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An extended risk assessment approach for chemical plants applied to a study related to pipe ruptures

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Abstract

Risk assessments and Quantitative Risk Assessment (QRA) in particular have been used in the chemical industry for many years to support decision-making on the choice of arrangements and measures associated with chemical processes, transportation and storage of dangerous substances. The assessments have been founded on a risk perspective seeing risk as a function of frequency of events (probability) and associated consequences. In this paper we point to the need for extending this approach to place a stronger emphasis on uncertainties. A recently developed risk framework designed to better reflect such uncertainties is presented and applied to a chemical plant and specifically the analysis of accidental events related to the rupture of pipes. Two different ways of implementing the framework are presented, one based on the introduction of probability models and one without. The differences between the standard approach and the extended approaches are discussed from a theoretical point of view as well as from a practical risk analyst perspective.

Keywords

Quantitative risk assessment; Uncertainties; Chemical industry

Figures and tables from this article:

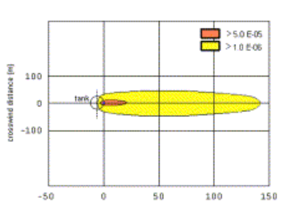

Fig. 1. Example of iso-risk curves for the release of benzene from a pipework connection related to a tank (leakage of 5 mm and meteorological condition F2).

Figure options

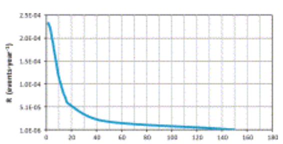

Fig. 2. Risk (i.e. frequency) vs. downwind distance (*d*) for the dispersion of benzene (leakage of 5 mm and meteorological condition F2) (downwind direction for crosswind equal to 0).

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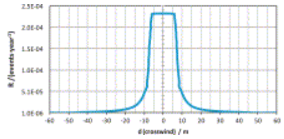

Fig. 3. Risk (frequency) vs. crosswind distance for the dispersion of benzene (leakage of 5 mm and meteorological condition F2) (crosswind direction for downwind equal to 0).

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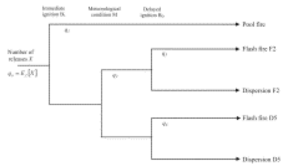

Fig. 4. Event tree related to the random rupture of a pipe containing benzene (leakage dimension equal to 5 mm).

Figure options

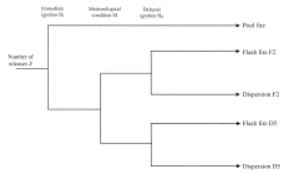

Fig. 5. Event tree related to the random rupture of a pipe containing benzene (leakage dimension equal to 5 mm).

Figure options

Table 1. Results of the frequency estimation for the rupture of a pipe containing benzene.

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Table 2. Probit function for lethal effects [32]; *x*: dose, *t*: exposure time.

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Table 3. Uncertainty and sensitivity score categories with interpretations.

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Table 4. Uncertainty assessment of identified uncertainty factors.

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