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Risk-based operational performance analysis using loss functions

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Abstract

This article proposes a risk-based process performance assessment methodology using loss functions. The proposed method helps to overcome the existing challenges in assessing impacts of deviations of process variables on safety and economy of a process operation. The inverted Beta loss function is used to incorporate the effects of process deviations on the safety and quality losses. The demand rate adjustment factor is used to model the effect of process deviations on the failure probability of safety systems. The probability of a failed process state due to abnormal events is continuously updated based on the current value of the characteristic variables. The use of the loss function approach in combination with probability updating provides a continuously revised risk estimation. Such a real-time risk profile provides a leading performance indicator for decision-making at an operational level. As an example, a temperature surge in a continuous stirred tank reactor is used to demonstrate the efficacy of the proposed methodology.

Key words: loss function; safety loss; quality loss; performance analysis; risk.

1 Introduction

Meeting the financial targets of stakeholders, as well as the quality requirements of consumers without compromising operational safety, are critical for the economical and safe operation of a process facility. Achieving this goal requires the proper management of the process facility's operational performance, along with management of process safety. Efficient management of an operation demands a leading performance indicator (Khan et al., 2010) that

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