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Inherent Safer Design for Chemical Process of 1,4-dioldiacetate-2-butene Oxidized by Ozone

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Abstract

Oxidation reaction is the typical thermal runaway reaction. The reaction of 1,4-dioldiacetate-2-Butene oxidized by ozone was chosen to study the thermal hazards during the chemical process and the inherent safer designs (ISD) were proposed after analysis. The Qualitative Assessment for Inherently Safer Design (QAISD) was used to identify the risk during the chemical process. Meanwhile, the Reaction Calorimeter (RC1e) was used to analyze the thermal hazards of the chemical process. Two Inherent safer designs were proposed to increase the safe level of the process. ISD Ⅰ is the improved reaction condition of reaction temperature at -5℃ and ventilation rate of 200L•h-1, as well, ISDⅡ is using a tubular reactor. The results indicate that the classification of the reaction hazard was lower with improvements of two ISDs, and the severity was reduced by 43%. Moreover, the inherent safety level of the reaction was increased by ISD Ⅰ & Ⅱ of 63% and 43.4% respectively, which both have positive effects on inherent safety theories of "minimize", "substitute" and "moderate".

Keywords: runaway reaction, oxidation, thermal stability, inherent safer design.