often meet disturbances that the control system cannot handle and therefore can cause process to enter abnormal conditions. Such disturbances might be fire, loss of cooling water flow, power failure, blocking of outflows or runaway of the reaction. The pressure relieving devices prevent the

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