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Predicting the formation and the dispersion of toxic combustion products from the fires of dangerous substances

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Natural events, such as wildfires, lightning or earthquakes represent a frequent trigger of industrial fires involving dangerous substances. Dispersion of smoke plume from such fires and the effects of toxic combustion products are one of the reference scenarios expected in the framework of major accident prevention. Nowadays, tools for impact assessment of these events are rather missing. Detailed knowledge of burning material composition, atmospheric conditions, and other factors are required in order to describe quantitatively the source term of toxic fire products and to evaluate the parameters of smoke plume. Nevertheless, an assessment of toxic emissions from large scale fires involves a high degree of uncertainty, because of the complex character of physical and chemical processes in the harsh environment of uncontrolled flame. Among the others, soot particle formation can be mentioned as still being one of the unresolved problems in combustion chemistry, as well as decomposition pathways of chemical substances. Therefore, simplified approach for estimating the emission factors from outdoor fires of dangerous chemicals, utilizable for major accident prevention and preparedness, was developed and the case study illustrating the application of the proposed method was performed. ALOFT-FT software tool based on large eddy simulation of buoyant fire plumes was employed for predicting the local toxic contamination in the down-wind vicinity of the fire. The database of model input parameters can be effectively modified enabling the simulation of the smoke plume from pool fires or jet fires of arbitrary flammable (or combustible) gas, liquid or solid.

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