

241c Solar: a Tool for Early Runaway Detection

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Risk analysis is essential for the safety enhancement of chemical plants. An effective risk analysis method should provide an insight into the complex interaction of the factors that determine the probability and consequences of the possible accident. Early online runaway detection is critical for chemical process safety and many runaway detection criteria has been developed. The available criteria are all temperature-based. These include checking the temperature limits and the progressive increase in heat evolution within the reactor. The second criterion requires checking the first order derivative and the second order derivative of temperature with respect to time. If both are greater than zero, then it is a runaway scenario; otherwise it is a safe operation.

However, only temperature-based criteria are not sufficient to distinguish the runaway reactions from safe operations. The essential safety threat within the runaway reaction is the sharp increase in pressure due to violent boiling and/or rapid gas vaporization with increase in temperature. Therefore, one more factor that needs to be taken into account is the pressure variations within the reactor, as the pressure and temperature are interrelated.

In this paper, a prototype software tool, SOLAR is presented, which can effectively detect the onset of runaway conditions for batch reactors. The methodology embedded includes the temperature-based criteria, POS index (process operational security index) method and the pressure criteria. Matlab 7.0 is used to develop this prototype software. Visual Basic is used as an interface to make SOLAR user friendly. A case study has been carried out to demonstrate the efficacy of this tool.