Identification and Analysis of the Key Drivers for a Systemic and Process-Specific Reactive Hazard Assessment (RHA) Methodology

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Abstract

The development and adoption of Quantitative Risk Assessment (QRA) techniques in process safety studies have shown a growing level of detail and completeness. A comparable accuracy and holistic degree has not been generally achieved in Reactive Hazard Assessment, as the incident case history and the methodological gaps demonstrate. Although regulatory and standard frames like OSHA, EPA, CCPS and NFPA in the United States and REACH, ECHA, CLP and Seveso / COMAH in Europe have increased the relevant awareness and knowledge, the real picture is still fragmentary, non-systemic, non-process oriented and site specific. Typically, in reactive hazard studies, only the intrinsic properties of the substances are considered and partially analysed, whereas chemistry, physical-chemistry and chemical reaction engineering should be assessed with similar importance, as is done for other specific hazard scenarios, such as explosion, fire and inherent toxicity, otherwise some hazard areas would remain completely unaddressed. Finally, the competencies required are significant, since reactive chemical incidents generally occur in circumstances and according to mechanisms which are sometimes very complex and not easily foreseeable, unless they are fully identified and analysed. This paper presents a new systemic quantitative reactive hazard assessment methodology to be implemented within the QRA activity and Consequence Analysis (named THEPOWER Analysis, short for a Threat – Protection – Weakness – Consequence – Recommendation Analysis). Unlike the usual approach, which is essentially limited to inherent chemical hazard properties identification, the focus is on process features, equipment arrangement, site and logistic factors, plant configuration, failure and operational scenarios, pre/post incident aspects, off-set situations, transient operating conditions, behavioural and management issues. The presented criteria are retro-fitted to a comprehensive list of significant incidents, highlighting the gap and the failure in the current hazard assessment process. The method has been applied to a case study, illustrating the benefits of a reactive specific technique.